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Title Hand Book of Cost Accounting Method

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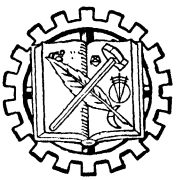
Handbook of
COST ACCOUNTING METHODS

J. K. LASSER, C.P.A.
Editor



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INTRODUCTION

The "Handbook of Cost Accounting Methods" represents cost accounting, strong, virile as it emerged from the war, ready now to guide management in its peacetime production.

The brusque and impatient realities of war helped enormously to give us new and more workable cost accounting practices. That is because the demands of war accounting gave us a swift interchange of the ideas of many minds. Working at high speed and under urgent need, they generated greatly improved cost accounting techniques.

The needs of the war machine, the procedures of war contract renegotiation and termination, and the strong controls—like price fixing exacted by government to keep the war economy at full steam—all had tremendous influence on the war growth in cost accounting. Cost accounting procedures had to work well under the scrutiny of government audits. Those that failed eliminated their sponsors. Those that survived usually gave good management a chance to work well. More important, they created a pattern of record-keeping that was spread with government aid among the industrial plants of the nation.

So developed by the war, our improved cost accounting can now be harnessed to the great needs of the years that lie ahead. It can be enlisted to fight for better —more useful—management. The war gave it great impetus to make possible wiser use of men and machines, and the most efficient use of production know-how techniques. It is much more able today to point out pitfalls and waste, and to direct the managerial mind to those methods of production that give the greatest economies and most abundant return.

The industrial process has become so great and complex that the human mind cannot readily see the whole arena. Cost accounting furnishes the apparatus to guide intelligent management. Warning signals are flashed by its own special radar devices; and direction is given to the productive processes by the procedures it has developed. More than ever before, cost accounting today prevents social loss by piloting capital safely through the treacherous channels of production.

Cost accounting helps the economy in still another way. It makes for sounder pricing policies. Artificially high prices, based on misconception of cost, cannot long prevail where cost accounting lights up the truth. On the other hand, cutthroat competition, spurred on by ignorance of costs, likewise can be avoided. Cost accounting lights up the way, too, to better industrial relations between employer and employee. The contributions of each to the joint effort can be fairly measured. Incentives can be given and their effectiveness made known by cost accounting.

Purpose of the Book

The "Handbook of Cost Accounting Methods" was designed to report the mechanics to secure the full aid of cost accounting in the problems of better man-

agement, better pricing, and better wage policies. Your index will tell you how to use it as a reference book. It is also designed to be well-thumbed by the men charged with forming costing policies and translating these policies into effective action. Seventy contributors have made it a veritable mine of up-to-the-minute cost accounting information for accountants, engineers, and business advisers. Included in it are directions for the installation and operation of a wide variety of cost systems. These have been tested in the crucible of experience. They have been selected because they work efficiently with great economy in effort and cost. Prototypes will be found that can be adapted for every kind and type of business and industry.

The Plan of the Book

The plan of the book is simple. Section I is an integrated series of articles by authorities. They give rich meaning and penetrating insight into the practices and problems of cost accounting. They make cost accounting a living art, not a closet philosophy. And they show how the techniques can be used as an instrument for management control as well as for profit.

Perhaps they express the precepts that are the basis of experience for Section II. This part of the book is applied cost accounting. It is cost-accounting-on-the-job, or cost-accounting-in-action. The range of industries and diversification of systems presented are no accident. They have been selected so that other businesses can readily find in it immediate and great value. The collaborating authors are seasoned experts who present the fruits of their experience. The material presented in Section II illustrates and demonstrates the presentations in Section I. Section I gives vitality and light to Section II.

Section III contains a carefully classified Bibliography. It was painstakingly and carefully selected to express the current status of our cost literature in *all* fields —including that covered by Section II.

* * * * *

My task, as editor, has been to bring together the war-enriched, new leaders in cost accounting and put them to work for the reader.

This is the group to whom cost accounting was a formidable weapon during the war. They enabled industry to get out speedy and abundant production at the lowest possible cost. Their help cannot be safely ignored by those who now engage in the production of goods and services for profit. Through their rich experience, their cross-fertilization of ideas caused vast changes in the art. They lived intimately with cost accounting during the war. The reader will find the distillations of that knowledge here.

With your editor as a sort of moderator, the group has given to you, between the covers of this book, the essence of their newly found techniques.

J. K. LASSER

New York, N. Y.
September, 1948.

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Chapter 1

A GENERAL SURVEY OF COST ACCOUNTING ITS PROBLEMS AND SETTING

By
MAURICE E. PELOUBET *

What Does "Cost" Mean?

There is a basic confusion, a double meaning, in the word "cost" as used in ordinary language and in the usual situations of everyday life. Lexicographers, reflecting as they should popular and actual rather than scientific or ideal usage, have failed to resolve the ambiguity, if, indeed, they are aware of it. The Oxford English Dictionary defines cost as: "That which must be given in order to acquire, produce or effect something; the price paid for a thing."

Here we have at least three differing concepts: cost to acquire, the obverse of a purchase; cost to produce, a complex of many elements arising from the activities of the producer; and cost "to effect something," the cost of a service or utility. The second and third concepts are quite similar. They are wholly distinct from the first.

From this ambiguity in the meaning of the term "cost" stems the difficulty which anyone not technically acquainted with the basic theory and at least some of the practical aspects of cost accounting finds in accepting the conclusions of cost accounting and perhaps in understanding them. In ordinary life, cost is what we pay for a finished article, for a service rendered to us, or for a material we intend to use for our own or our family's benefit or comfort. It is the first of the three dictionary concepts, the other side of somebody else's sale. To the purchaser it is a simple thing: so much money for a shirt, a steak, a can of paint, a month's electricity, or any other service or material for our own use.

The other aspect of cost is almost totally foreign to anyone but a cost accountant. Perhaps this is just as well. It would be a more difficult, if not a sadder, world if the housewife should sit down and calculate the cost of baking a pie as opposed to buying one at a bakery. She would be confronted with all the multitudinous questions that plague the cost accountant; direct material, how much flour, fruit, sugar, spice and shortening; manufacturing expense, how much gas and electricity would be used; overhead, what proportion of the cost of keeping the kitchen clean, removing garbage, heating the house, water, depreciation of the stove and cooking utensils, and repairs and maintenance of the general fabric of the house should be charged; and labor, how to apportion the time of a maid or how to charge her own time.

She would be tired and confused with all this, but the hardest part of her cost problem—buy or make, or in this instance, bake—would not be answered. A mere apportionment of costs, difficult and laborious though this would be, would not be enough. She must look at her buy or bake problem from the point of view of differ-

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ential costs as well. Would there be any less gas or electricity used if she didn't bake that pie? Wouldn't the repairs, garbage removal, heat, water, and depreciation go on just the same whether she baked the pie or not? If they wouldn't, what would the effect be? Would such a calculation be better than a straight apportionment on a number of quite complicated bases?

By then it would be almost time for her husband to come home, she would have a headache and she would dash down to the bakery in her car. This would start her off on a calculation of how much should be added to the purchase price of the pie to arrive at a delivered cost f.o.t. (free on table) taking in a calculation of depreciation and upkeep of the car. As she started to figure this she would decide that cost accounting was all right in a factory, perhaps, but if applied to the home nothing would ever get done, including the cost accounting.

No housewife would ever think that way or go through any such mass of calculation. And to many businessmen and lawyers, including judges, such mental processes are equally foreign. They have the "purchase" idea of cost and they assume, subconsciously, that cost is something simple, fixed, and clear. They often have little patience with a cost accountant who tells them that a product may have several different costs depending on the point of view of the purpose for which the cost is to be used. They cannot see why there should be any elements of vagueness or uncertainty in costs. They have a tendency to regard the cost accountant as intentionally obfuscatory and, perhaps, a little dishonest when he does not come up with a definite, unchangeable and unassailable cost and say "This is it."

Cost accounting is primarily concerned with the cost to produce. The cost to purchase is an element in the cost to produce but no accounting methods or devices beyond those of financial accounting are ordinarily required to arrive at that element.

Cost to Produce an Amplification of Financial Accounting

The cost to produce is arrived at by an extension and amplification of the financial records. We used to be told that cost records should "tie in" or be agreed with the financial books and that no system not so tied in was reliable. The present view seems to be that cost records should be agreed with or based on the data and controls derived from financial records but need not, necessarily, be actually reconciled in total with the financial books.

The totals, the items to be allocated or distributed to processes or products or to subsidiary distribution media, such as production or burden centers, are definite and unchangeable financial facts. A payroll is money paid out to employees. Material costs are so much a unit; electricity costs so much a kilowatt, so many of which were used in a period. This is the external side of cost, the obverse of someone else's sale. Nothing is required, ordinarily, beyond what the financial records show.

When we come to the other side of cost, the compilation of "cost to produce," we have an entirely different problem. The basic process and the basic problem in cost accounting is allocation. Even the simplest allocation is, to some extent, subjective. It requires a knowledge of the purpose as well as the nature of the operations and is dependent on the judgment of one or more individuals.

Cost to Produce One Simple Material

Perhaps the simplest cost problem is found in an enterprise producing one identical, fungible material—for instance, a mine equipped to produce a merchantable commodity such as zinc concentrates or blister copper. Here all the costs are incurred for one general purpose—the production of the one material. There is no reason to differentiate between lots or quantities for cost purposes. The whole of the cost accounting is somewhat like keeping one huge job cost for the enterprise. But even here allocation is necessary. If management is not interested in allocating costs to units it is vitally concerned with allocation to processes and with comparisons of process costs from period to period. Some costs—direct labor, for instance—are simple to allocate. Others, such as power, office expense, warehouse expense, mechanical shops, or the services of technical personnel, present more difficult problems. After these are allocated to processes and the process costs accumulated to arrive at a total and a unit cost the further question arises: What cost should we carry forward in inventory? Is the inventory to be a mere carrying forward of accumulated expense or are the expenses to be examined to determine which are wholly chargeable to the period in which they were incurred and which are properly chargeable to inventory? Extraordinary mining expense caused by floods or caving, the mechanical failure of a mill which reduced production and increased expense are examples of expense not usually carried forward in inventory.

It is clear that the simplest cost situation requires the continuous exercise of judgment based on a knowledge of the purposes and intentions of management.

Allocation of Costs to Products

As soon as we have more than one product, a new series of problems arises. We must allocate to products as well as processes.

Fundamentally there are two methods of allocation of costs to products. One is where the activities of the organization are directed primarily to the production of one principal product, but where several by-products result from the process or where several co-products result from the process of manufacture. Here the process is a physical separation, reduction or breaking down of a raw material into its useful components and such scrap, slag, or refuse as may result. The other is where several products are produced in such a manner as to permit direct allocation of the principal items of cost. This process is essentially a synthesis, a building up where one element or material may be worked on and altered or, as more frequently happens, where several parts or materials are worked on, altered and assembled into a finished product.

Co- and By-product Cost Accounting

In the first group we have most of our basic processing industries, for example, meat packing, the refining of petroleum, the smelting and refining of non-ferrous metals, and the manufacture of chemicals. Many other industries fall into this group but these will suffice for illustration.

In the meat packing and petroleum industries we have the problem of co-products. One commodity—for example, beef cattle or crude oil—is purchased and is processed into a large number of materials and products of varying value. The allocation of the price of the cattle or crude oil over the resulting products can only

be made by a consideration of the purposes and policies of the management. The costs beyond the original purchase price cannot, for the most part, be directly allocated to any particular product. The primary purpose of the meat packer is to produce and sell, first, the better cuts of meat and, second, the poorer. He must, however, realize the best prices he can on the other products such as hides, hoofs, hair, blood, bones, fertilizer, and certain medicinal and pharmaceutical products, to name only a few of the varied products of the modern meat industry.

Total costs are not difficult to arrive at and the costs of particular operations can be calculated with reasonable accuracy. However, it is quite possible that the costs of some of the operations which produce the less valuable and desirable products may be more than those of the more valuable products. This, however, is not a proper basis for allocation as even though these costs could be determined they would indicate to management that losses were being made on certain subsidiary products and extremely high profits made on primary products. The facts are that so long as the costs directly attributable to the lower priced products after their separation from the principal product are less than what will be realized from the sale of the lower priced product, it is profitable to produce and sell that particular commodity. For example, so long as the price realized for a fertilizer made from bones is more than the cost of treating such bones as are removed from the carcass, after their removal, it is more profitable to produce the fertilizer than to throw the bones away. The fact that a considerable cost on some basis, say gross weight, could be allocated to the bones thus showing an apparent high cost for the fertilizer would not make the production of the fertilizer a losing proposition. It would merely fail to give management the facts it needed and it would fail to express the purpose of management.

The same considerations apply in the petroleum industry where certain products, such as gasolene and lubricating oil, are in great demand and have a high value, while others, such as some of the waxes and heavy fuel oils, sell for much lower prices per pound or gallon.

The basic principal here is much the same as that of the differential cost: What would happen if we didn't sell the cheaper product at what we could get for it? If we would have spent $1.00 more to get $1.20 it is a profitable operation. If we spent $1.00 more and got $0.90 it would be unprofitable. The fact that on some methods of allocation the product would have had $1.90 of cost attributed to it is entirely immaterial.

By-product cost accounting, as distinguished from co-product cost accounting, is well illustrated by non-ferrous metal smelting and refining. Here the smelter buys ore from a miner which contains, say, copper, silver, and gold. Let us assume that the ore contains copper values equivalent to $50.00 a ton and gold and silver values equivalent to $7.00. The usual practice is to attribute all costs to copper, the principal metal, and to credit to such costs the market price of the by-product metals recovered. Here the by-product metals are merely incidental to the production of the principal metal. No logical basis exists for attributing costs to the by-product metals. Costs based on weight of ore going through the process or on any other physical basis would result in a ridiculously low proportion applied to the by-product metals. There are no direct costs attributable to the by-product metals until they are nearly finished.

The method of attributing all costs to a principal product and crediting realiza-

tions of by-products is sound where there is great disparity in the quantity or value of the principal products and by-products. All of these questions are dealt with in full detail in another part of this book and are brought forward here merely to illustrate the principle.

Cost accounting for co-products or by-products is, essentially, the allocation of costs to departments or processes for management purposes, followed by the allocation of these costs to products on a basis determined by the purposes of management and conditions existing within the industry.

The allocation of cost to departments is important as a measure of the efficiency of the process. It may be more important from an internal management point of view than the allocation of costs to products. A comparison, for instance, over months and years of the cost of each refining process in a petroleum refinery indicates the efficiency of the operation whether or not these costs can be attributed on any exact basis to products.

In the second type of manufacturing, where the operation consists of making a product from one raw material or combining a number of raw materials, it is possible to keep the costs of the product or a group of products separate from those of any other.

The real distinction between co-product or by-product accounting and cost accounting for individual products is that co- or by-product accounting is required when one material or commodity is broken down into a number of others. Cost accounting for individual products is required and is possible where one or more raw materials are processed and combined into a finished product.

Cost Accounting for Individual Products

The first distinction to be made is between direct material and labor and indirect material and labor. On the surface this seems to be simple and occasionally it is so in practice. However, this is not invariably true. Paint or dye in one situation may be charged as direct material and in another as indirect material. A maintenance mechanic spending all of his time on the machines in one production center may be charged as direct labor, although work of this nature is generally considered to be an indirect charge. Even when these questions are settled in principle, there still remain varied and complex problems of detail. Some things, however, are definite.

If an electric motor is to be manufactured we know precisely the components of the motor. Where material is purchased, we know its cost. Where parts are produced in the factory, we can calculate the cost of raw material and direct labor required. The difficult questions in this type of manufacturing arise when we attempt to allocate the indirect charges and overhead. In many industries these amount to as much as the direct charges.

In certain sections of the electronics industry, engineering, research, and laboratory expense, which cannot be directly attributed to a product, may equal or exceed the amount of the direct labor and direct material. The allocation of such costs calls for, first, a knowledge of the purpose and policy of management; second, a knowledge of the process and the operations; third, good basic records for the expenditures as made; and, fourth, a sound system, as simple as possible, for the allocation of these costs taking into consideration the three factors first mentioned.

Standard and Differential Costs

The method of allocating charges just described does not give us much more than the old-fashioned job cost and is applicable only to organizations which operate on special orders or are, to a large extent, in the stage of development. For the company which produces a series of standard or semi-standard products, there are many considerations more important than the historical or, as some inexactly term them, "actual" costs.

Two questions are, or should be, always in the mind of an active and efficient management; first, are we doing as well as we should with the business we have? And, second, on what terms can we afford to take new business?

The answer to the first question may be supplied by a suitable system of standard costs which includes provision for an adequate explanation of variances from standards. The answer to the second question is given by the various techniques grouped under the general heading of differential cost accounting, which measures the additional or incremental cost incurred in producing an additional unit or units of product. The basic principle of differential cost accounting may be stated as the answer to one of two questions. Could we, in the present state of our business with present volume and present overhead, accept certain business offered to us at more than the cost of direct material and labor but at less than our cost would be if indirect cost and overhead were allocated to it on the same basis as they are now allocated to other products? In other words, do we wish to allow our present business to bear its present burden, getting little or no relief from additional business? The other question which differential costs may answer would be—do we wish as a settled policy to sell a particular product as a "loss leader" or "feeder" for other products? That is, are we willing to allow one particular product to be sold at little or nothing above the cost of direct labor and materials, in order to induce our customers to buy the other products in our line?

"Make or Buy" or "Competition with Cost"

There is another aspect to differential cost accounting which is getting more and more attention. It is similar in some ways to the two questions which differential cost accounting in general must answer but it has some features of its own. This is what might be called "competition with cost." Large fabricating units, such as large motor and electric companies use the equivalent of the full output of many smaller factories. The purchaser's side of this problem is "make or buy." The seller's side is "competition with cost."

Should a motor company manufacture its own glass, its own screw machine products, its own sheet steel? The answer here is not a question of competition between suppliers of these commodities. It is a question of comparison between the cost of erecting and operating a glass works, an automatic screw machine plant, or a steel mill, and the prices at which the commodities can be bought. Obviously, the only way in which sales can be made on this basis is to show the motor company that the glass factory, screw plant, or steel mill can sell profitably to the motor company at less than the motor company's cost. The glass factory, screw plant, and steel mill must demonstrate that, because of superior efficiency and larger volume, these plants can produce at prices which, while they yield a small profit are, however, less than what the total cost plus an adequate return on investment

would be to the motor company if it operated smaller, more specialized, and less efficient plants to produce the same materials.

For some years the tide seemed to be turning in the direction of the large fabricating company erecting its own supply plants. But of late years the tide seems to have been reversed. There are cases on record where large fabricating companies have found that their investments in supply plants were not at all profitable. However, the large fabricator still has an advantage and will always expect to buy on a more favorable basis than the smaller customers can expect. The most carefully thought out differential cost accounting should be the basis on which those who supply the large fabricators determine whether or not contracts can safely be accepted on such a basis.

Costs Where Machinery Is Furnished by Purchaser

Another similar development which raises new cost problems is the growing practice among large organizations of buying machinery and equipment outright, installing it in a manufacturer's plant and paying the manufacturer for the resulting production. Here we have something that is almost the reverse of competition with cost. The large organization has decided that it does not wish to enter into production for its own use, presumably because it has some doubts of its own capability and efficiency in that particular line. It is, however, unable to persuade its suppliers that the business resulting from the production of the commodities which the large organization desires will be profitable, or it may be that the small organization would have difficulty in financing the purchase of the necessary equipment. For whatever reasons such an arrangement may be made, this practice is increasing.

A publishing company will buy special presses and have these installed in the plant of a printing company. It will retain ownership of the presses and will make a contract for having its publications printed over a considerable period. An electrical company may require certain precision parts. It will purchase machinery and install it in the plant of a producer who would not otherwise be able to make the parts required. The electrical company, presumably, believes it cannot do as well in its own plant. Many examples of this practice could be given.

Several interesting cost questions arise. Obviously, the cost to the purchaser of the product is the price paid plus the depreciation of the machinery supplied. Whether the costs for the seller should include, for statistical purposes, depreciation on the machinery furnished by the customer, later, of course, to be eliminated in the financial accounts, is a question the answer to which would depend on the cost system in effect and the purposes for which the costs are to be used, but it is a question which should have consideration. This is not the place to consider it in detail, but it is a new and interesting development.

Costs Where Material Is Supplied by Purchaser

Another similar problem is the increasing tendency on the part of customers to supply material to manufacturers. Obviously, where, say, 50% of a manufacturer's operations are on his own material and 50% on material supplied by customers, no figures for gross profit or any other figures relating to sales and cost of sales can be of any use unless they are modified to cover this condition. It also means that in all probability material costs must be completely segregated from fabricating costs.

For cost purposes the manufacturer must treat all material going through a process or a plant in the same way. Several solutions to this problem are possible. One way is to put the raw material through on a statistical basis in the cost accounts and eliminate it in the financial accounts.

Costs on Contracts for Partial Fabrication

Another condition quite similar in character is where one manufacturer, instead of supplying material which will return to him as a finished product, farms out certain operations to another manufacturer. This is sometimes done on a basis of so much per unit or on the basis of so much per labor hour, which rate would cover manufacturing expenses and profit, as well as payment for direct labor. In all these partial operations it is necessary to exercise the greatest care to see that they carry their full weight of charges. Generally these partial operations appear to be more profitable and favorable than they really are.

In preparing cost figures to be used as a basis for a decision on whether or not to accept this type of business, the cost accountant should be very sure that he is not presenting too optimistic a picture of the probable results. He should be sure that all indirect costs are included and that all costs arising from the possible disruption or necessary rearrangement of ordinary processes and schedules are allowed for.

Escalator Clauses

A feature of cost accounting which received little attention before World War II, but which assumed immense importance in the war contracts and which, so long as we live in a disturbed and changing economy, will maintain its importance, is the so-called "escalator" provision in many contracts. A contractor whose individual contracts run over long periods has great difficulty in covering himself on materials, if he can do so at all, and has practically no assurance of stability of labor rates. The contractor may endeavor to cover himself by quoting a very high price but will find that, while he may incur no losses on this basis, he will soon have no business. The only way to quote is on the basis of present prices, with proper and reasonable provisions for increases in labor, materials, and expenses.

It should be the cost accountant's duty to examine "escalator" clauses in contracts in order to make sure that the contractor is adequately protected, and it will generally be the duty of the cost accountant to prepare and present the evidence required when increases are called for. If prices or wage rates should decline, it will still be the cost accountant's duty to calculate the extent of the decline and the effect on prices. Experience with "escalator" clauses indicates that it is necessary to make certain in advance that both parties to a contract agree on the detailed method by which increases or decreases are to be calculated, the extent to which the contractor's records are to be relied on, and the nature and extent of any examination that the purchaser's representatives may make. Occasionally it may be desirable for a third party, such as an independent public accountant, to pass on the accuracy of the figures on which a claim for an increase is based.

Costs Under Cost-plus-fixed-fee Contracts

The concept of costs which grew up during the war and was applied principally to cost-plus-fixed-fee contracts is to some extent like that of standard costs. Under

a cost-plus-fixed-fee contract, contractors were supposed to be reimbursed for their total costs. However, it soon appeared that the idea of total cost under cost-plus-fixed-fee contracts was not at all the idea of total cost from a commercial point of view. Commercially speaking, money spent was cost. It might be spent unfortunately or unwisely but as it was spent it was a cost. However, under cost-plus-fixed-fee contracts the concept of "allowable cost" was introduced. That is, certain costs which admittedly represented money spent were not reimbursed to the contractors but were supposed to be covered by his fee. Among these were salaries above certain amounts, certain types of research expenses, certain types of experimental expenses and expenses for which satisfactory evidences of payment or of allocability to the job could not be produced. This was a concept unknown to industrial cost accounting. It may be a step toward considering a proper profit as part of cost. It was generally assumed that certain of these disallowances were profits improperly charged as expenses as, for instance, unallowable salaries. In other cases they were assumed to be expenditures which the contractor should have made in order to have the knowledge or capacity necessary to carry out the contract. Whatever the theory, the old commercial idea that total expenditures equaled total costs was abandoned.

Break-even Points and Optimum Production

The possibilities of stratification of wage rates and commodity prices at fairly high levels, short work weeks, and declining or uncertain efficiency of labor tend to raise the "break-even" points of most manufacturing enterprises. Cost accounting, rather than fantastic geometrical or mathematical formulas, should give the answer to how much volume at how much margin is necessary to maintain a profit or prevent a loss on manufacturing operations.

The pressure for maximum production during the war brought out the possibilities of expansion in different industries. For example, in the metal working industries, full utilization of machinery and continuous runs made, in some cases, increases of eight to ten times normal production volume possible. This was not uniformly true throughout the metal working industry but it illustrates the difference between operating on the basis of small orders for special material and operating on the basis of continuous runs on a uniform product, even where high accuracy was required—for instance in the manufacture of shell fuses or cartridge cases.

In other industries, such as textiles, straight runs and full utilization of machinery did not bring about increases of anything like this proportion. In general it seemed to be true that straight runs or simplification of products had a greater effect on production than increased working time.

Pressure for production also brought manufacturers to the realization that while a certain amount of increased volume brought remarkable cost reductions there was a point where the additional production became more rather than less expensive. Several factors caused this: necessity for new equipment when the old was running to capacity, requirements for additional supervisory and indirect labor when the time of those employed in such capacities became fully occupied, substitution of materials, inexperienced labor, and other similar factors.

It was always true that any enterprise had a certain optimum size and optimum production. Before the war the question was largely academic as it related to production, since few plants ever were called on to produce enough to be faced by

these problems. Optimum size, however, was a recognized factor for many years. As far back as 1914, Professor Dewing of Harvard University covered this question by example and precept in his penetrating book "Corporate Promotion and Reorganization."

The cost accountant should have the break-even and optimum production points in his mind continuously. They are the lower and upper levels of profitable volume. They are alike in no two businesses. We cannot state them with any degree of precision but every businessman knows they exist and knows that he is either constantly advancing toward, or receding from, these norms. The more the cost accountant can tell management about them the more valuable he will be.

Influence of Inventory Methods on Costs

Costs are used to arrive at inventory, but it is also true that inventories are used to arrive at costs. The cost accountant should be familiar with the theory and practice of the different accepted inventory methods and he should analyze the methods used in his own company to satisfy himself that the most useful and suitable system is in operation. Every recognized inventory method is valid for some purpose. If each purchase is of a different type of material—say, special parts—the only proper method would be identification or first-in, first-out. If a standard cost system is in successful operation, standard costs modified as may be necessary for current material prices would probably be the best basis. For quotation costs, some method which has the effect of applying current costs to current sales, such as the last-in, first-out method, is indicated. Occasionally, an inventory method will need to be used for some cost purpose that is not the method used for the company's financial accounts. If a company is operating on the first-in, first-out method, it may be necessary to prepare quotation costs on what is, effectively, the last-in, first-out method in order to make certain that the quotation is based on current purchases rather than purchases made at some previous time. This was illustrated in cost-plus-fixed-fee contracts during the war where current purchases were charged to the contract, and the inventory on hand at the beginning of the contract was used for other contracts or left undisturbed.

The theory and practice of inventory valuation have been discussed frequently and at length. The literature on this subject is available to anyone who wishes to use it. The cost accountant should familiarize himself with inventory methods, at least to the extent of becoming able to form an intelligent and independent opinion on the applicability to his own industry of the method in use in his own plant.

Cost Accounting Is a Method of Description

Cost accounting, like financial accounting, is a method of description. It is a language and, like any other language, is a conglomeration of ideas and concepts that range from the most abstract and indefinite to the most positive and concrete. Not all words have the same degree of definiteness of meaning. Words like good, bad, real, actual, true, have a different meaning for almost every person who uses them. The names of emotions: hope, fear, or love, are only the most approximate descriptions of the feelings they are intended to signify. We range from words like these to the most precise, scientific terms.

No one, for instance, has any doubt what is meant by, say, geometrical terms:

circle, square, cylinder; nor is there anything vague about simple arithmetical terms.

Allocation Is Based on Assumptions

It is the same with accounting. We may make a record in a set of books which shows that $57 was paid for telephone service in a month, $500 for rent, and $20 for electricity. These are definite items which no one can misunderstand. We progress a little further and divide the payment for rent in three parts between three departments which occupy an equal amount of floor space. This is a fairly simple allocation but we enter immediately into the realm of assumption and judgment. We assume that the floor space is equally valuable, we assume that each department should bear its proportionate part of the expense. These assumptions are generally correct but still are assumptions. After we get all the expenses allocated to the department, we then decide that there are five machines of one type and ten of another in the department and that the expenses should be divided between these two production centers. After allocating the expenses to production centers, we then devise methods of charging the proportionate parts of the expense to the product which goes through the process. We assume that the cost of each of the five machines is one fifth of the total cost of the five. This is almost certain to be untrue from one point of view, that is, the actual expenditure of time and money on the machine, but is correct from the point of view of the purpose of the management which is to get the best production in total from the five machines. It is most unlikely that the repairs on the five machines will be the same or that the time of the mechanics servicing the machines would be equally divided. However, the assumption that this is the case produces a more useful cost. The allocation of the cost of production to the units passing through must be based on assumptions, perhaps, that each unit bears the same proportionate cost or that each pound or yard of the unit bears its proportion of cost at the same rate. This, again, is not on the basis of present physical events but on the basis of arriving at a useful cost on reasonable assumptions.

Standard Costs

After we have gone through all this, we merely have a historical record. If we have a standard cost system, we have a whole series of assumptions, deductions and inferences, gathered together to produce what we call a standard cost. What the operation or the unit should cost under given possible conditions, is the standard cost. We compare this bundle of assumptions, deductions, and inferences with the results of the other bundle of assumptions, deductions, and inferences which we called the expended or actual cost. The difference is what we call a variance and this difference is the index to the efficiency of the operation.

When properly developed, this should tell the management why and how operations are better or worse than the standard. By the time we have reached this point we have progressed a long way from the simple payment of money for goods or services. We have a total that is the result of a long series of allocations all based on assumptions, deductions, and inferences.

What Is Definite in Cost Accounting

Anyone unfamiliar with cost accounting, reading a description of how the variances between standard and historical costs are arrived at and explained, would be pardoned for thinking that there is nothing clear, definite, or positive in cost accounting and that, under recognized cost accounting methods, almost any cost could be arrived at. From one point of view this is true, that is, for different purposes and under different assumptions several different costs can be arrived at for the same article or unit. However, there are two things which we may tie to. The first is the original, actual expenditures as recorded in the financial accounts. Whether or not the cost accounts actually agree in total with the financial accounts, they must be based upon them. The second is the fact that the bases, assumptions, and inferences on which the allocations are made must be consistent within themselves and must be stated in such a way that whoever uses the cost figures knows the type of information he is receiving and the purpose for which it was prepared. We could not, for instance, prepare an historical cost on the differential basis and compare it with a standard cost based on the full allocation of all items of overhead over the whole production. We could not compare costs arrived at on a by-product basis where by-products were credited at selling prices to the principal products with costs for the same type of product on a co-product basis where costs were allocated, say, on the basis of selling prices.

Limits on Individual Judgment

The scope for individual judgment in cost accounting is necessarily wide. It is, however, definitely limited as well. The executive who uses cost data and the cost accountant who prepares it must both recognize this. If a cost accountant is instructed to allocate the expenses of a department to material passing through the department, he must decide among several different bases the most suitable ones on which to apportion the total expenses. He cannot alter the total expenses. Once he has made the allocation to the department, he must then decide on a method which primarily involves the selection of a unit on which to allocate the cost of the department to the units passing through. He may have to consider whether weight, superficial area, length, the content of a particular raw material, or time spent in the department is the best basis. Once the basis is decided upon, he must stick to it and that factor and the total expenses in the department are the definite factors with which he must work. There is nothing to prevent the cost accountant from setting up costs on alternative bases. It might frequently be valuable to allocate the cost of a department to products, say, both on a weight and time basis. It depends entirely on the information which the management needs and the purpose for which the cost is to be used.

The Cost Accountant Answers the Questions Put to Him

The information needed and the purpose for which the cost is to be used are within the discretion of management. It is the duty of the cost accountant to determine what the results will be on a given basis. The cost accountant might be said to be in the position of a man who was asked to describe a cube of marble a foot square. If a geometrician asked him what he had, he would say a cube, one foot square. If a geologist asked him, he would say he had a piece of limestone, granular

in texture and crystallized by metamorphism. If a chemist asked him, he would say he had a mass of solidified, calcium carbonate. If a sculptor asked him, he would say he had the material for a beautiful little statuette. If a builder asked him, he would say he had a block suitable for ornamental stone work; and if an undertaker asked him, he would say he had a headstone. There are no doubt many others who could ask him questions about his block of marble to whom he could give entirely different and quite correct answers. Each one of his questioners would be interested in what the owner of the marble had as applied to the questioner's own purposes. It is the cost accountant's first duty to make sure that he knows just what a questioner means by his question and, second, to give the appropriate answer.

Cost Accounting During the War

It is generally conceded that cost accounting did not advance during the war either in theory or in the technical means of arriving at costs. It is quite probable that a greater volume of cost work was done during the war than previously. However, most of this was on job-cost, historical basis. It was intended to support and justify claims for moneys expended and expenses incurred. What are generally considered to be the more important functions of cost accounting were largely ignored: cost accounting as a means of cost reduction, as a method of improving factory administration, as an index to the desirability of one type of business as opposed to another, as an index of general efficiency, and as a guide to management in its varied problems.

Accurate cost accounts designed to help management increase productivity and efficiency were largely discontinued or ineffective. This was because production at any price was what was demanded of the manufacturer. As long as his costs were actually incurred and honestly paid out, he could be sure of reimbursement without loss. Theoretically, the old-style World War I cost-plus contract was outlawed. Cost-plus contracts were required to be on the basis of a fixed fee, which could not be increased and might be reduced if costs increased. This part of the law, so far as I am aware, was never infringed. The spirit of the law, however, was disregarded on all sides. The inefficient producer was given prices under fixed price contracts which gave him almost as much percentage profit as the efficient producer, and the price adjustment boards were never able to get far away from percentages on costs when they were determining the amount of excessive profits.

Cost Accounting in the Postwar Period

The transition from such an era is neither pleasant nor easy. No matter what manufacturers said about the government, there was a certain comfort in having a floor on losses and being practically exempt from criticisms of costs provided the production came through.

We are now entering on what promises to be a highly competitive period. It will not be long before the people who must have goods at any price will have had them. Manufacturers will need to consider prices, and if they need to consider prices, they must consider costs. Management is being forced to resume its old functions—taking risks, planning ahead without guarantees, and taking business on which there is no assured margin of profit. Management entering this competitive era must, in order to survive, use all of the tools available to it. One of the most necessary and useful of these is the information given by a well-staffed and well-

organized cost department, at the head of which is a man of sufficient standing in the company and of sufficient general ability to understand the manufacturing and merchandising problems and policies of the company. Without such a man it is doubtful whether any cost department, no matter how well organized, can be of full value to management. Such a man will provide guidance that will help the management to make wise decisions and will guard it against making dangerous ones and entering into unwise commitments.

Chapter 2

THE NATURE OF COST IN ACCOUNTING

By
C. W. SARGENT *

Cost accounting is a division of general or financial accounting. Its methods and procedures are designed for use wherever the determination of cost is particularly difficult or important. Financial accounting developed first; with it originated the basic accounting device of double entry. Because of the limitations on cost determination present in financial accounting procedure, and because of the importance of costs under modern industrial conditions, cost accounting evolved as an outgrowth, an expansion, of financial accounting to meet present-day needs. Cost accounting and financial accounting are, therefore, not independent but interrelated procedures; the latter is, rather, the parent and the basic, and the former the offspring and the more specialized, technique.

Both the cost accountant and the financial accountant are concerned with problems of cost determination. The latter must determine the cost of assets acquired. He uses cost as an important element in representing the financial condition of the business as displayed in the balance sheet. He determines the cost of periodic revenue. At this point an important difference between cost and financial accounting appears. The financial accountant determines the cost of revenue in the aggregate. The cost accountant determines the cost of revenue in detail by following all the internal transactions of the business. He records the introduction of materials, labor, and other production elements, their combination into particular items of product, and the disposition of these products and their associated costs in the course of producing revenue. By this analysis of the internal transactions of the business the cost accountant is able to:

1. Determine individual product costs; thereby providing more accurate figures for balance sheet valuation purposes, and for determining in detail the cost of goods sold and of the various production and distribution activities.
2. Provide management with the detailed information necessary to control expenditures so that, so far as possible, the costs incurred are in reasonable relationship to the output produced.

Before proceeding to an examination of the procedures of cost accounting, some basic matters bearing upon the concept of cost, common both to cost and financial accounting, will first be examined. Definitions that will convey adequately the meaning of cost, and specify the variety of theories, principles, and methods associated with the subject of cost accounting, are difficult to formulate and will not be attempted. This problem of indicating the meaning of cost in accounting is approached by examining—

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1. Certain basic types of transactions which involve cost.
2. The use made of the term "cost" in the balance sheet and income statement.

Business Costs Are Expressed in Money

In the most general sense, the cost of a thing is that which is suffered or given for it, the outlay of time, labor, pain, sacrifice, the disutility of acquiring it, or the money or other objects given in exchange for it. The "price" in this sense is thought of as attaching to the thing acquired and is its cost. In cash transactions the amount of money paid, or promised to be paid, is the cost.

The businessman is not concerned with nor does accounting record subjective costs, disutilities, except as they are involved in transactions and are thereby expressed in money. It is customary to look upon the cost of labor as the wages, expressed in money, paid to laborers. The cost of a machine is the amount of money paid or promised to be paid for it. Cost in this sense is the equivalent money value expended, thought of as attaching to the object or services received. This identification and transference of money-value equivalence from the thing parted with to the object or service acquired is one of the basic assumptions of accounting procedure, and underlies all accounting determinations of cost.

Basic Transactions Involving Cost

Business transactions involving cost, this transference of money-value equivalence, may be grouped into three major categories:

1. The *purchase transactions* by which the enterprise acquires and dedicates the factors of production—the cost factors as they are referred to below—the materials, labor, machines, and other services by means of which the enterprise carries on its activities.
2. The *internal transactions* of the business through which the cost factors interact to create the form utilities which are the basis in part for the enterprise contribution to the sum total of economic goods.
3. The *marketing transactions* of the business, partially internal and partially external, by which the material objects transformed and the time and place utilities created by the enterprise are disposed of as the last step in the sequence of events leading to the production of revenue.

The second category of transactions is the particular province of cost accounting. Recently greater emphasis has been placed upon the application of cost accounting methods to the marketing activities of business.

Each of these categories of transactions will be analyzed briefly for the purpose of indicating the diverse nature of cost as an accounting concept and the various cost problems that emerge at different stages in the business process.

The First Category of Transactions—Purchase Transactions

The introduction of cost factors into the enterprise, through transactions falling in the first category, is a common and inescapable occurrence. These transactions, which occur simply because the business is not self-sufficient and automatically self-perpetuating, involve usually the giving up of money by the business in exchange for a variety of, that is, all the economic goods and services required by it for the conduct of its activities. A few examples only of the *purchased cost factors* to which this category of transactions gives rise will be cited:

1. The purchase of labor and other services.
2. The purchase of materials.
3. The purchase of land, buildings, machinery, and other objects that are the sources of more or less permanent services.

These cost factors, irrespective of how much they differ among themselves in nature or period of usefulness to the business, have this characteristic in common—*cost appears as a purchase price,* and usually as a market price, and a cash price. As a cash price, the result of a money expenditure, an outlay of funds made or promised to be made, cost emerges as a reliable representation of value, and assumes a qualitative aspect that has great importance in accounting. Cost, in general, as a basis of valuation, merits and receives an amount of confident support from accountants accorded no other type of value representation. And it is apparent that, among a variety of "costs," cash-purchase price is the most definite and exact cost, the cost least likely to be miscalculated, misunderstood, or misrepresented. The problems of cost determination arising in connection with cash-purchase costs are relatively few and simple.

Problems of cost determination do arise in the acquisition of purchased cost factors whenever the purchase price is not determined in a free market, and when the consideration is not cash. Difficulty of measuring the outlay arises when the outlay is not cash. Then the question of imputing some money equivalence to the item purchased must be considered. What the cost is in these circumstances is not easy to determine.

Although the purchased cost factors cited above have this in common—that cost is purchase price—they differ one from another in the nature of the object or service acquired, and as to the *period of usefulness* to the enterprise. Some purchased cost factors are consumed immediately; some are usable over an extended period of time. This difference in useful life is important because accounting itself is geared to a periodic presentation of operating results and of financial condition. Both of these statements are dependent upon the solution of this cost-determination problem—how much of the purchase price of cost factors having a life that extends over more than one accounting period should be allocated to each period? The transactions expressive of the solution accorded this problem might be called internal and hence be classified in the second category, but they so naturally grow out of the purchase transaction, and differ so markedly from the transactions of the second group, that they appear better placed here.

A consideration of transactions in this first category leads to several conclusions:

1. There are two types of original cost factors:
   a. Temporary cost factors, having a usefulness, *in their original form* for one accounting period or less; that is, they are wholly consumed in the internal operations of a single period. The accounting for the money value of these cost factors involves no problems of periodic apportionment and partial deferment to future periods.
   b. More permanent cost factors, having a usefulness in their original form for more than one accounting period. These cost factors are not wholly consumed, that is, transferred into *derived* cost factors through the operations and internal transactions of the business in a single accounting period. They impinge therefore in this original form both on the balance sheet to the extent that their value is deferred, and upon the operating statement to the extent that their value is allocated to the current period.

2. Certain qualitative distinctions must be drawn between types of cost:
   a. The costs in this category are all *at the outset* of the purchase-price variety. A distinction of quality must, however, be made affecting those costs which are not cash-purchase prices determined in a free market.
   b. As to the nontemporary cost factors, a new type of cost is introduced by reason of the necessity of periodic allocation of the original cost. This allocation is effected by depreciation, depletion, amortization, or other type of assignment, under a variety of circumstances, plans, and purposes. The resulting *deferred purchase cost* appearing on the periodic balance sheet differs materially in quality from the original cost, because of the unavoidable uncertainty of the estimating process involved in the write off.
3. A number of cost problems are indicated:
   a. The problems of determining purchase price even when this is on the cash basis —the problems of cash discount, freight, handling, and storage.
   b. The difficulty of determining purchase price when cash is not the medium of exchange.
   c. The problem of the periodic allocation of the cost of long-term cost factors to current operations.

It should be pointed out that there are no ideas associated with the concepts of cost, nor with the cost problems discussed above that are the special concern of cost accounting. These matters are all included in general accounting theory. Although no hard and fast lines can be drawn separating the subject matter of these two divisions of accounting, were it necessary to decide wherein the above matters fall, general accounting would unquestionably be indicated as the field. By contrast other aspects of costs, particularly those transactions falling in the second category, are peculiarly the concern of cost accounting in the sense that cost accounting technique contributes more to their satisfactory solution.

The Internal Transactions—The Interaction of Cost Factors

The transactions of the first category have introduced the various cost factors to the periodic operations, brought them to the factory door, as it were, in their purchased material or service form in amounts assigned to the activities of the period. The transactions of the second group conduct the purchased cost factors from the factory entrance through the internal operations until they emerge as finished goods or services at the factory exit. Within the factory few or many, simple or complex, combinations and modifications of the original cost factors have been made. In any event, these factors have been absorbed and transformed, and there emerge new and different cost factors, one or more, dependent upon the physical and cost characteristics of the product output. The original cost factors have lost their identity in the composited materials and services that make up the finished product.

There arises from this sequence of transactions a new type, the fabricated or derived cost factor, represented by goods finished and still in process. The cost pertaining to this new factor is also different in characteristics and quality from the purchase-price cost associated with original cost factors. The same principle of cost determination, however, applies in both cases. Cost of original cost factors is the money-value equivalent of the thing parted with. Cost of derived cost factors is also, *in general,* the money-value equivalent of the original cost factors that go into their fabrication, *in so far as these are or can be measured* or imputed. The exception suggested by this last phrase is one of inherent difficulty and expediency, not of

principle. There may be, particularly with certain types of items, no physical or other tangible basis for measuring how much of the initial cost factors, and therefore how much of the purchase cost associated with these factors, should be transferred to the derived cost factors. Lacking such measures, expedients of value allocation and imputation are necessarily resorted to, with greater or less modification of what calculated cost would be if this principle of cost determination could be fully observed.

Another modification of this principle of cost determination, implied by the words "in general" used above, arises in these circumstances: sometimes more of the original cost factors are put into process than is needed to fabricate the resulting derived cost factors, or looking at the situation in reverse, fewer of the derived cost factors result than one should expect. Is the cost of this excess quantity of input to be considered a cost of the output? In this situation cost accounting recognizes the appearance of another type of item, namely, loss. So there is split-off from the stream of original cost, a segment which is allocated to loss, rather than to the cost of the derived factors. The total sum of cost entering is greater than the sum total emerging as recognized product cost. This circumstance should not be regarded as an exception, but rather as an affirmation of the principle that the cost of the derived cost factors is the money-value equivalent of the original cost factors that *go into their fabrication.* What is wasted in certain circumstances cannot be thought of as going into the final product. Losses represent diminutions of assets for which there is no equivalent return.

This category of internal transactions is particularly the province of factory cost accounting. The central problem is essentially this: how may these transferences of cost from original cost factors to derived cost factors be traced, measured, recorded, and presented through enterprise records and reports so as to result in accurate, intelligent, and useful calculated costs. This problem, the discussion of which in its various subdivisions and aspects constitutes the principal subject matter of cost accounting is inadequately handled in general accounting procedure—hence the development of cost technique as a much needed supplement at this point.

At the end of the transactions in this category the product has been physically completed, the original cost factors have been absorbed and transformed in such manner as to constitute a new type of cost factor. The associated cost transferences have also been of a nature to give rise to a new type or quality of cost, to which the term "calculated cost" has been applied to distinguish it from the purchase cost associated with the original cost factors. Although the basic principle of cost determination has not changed, many new and difficult problems have arisen in applying this principle, comparable in complexity to the intricate combinations of initial cost factors that take place within the modern factory.

The Third Category of Transactions—Marketing Transactions

In the third category of transactions two general types of business events are involved:

1. Additional initial cost factors are utilized to add time and place utilities to the finished products arising from the operations of the second category—that is, to bring the product to the market, and to administer the business. The cost of these factors consumed is usually assumed to be a direct cost of revenue in the period of consumption.

2. To the extent that finished products are sold, the calculated cost associated with these derived cost factors departs from the business as a cost of periodic revenue.

The same principle of cost transference and equivalence applies here as in the preceding categories. To the extent that initial cost factors are consumed in providing distribution and general administrative facilities, the cost of these cost factors is the cost of the facilities provided. To the extent that derived cost factors (finished products) are sold to produce sales revenue, to the same amount the associated cost of the departed products is the cost of the revenue secured.

By a convenient and generally recognized assumption of accounting the costs of the marketing and administrative activities in a given period are considered to be revenue costs of that period. These types of expenditure are not usually associated as costs with the particular units of product that provide the sales revenue and the cost of goods sold. In accordance with this convention, which is not acceptable to all accountants, marketing and administrative costs, in contrast with production costs, do not follow the product. As a result, the sales revenue and cost of goods sold associated with some items of product are included in one period, while the distribution costs applicable to the sale of these items is charged against revenue in the previous period. And conversely, distribution costs may be charged in part against the revenue of one period for units of product that will not enter the revenue and cost of goods sold accounts until the succeeding period. Inasmuch as the costs of distribution and administration are not usually regarded either as inventoriable or deferable, these types of expenditures are not charged to revenue on a basis consistent with the cost of products sold.

This difference in the handling of costs, between the production functions on the one hand and the marketing and administrative functions on the other, may be due to the divergent effects of expenditures made for these respective divisions. Manufacturing expenditures result in tangible objects, material goods that can be counted and inventoried. The exact number of the units of each product can be determined. Manufacturing processes usually deal with an inventoriable product the accounting for which under cost methods proceeds in the separable stages of manufacture and shipment. In these circumstances, the accountant can, and under cost procedure does, identify product cost with each increment of sales revenue.

In the marketing and administrative divisions, no such inventoriable product is obtained. The services received for expenditures can neither be easily counted or measured, nor can they be readily identified with a particular increment of sales revenue. As a result, accountants have not usually thought of these expenditures as deferable. They have assumed, rather, that they constitute cost of revenue in the period in which incurred. They follow the period, and not the product.

Bearing upon the difference in treatment discussed above, it is significant to note that the conventional income statement usually refers to the money value of products shipped as a "cost," and to the money value associated with distribution and administration activities as an "expense." This use of these words agrees with the common accounting practice of associating the word "cost" with property and inventoriable product units, and applying the word "expense" to expenditures which are direct charges against the period's revenue.

Recent developments in cost accounting procedure indicate a tendency to:

1. Disregard administrative costs as an independent category, and assign such costs, after first determining their amount, to the production and marketing functions.
2. Analyze the marketing expenditures, using the cost methods applied to the production expenditures.

The types of transactions discussed above find their final accounting expression in the balance sheet and income statement.

The Nature of Cost Factors

Cost factors are services usable in the realization of future revenue. At the balance sheet date some of these services are about to start on their course toward that goal; others are well advanced. Some of these services are in such form that, with the addition of current costs of distribution, they may be used immediately to produce revenue. Others among the cost factor assets—work in process and raw material, for example—are already partially identified with or intended for particular items of finished products, but require the addition of current cost factors, such as labor, and of other deferred cost factors, such as the productive services of plant assets, before their form utility can be finished and this necessary step toward the realization of income completed. Other productive services—land, buildings, machinery, equipment—are still further removed from, although irrevocably dedicated to, that final objective of business enterprise.

This attitude of looking upon a large section of enterprise assets as productive services in various stages along the route leading to the realization of income, illuminates the nature of these assets and the cost problems associated with them much more effectively, in at least two particulars, than the attitude of looking upon these assets as tangible objects or intangible rights. (1) A harmony of purpose between the balance sheet and income statement is emphasized. Both of these statements are related by this point of view to operations and the basic problem of income determination. They differ, in relation to the cost factors involved, only as to the time element and the resulting change in perspective that that element introduces. (2) Emphasis upon cost and continuous valuation at cost of all cost factors in the balance sheet also gives to the balance sheet alone a depth and significance lacking when other and possibly shifting bases of valuation are used.

The deferred cost-factor division of the balance sheet, if stated consistently on a cost basis, tells a story not only of the present but also of the past and the future. Looking to the past, proper balance-sheet presentation will show the amount of original expenditure, and the portion of that expenditure that has been accounted for as a cost of past revenue, or it may be as a loss. Many problems for the accountant are involved in determining this portion of cost, in choosing suitable measures in terms of time or productive events by which the passage of original cost price over to the calculated cost of derived cost factors may be reckoned, and in analyzing this stream of cost flow in terms of functions, departments, operations, jobs, products—whatever analysis may be desirable the more fully to understand for management purposes the detailed composition of the cost of revenue. Looking to the future, the balance sheet presented consistently on the cost basis displays as a difference between original cost and the amounts charged as cost to past revenue and/or recognized as a loss, the residual quantum of original cost that remains dedicated to the earning of future revenue and that will be charged for the remaining productive services when they are utilized for this enterprise purpose. By con-

trast, it need scarcely be pointed out to the student of accounting that, to the extent that non-cost valuations are used in the balance sheet in connection with items which become charges to revenue, the resulting deductions from revenue can hardly be called costs of revenue. In this situation the term "cost" is sometimes stretched beyond the reasonable limitations of the meaning of the word. Whatever useful purposes statements containing non-cost valuations may serve, the statements themselves cannot legitimately be described as cost statements.

Conflicting Purposes of the Balance Sheet

It is too far from the purposes of this inquiry to point out in detail why cost is not used exclusively as the valuation basis for cost factors in the balance sheet. The fact is, however, that the balance sheet is by no means used exclusively as a cost statement. The emphasis is often upon the presentation of the momentary financial position of the company. From this standpoint concepts of value are often introduced which involve realization other than through the cost of revenue. What these other bases of realization are is sometimes not made clear. In other words, the cost purpose of the balance sheet is sacrificed or disregarded. It must not be inferred that the cost basis should not on occasion be adjusted to give recognition to irretrievable losses, or to reflect major and permanent changes affecting the economic position of the enterprise. But frequent and promiscuous changes should be avoided. It must be reiterated again that, if accounting aims to arrive at the *cost* of goods made and sold, to the extent that this value derives from the absorption of certain balance sheet items, cost must be the value associated in the balance sheet with these items.

Income Statement

The conflict of purposes existing in connection with the balance sheet is not present to the same degree in the income statement. The latter is predominantly a cost statement aiming directly at a presentation of the cost of periodic revenue. Two types of limitations may in particular cases interfere with the full realization of this purpose:

1. The carry-over into the income statement of non-cost valuations introduced into the balance sheet for the purpose of modifying a cost representation of financial position. The nature of these changes has been discussed in part in the preceding section.

2. The limitations involved in the costing methods employed by the company making the report. If financial accounting procedures are used, the weaknesses of cost determination inherent in this method interfere with the accurate expression of cost in the income statement. If cost accounting procedures are used, failure to observe correct principles will prevent the accurate or full expression of cost. Cost methods themselves are not immune from defects. Intelligently applied, however, they produce the closest representation of cost that it is possible to obtain, and should be used wherever possible in preference to financial accounting procedures.

Several aspects of cost and the mechanics of cost determination of the conventional income statement are worthy of attention.

1. The term cost is associated therein particularly with the cost of goods sold, the product cost of revenue, and the various specific elements that compose this final figure.

2. The statement displays the major elements involved in the determination of the cost of revenue. These are—

a. The cost assigned to the product unfinished at the beginning of the period, an initial balance sheet item.
b. The new costs introduced into the manufacturing processes during the period. A classification of these costs is given. Direct material, direct labor, and elements of manufacturing overhead are separately stated.
c. The costs in process at the closing date, a final balance sheet item.
d. The aggregate costs of goods manufactured during the period.
e. The initial inventory of finished goods.
f. The final inventory of finished goods.
g. The cost of goods sold.

3. The statement indicates that the determination of the cost of major elements—cost of raw material used, cost of goods manufactured, and cost of goods sold—is indirect, and is dependent upon the listing and valuation of items in a final inventory. This dependence of cost determination upon physical inventories is characteristic of general accounting procedure. The method used may be expressed in a series of equations:

a. Cost of raw material used =
   Cost of raw material in the initial inventory, plus
   Cost of raw material purchased in period, less
   Cost of raw material in the final inventory.
b. Cost of goods manufactured =
   Cost of work in process at beginning of period, plus
   New costs introduced during the period (raw material, direct labor, and factory overhead), less
   Cost of work in process at end of period.
c. Cost of goods sold =
   Cost of finished goods in the initial inventory, plus
   Cost of goods manufactured in the period, less
   Cost of finished goods in the final inventory.

It should be observed that this method of presentation in an income statement is not necessarily conclusive indication of the costing technique followed in the books, inasmuch as this form of final presentation is not infrequently used under both cost and financial accounting procedures.

4. The costs of revenue are stated as major categories corresponding to the major operating divisions—production, marketing, administration, and finance. The term expense is employed, as noted earlier, in the marketing and administration sections.

The student of accounting will realize that there are a variety of ways in which the conventional income statement is presented, dependent upon the nature of the business, the purpose and use of the statement, the amount of detail to be shown in the statement or assigned to supporting schedules.

The Accountant's Responsibility with Respect to Costs

The accountant's task with respect to costs as set forth in an article by Professor Paton is as follows:[1]

"1. He must make an acceptable record of costs as they are incurred.
2. He must follow costs in terms of internal business operation, classifying and departmentalizing the costs incurred in the most effective manner possible.

[1] W. A. Paton, "Costs and Profits in Present-Day Accounting," *N.A.C.A. Bulletin*, Vol. XVI, No. 3, Section 1, October 1, 1934.

3. He must assign a proper quantum of costs to the revenues of the particular period, at the same time deferring the unassigned amount for future absorption."

Summary:

The purpose of this chapter is to convey some insight into the problems of cost determination in accounting. Toward this end three main categories of business transactions have been outlined, and the major accounting statements have been reviewed. Certain general conclusions can be drawn from the discussion:

1. Three qualitative types of costs have been described:
   a. Purchase cost, the money value paid out in the acquisition of cost factors.
   b. Amortized cost, associated with deferred cost factors, principally long-term assets.
   c. Calculated cost, arising from the internal combinations of initial cost factors that are effected in the production of finished and semi-finished products, and in the provision of marketing and administrative services.
2. A certain uniform principle of cost transference is common to these three qualitative types of cost. In accordance with this principle the cost of a factor is the money-value equivalent of the amount expended, paid to suppliers outside the business or used internally within the business in its acquisition.
3. Both financial and cost accounting are concerned with problems of cost determination. They differ materially, however, in their approach to the determination of calculated costs. Financial accounting relies upon end-of-the-period physical inventories, and deals with aggregate costs as a step in determining the periodic cost of revenue. Cost accounting analyzes all of the internal transactions of the business for the purpose of costing the product output in detail, and for the purpose of supplying adequate information for the control of expenditures. The flow of product through the plant is traced, and its costs accumulated. Specific unit costs are calculated. Shipments of products are accounted for separately from their manufacture. Distribution activities are measured, not only in money, but in effect; in this way unit costs of these activities may be stated.
4. Both the balance sheet and the income statement are essentially cost statements. Both are related to the basic problem of income determination. The most important element in this determination is the cost of revenue. The valuation of the cost factors should be handled so as to preserve the integrity of the cost figures.

Chapter 3

COST ACCOUNTING AS A TOOL OF MANAGEMENT

By
C. W. SARGENT * *

Purposes of Cost Accounting

There are many specific purposes of cost accumulation. It is useful to recapitulate some of these purposes in four major categories, although some overlapping results. These categories are:

1. *Financial Purposes*—to facilitate more accurate balance-sheet valuation and income determination by:
   a. Providing unit product costs for goods in process, finished parts and stock, and goods sold.
   b. Removing dependence on physical inventories through the use of perpetual records for materials and supplies, goods in process, and finished products.
   c. Making possible through (a) and (b) the preparation of monthly statements and hence providing more frequent information about the financial position and trends of the business.
   d. Furnishing accurate costs of plant construction and other property changes.
   e. Protecting the investment in inventories and plant through adequate records control.
2. *Marketing Purposes*—to facilitate the profitable distribution of the companies' products by:
   a. Providing finished product unit costs, and analyses of distribution expenses.
   b. Aiding in the preparation of estimates and bids.
   c. Demonstrating the relationship of volume and price, and the increase in volume needed to offset a reduction of price, or the reverse.
   d. Providing information about the relative profitability of different product lines and items and hence aiding in the formulation of sales policies and in the direction of the company resources toward maximum profit.
   e. Promoting more intelligent competition through cost information arrived at by uniform procedures among companies engaged in the same industry.
3. *Operating Purposes*—to facilitate the economical management of internal activities by:
   a. Providing detailed historical costs for each department, operation, and workman.
   b. Cooperating in the preparation of cost standards suitable for furnishing a measure of the efficiency of departments, operations, and workmen.
   c. Helping to control performance and expenditure by comparing the current cost facts with the cost standards and presenting this information to general, functional, and departmental executives.

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d. Making management and employees cost conscious by emphasis on the costs of wastes and idleness.
e. Participating in all studies in cost reduction..

4. *General Purposes*—to facilitate the over-all transaction and coordination of the company's business by:
   a. Aiding in the formulation of the general policies and plans of the company.
   b. Cooperating in the preparation and use of the budget as an instrument of managerial control.
   c. Providing the cost portion of the factual bases of all management decisions.

Two aspects of this recapitulation of some of the specific purposes of cost accounting require comment:

1. The same kind of cost, and of cost determination, cannot serve all of these purposes. Mr. Robert N. Wallis of the Dennison Manufacturing Company emphasizes this point [1] in stating that his company wants costs for four purposes—(1) bookkeeping, (2) pricing, (3) operating control, and (4) special problems—and explaining why a different kind of cost may be required for each of these uses. Mr. Wallis points out that in his company average costs covering a group of finished product items are satisfactory for bookkeeping purposes, but they are not an accurate basis for pricing. Operating control requires operations and department costs, rather than product costs. In other industries—for example, in the manufacture of paint, varnish, and cotton textile fabrics—pricing may require the use of the replacement cost of materials and normal labor and overhead rates, although these values are not entirely satisfactory for other purposes, for example, income determination and balance-sheet valuation.

2. The outstanding fact apparent from the above recapitulation is the emphasis upon the use of cost data for purposes of managerial control, usually in connection with other instruments of control such as policies, standards, and budgets. Modern business requires a minute division of operating effort. This fact is demonstrated in the elaborate functionalization and departmentalization found in large enterprises. Adequate direct supervision must be furnished for each of these divisions of activity. This end is accomplished by development of the organization structure, the establishment of lines of authority and responsibility at various levels, and the assignment of supervising personnel. This specialization of operating effort and supervision also introduces the necessity for coordinating the various activities into a harmoniously working whole. Management has evolved several instruments for this purpose, which supplement direct observation and supervision and facilitate control and coordination. Cost accounting is one of these instruments. This chapter discusses briefly the nature and uses of these instruments and the place of cost accounting in the scheme of managerial control.

Phases of Managerial Effort

The management of an enterprise requires various kinds of managerial effort. These are provided at two primary levels of control which may be called the administrative and the executive. At the administrative level, management is concerned with:

1. Defining the general objectives of the business.
2. Formulating its general plans and policies, particularly in the relationship of aspects of the business to outside influences—economic and competitive conditions, and governmental regulations and policies.

[1] Robert N. Wallis, "Overcoming Management Inertia," *N. A. C. A. Bulletin,* Vol. XII, No. 20, Section I, June 15, 1931.

3. Developing and improving the structural plan and personnel in the higher divisions of the organization.
4. Determining the general standards of operation, particularly those bearing upon rate of return on investment, financial position, and the direction and flow of new and replacement funds.
5. Providing motivation and unity of purpose, and harmonizing the various functional demands and requirements.

On the executive or functional level, management is concerned with:

1. Interpreting the general objectives, plans, and policies to the operating personnel.
2. Originating detailed plans and policies on various functional and departmental levels.
3. Developing and improving the structure and personnel of the subsidiary organization.
4. Formulating operating methods, and physical and cost standards.
5. Directing the operating activities in terms of the policies, plans, and standards.

Organization Structure and Direct Supervision

All enterprises require many kinds of technical skill, both manual and mental, and use a variety of types of productive machinery and facilitating tools and equipment. Thus, specialization is present in the production, distribution, and other divisions of the business.

Organization, based on this specialization in skill and equipment—the division of operating effort into specific functions and departments, each under a responsible head—requires:

1. The delegation of authority to the various line and staff, the different functional and departmental, executives.
2. The defining of the duties and the responsibilities of each of these executives.

These matters provide the framework, the organization structure. In this way there are set up lines of direct and personal supervision running from the general to the minor executives and workers—supervision by direct observation and personal contact.

The development of the plan of management through organization, if viewed at this point, is found to lack two important elements in the basis of managerial control. These are:

1. Provision of means for measuring the discharge of responsibility in each of the organizational divisions.
2. Provision of means of coordination.

Associated in concept with authority and responsibility is accountability, the need for measuring the use made of authority. The delegation of authority, and the designation of duties, require measurement of the discharge of responsibility. The source of authority, whether stockholders or minor official, should require a reporting upon performance. To appraise performance adequately requires the establishment of standards, budgets, and sound cost accounting procedure that furnishes information about the actual operating expenditures and output. It is a basic principle and requirement of cost accounting that operating accounts shall be set up to correspond with organizational divisions of authority and be usable in the measurement of the discharge of responsibility; that is, reflect accountability.

The division of authority and responsibility through organization makes the development of instruments of coordination imperative. Functionalization requires the improvement of the function of management itself. The organization, specialized and subdivided, must be unified; the activities of the various divisions must be integrated. Marketing, manufacturing, and purchasing must be not only well operated as individual activities, their programs must be harmonized and interrelated, fitting the enterprise into the current and longer-term economic and competitive situations. Coordination requires plans in which the activities and needs of all divisions are weighed and adjusted to the general purposes and objectives of the enterprise.

Sound organization structure, trained personnel, and the daily contact of responsible executives with each other and with the chief executive are unifying influences, but they are not in themselves sufficiently impelling to effect the coordination of diversified activities.

Instruments of Managerial Control

Direct, supervise, manage, head, lead, regulate, guide, steer, pilot, look after, oversee—all these words are descriptive of phases or aspects of control. Managerial control in the broadest sense comprehends all forms of directing the activities of an enterprise.

Organization structure provides the framework of managerial control. The primary agency of control is the supervisory personnel provided in the organization plan, the responsible general, divisional, departmental, and minor executives. This agency uses the primary instrument of control—direct contact, observation, and supervision of the productive resources within the jurisdiction of each executive.

Direct supervision, however important, is incomplete and inadequate; it cannot be relied upon as the sole control device. Hence other instruments are introduced which supplement direct supervision, facilitate the measurement of individual accountability, and aid in coordinating the diverse and sometimes conflicting purposes and activities of the several divisions of the enterprise. These instruments are:

1. Policies—the formulated aims, objectives, and guiding principles for the business—at general, functional, and departmental levels.
2. Standardized and stabilized operating conditions, methods, and practices.
3. Predetermined standards of performance and of cost.
4. Predetermined programs and budgets of operations.
5. Knowledge of operating facts, accomplishments, and results, summarized through formal cost accounting procedures, cost studies, and cost reports.

These devices may be classified into several overlapping groups:

1. Conditioning instruments—establish the setting within which operations take place:
   - Policies
   - Standardized methods and practices
2. Planning instruments:
   - Policies
   - Budgets
3. Coordinating instruments:
   - Policies
   - Budgets

4. Cost control instruments:
   - Cost and performance standards
   - Budgets
   - Cost accounting

These classifications indicate in a general way the managerial uses to which these instruments are put.

General Comments on the Control Instruments

Before discussing these management instruments individually, a number of general comments are pertinent.

1. Some of these instruments of control—the organization structure itself, the formulation of policies, and stabilization of operating methods and practices—are primary in the sense that they are antecedent to, and their use should precede the adoption of standards, budgets, and cost methods. These primary instruments may also be thought of as the relatively more static instruments, and standards, budgets, and costs as the relatively more dynamic participants in control.

2. These instruments of managerial control operate through the organization structure and personnel. Therefore, they must be adjusted to the plan and personalities of the organization. They must dovetail with the delegations of authority and responsibility. They must also interlock for greatest effectiveness; for example, the cost records of actual expenditure and output must be correlated with the budget and with standards.

3. Some of the instruments—particularly policies, standards, and budgets—are not in every instance wholly distinguishable from one another as *instruments*, although they are clearly separable as concepts. Policies, for example, and stabilization of operating conditions, are implied in standards and budgets, although they may never have been explicitly recognized and stated. Budgets are, in a sense, expressions both of policies and of standards. Records of actual expenditures may include standards and budgetary information. Several instruments are in reality superimposed one upon another. Upon the foundation of controlled conditions and policies, standards are adopted which are incorporated in budgets and costs.

4. In a discussion of cost accounting it is impossible to discuss organization structure and the supplementary instruments of managerial control fully. These instruments do, however, involve important cost aspects. This fact makes it desirable to explain briefly the nature of each of these instruments in order that the place of cost accounting in management may be more fully appreciated. Emphasis is necessarily upon their relationship to accounting, rather than upon their use as control instruments.

Policies

The word policy has a number of meanings suggested by objective, plan, goal, resolution. In another sense, it is a principle adopted as a guide to conduct. Lay [1] states, "Policy has for its purpose the control over the operating force by delimiting the field of action, in the manner that legislation aids as a directive control in relation to the executive division of government."

The following list, adapted in part from Lay's excellent article, is suggestive of matters about which policies may be formulated:

1. General policies—relative to:
   Centralization or decentralization—of operating supervision, plant facilities, office force

[1] Chester F. Lay, "Business Policy as Related to Accounting," *Accounting Review*, Vol. 4, No. 2, June 1929, p. 122.

Expansion of facilities, products, personnel
Organizational development of line or staff functions
Pensions and retirements
Planning through budgeting
Study of long-term trends and adaptation thereto of facilities and operations
Research

2. Distribution policies—relative to:
   Prices
   Product lines
   Territorial distribution
   Marketing channels, and dealer aids
   Advertising
   Turnover
   Order size
3. Manufacturing policies—relative to:
   Provision of emergency excess equipment
   Equipment replacement
   Equipment maintenance
   Wage payment, rates, bonus and incentive plans
   Experimentation, study of operating layout, and methods
   Materials—purchase, handling, use, quality control
   Low production period make-work and share-work programs
   Product quality control
4. Finance policies—relative to:
   Credits
   Discounts
   Collections
   Dividends
   Seasonal and long-term sources of capital
   Use of temporary excess funds
   Standards of normal return on investment

Those are illustrations of a few of the matters about which management intention may be formulated and expressed as a policy, a general rule or principle for the guidance of operating personnel. Every enterprise establishes policies consciously, or without purposeful adoption. They are necessary in small organizations to assure greater consistency of action upon similar matters presented for decision from time to time. They are indispensable in large organizations for this reason, and to provide greater harmony of action among departments, functions, and individuals at the same moment.

The cost accountant is rarely called upon to provide managerial policies, except those of local application within his own department. He is frequently required, however, to supply data on the cost consequences of policies, to determine the relative costs of proposed or alternative policies, and in this way to help formulate policies.

According to Paul W. Pinkerton [1] the aid the accountant may give in policy formulation involves the following elements.

"(1) The development of an idea for a profitable change in policy.
(2) The determination from figures that the idea is or is not worth while.

[1] *N.A.C.A. Yearbook*, 1932, pp. 21 and 22.

(3) The preparation of a demonstration of the developed proof.
(4) The presentation of the idea and the proving of it to others.
(5) Watching its carrying out to see that prejudicial conditions are not permitted to defeat it.
(6) Preparing and reporting mathematical proof of its success after the fact."

Stabilization of Operating Practices and Conditions

This topic is intended to indicate the wide range of engineering data and the standardization that underlies intelligently conducted industrial operations, with the consequent stabilization of the factory methods, practices, and conditions. By stabilization is meant the study of products and processes to the end that: (1) the effect of variables is made known; (2) unknown variables are so far as possible eliminated; and (3) the interactions of materials, men, and machines in processing are defined and controlled so as to conform to the best procedure. The advent and growth of scientific management are responsible for the attitude that requires thorough study and investigation of all aspects of operations. As a result, the factual basis is provided for:

1. Control of product through—
   Standardization
   Simplification
   Design, and detail specification of materials and processes
2. Control over quality through—
   Material specification
   Process standardization
   Standards for manufacturing tolerances
   Inspection of machines and product
3. Control of the production flow through layout, planning, routing, scheduling, and dispatching
4. Control of labor type and quality through personnel policies, job analysis and specification, and other measures
5. Control of operating methods and conditions through specification of machines, tools, speeds, feeds, and other operations factors

The procedure for the use of engineering data for these purposes is the formulation of standard product specifications, standard material specifications, and standard processing methods and instructions. These matters are comprehended in the meaning of standardization, which has been described as follows:

"Standardization is primarily technical and creative. It seeks to determine and establish, in use and in practice, best design, size, quality, method, or process for performing a desired function. As a process it is primarily an engineering activity. A standard . . . is not unalterable and ultimate as is often thought, but on the contrary is subject to change and is progressive. It crystallizes the best thought and practice at the time it is established." [1]

The cost accountant is able to contribute data about the relative costs of alternative processes and practices and hence aid in the standardization of shop methods. The cost point of view cannot be ignored in this work, but the major study and effort required to furnish the data and make the decisions leading to the stabiliza-

[1] L. P. Alford, Ed., "Cost and Production Handbook," The Ronald Press Co., New York, 1934, p. 305.

tion of shop conditions are an engineering task. The importance of this task in establishing control over operations needs no emphasis.

Standards of Performance and Cost

Without standardization of operating conditions and methods, performance must be relatively unpredictable and uncontrollable. With the stabilization of these operations factors, reliable performance standards can be adopted. These standards are stated as allowable quantities of material, time, and other factory services, for each operation, department, process, or product. Performance standards multiplied by unit standard prices give the standard cost for any product, part, operation or process.

The actual quantities of material, labor, and factory services used, extended at actual unit prices, when compared with the standard quantities and prices, provide a direct basis for stating individual and departmental efficiency and hence of managerial control. Any difference between total standard, or allowed cost, and actual cost is a compound difference due to both price and quantity. These two basic causes are separated because of the greater controllability of the latter.

This comparison between actual quantities of material, time and factory services consumed, and the quantities of these items allowed when performance is at standard, may be made for each workman, each operation, each department, and each product on a daily, weekly, monthly, and cumulative basis. Thus managerial attention can be focused on unfavorable performance, and the responsibilities and to some extent the causes of departures from standard performance are made known.

Standards of some sort, whether or not scientifically determined, and whether or not incorporated in the formal cost accounting system, are indispensable to careful management.

Some frequently used price and quantity standards are mentioned below:

Price standards:
- Standard sales price per unit for each product
- Standard material prices for each kind of direct material
- Standard basic wage rates for each occupation
- Standard total, variable, and fixed burden price (rate) per unit

Quantity standards:
- Standard quantity of direct material of each kind per unit of each product
- Standard labor time in each operation per unit of each product
- Standard machine, or processing time per unit of each product
- Standard output for each process at normal capacity

Cost standards (quantity standards $\times$ price standard):
- Standard material cost per unit of each product
- Standard direct labor cost per unit of each product for each operation, and for all operations combined
- Standard burden cost per unit of each product, for each operation, and for all combined
- Total standard manufacturing costs for each product
- Standard fixed, variable, and total distribution and administrative costs per unit for each product

The cost accountant's interest in performance and cost standards is a multiple one:

1. Although ordinarily not responsible for the determination of standards, which is primarily an engineering task, he must usually cooperate in setting them by participating in preliminary cost studies and by checking tentative standards against his records of actual performance.

2. The cost accountant, upon the setting of the standards, will usually wish, or be required by management, to use them by incorporating them in his current actual cost records through employment of some form of standard cost procedure. Thus comparisons can be made of standard and actual costs which tie in with the formal accounting records. In this way reliable comparisons may be compiled and interpreted by the cost accountant, and presented to management as a basis for control.

3. In addition to his task of furnishing management with analyses of actual and standard performance, the cost accountant has a direct professional interest in these comparisons, because a constant possible cause of difference is an error in the standard itself.

4. To the extent that the cost accountant participates in budget preparation, he will also use performance and cost standards.

Budgets

Budgeting is a device for planning and coordinating the activities of the enterprise in advance of operations. This predetermination permits:

1. Visualization of the operating requirements and results before occurrence. This may be carried to the final accounting stage of forecasted profit and loss statement and balance sheet.
2. Modification of the original plans if the indicated results are unsatisfactory.
3. Coordination of functional and departmental plans into a unified program.
4. Measurement of responsibility for departures of actual operating results from the expected (budgeted) results.
5. Revision of the plans to adapt the program to changing economic circumstances, with specific measurement of the cost effects of the changes.

Two general types of advantages accrue to companies using budgetary procedures:

1. Those arising from the thought and study necessary to the preparation of the budget, the advance planning, adjusting and coordinating of sales, plant capacity, purchasing, production, cash, profit, and financial position. The final plan, or rather the correlated group of plans that is the budget, is presumably the best program that internal and external conditions permit. If budgeting stopped here it would be worth while.
2. Those arising from the daily, weekly, and monthly comparisons of actual results with budgeted expectancies. These comparisons provide executive controls at various levels so that selling efforts, production scheduling, inventories, prices, working asset position, capital requirements, and profits are coordinated with each other and with changing conditions.

Successful budgeting is necessarily founded upon a high degree of standardization. Both cost standards and budgets can be accurately predetermined only if operating practices and conditions have been stabilized. Budgets also necessarily are based upon, and give expression to, the policies of the company.

Budgets and cost and performance standards are very directly related. The budget allowances are based upon the cost standard allowances when these are available. In this case, the budgeted amount is made up of a unit cost standard

multiplied by the budgeted volume amount. The volume factor, the quantity of units (of parts, products, operations, labor hours, material) expected to be required, produced, or sold during the budget period, is the distinctive new element contributed by the budgetary process. Budgeted volume—studied, estimated, forecasted, and coordinated for all phases of operations, and extended at appropriate unit cost standards—gives the money expressions of the operating goals. If the cost standards are fixed, as is true under one form of procedure, then the budget must be based upon the fixed standards modified by corrections factors to adjust them to unit costs expected to obtain during the budget period. In other cases, also, because of idle capacity and known variances, for example, cost standards may have to be modified in order that the budget may express the expected conditions.

The budget, based on unit cost standards, is upon adoption a standard, a goal to be attained, and a gauge or measure for appraising operating effectiveness in reaching the goal.

The cost accountant's interest in budgeting is a dual one:

1. He must usually cooperate in compiling the budget.
2. He must supply the actual costs that are compared with budgeted figures in using the budget as a current control instrument.

Relationships of the Managerial Control Instruments

The relationship of the control instruments so far discussed—policies, stabilization of operating practices, standards, and budgets—to organization and cost accounting is shown diagrammatically in Chart 1.

The function of managerial control is represented at the top. Control is effected through the organization structure, the various staff and operating divisions and executives. These executives rely first upon direct supervision, observation, knowledge of and contact with matters and personnel over which they have authority.

Supplementing this direct supervision are the other instruments of control just discussed:

1. Policies supply the background for operations through formulation of the aims and objectives of the business and its various parts.
2. Standardization of operating practices stabilizes physical conditions in the plant.
3. Standards of performance and cost supply the detailed measures of efficiency for each activity and operator. They are used to focus managerial attention on individual and departmental accomplishment, particularly below-standard performance.
4. Budgets supply the program, the coordinated operating expectancies, of each part and of the whole organization. The budget process supplies the volume factor, the expected rates of operation for the various activities. These expected quantities or rates, extended at the various cost standards, modified if necessary by expected variances from standard, give the total expected costs of each function and department.

Two of these instruments—policies and stabilization of practices—define the aims and conditions of operation. They are shown on the left side of the chart. The control instruments on the right side—budgets and cost standards—may be differentiated from stabilization and policies in that they, like cost accounting, employ money-value figures as a final form of expression. They are expressions of prospective costs.

These four instruments have this aspect in common—all are formulated and set up in advance of current operations—they are predetermined.

Cost accounting is shown at the bottom of the structure of control, the foundation upon which it rests. Actual costs must be accumulated so that management may know accomplishment. Figures on actual output and expenditure, following the same classifications as the standards and the budget, permit a wide range of comparisons between the standard, the expected, and the actual results. Points at which the budgeted program has been retarded, or accelerated, or has become unbalanced, will be disclosed. The rate of spending can be compared with the rate of output. The location and causes of wastes and inefficiencies can be determined. The inferior or superior performance of individuals, groups, and departments can be ascertained.

Management is given, by the addition of the actual cost figures, a full picture of operations; it knows what was planned and what was done; it is informed of the explanations of any differences. Knowing the progress and status of each activity in accordance with the plan, management can adjust the kind and the amount of productive effort on a coordinated basis. And for each of these amounts or changes, management is informed of the expected and the actual cost.

The Function of Cost Accounting in Managerial Control

The functions of cost accounting in managerial control have three aspects:

1. Cost accounting supplies some of the data necessary in predetermining the policies, practices, budgets, and standards used as managerial control instruments. Past cost records and special cost studies provide these data. Other non-cost technical information and judgment are also necessary in establishing these managerial tools.
2. Cost accounting collects, analyzes, and summarizes the current actual costs.
3. Cost accounting uses the predetermined budgets and standards, with the current actual cost data, in interpreting current performance for managerial appraisal.

The first aspect is indicated in Chart I by the dotted lines. The second and third aspects are indicated by the central solid black lines.

The major direct function of cost accounting has been in the past, and still is, the collection of accurate, actual cost data. These historical data cover both expenditures and output. Management must know not only the outlay but what is returned in productive effort and units of product. The actual cost data must be:

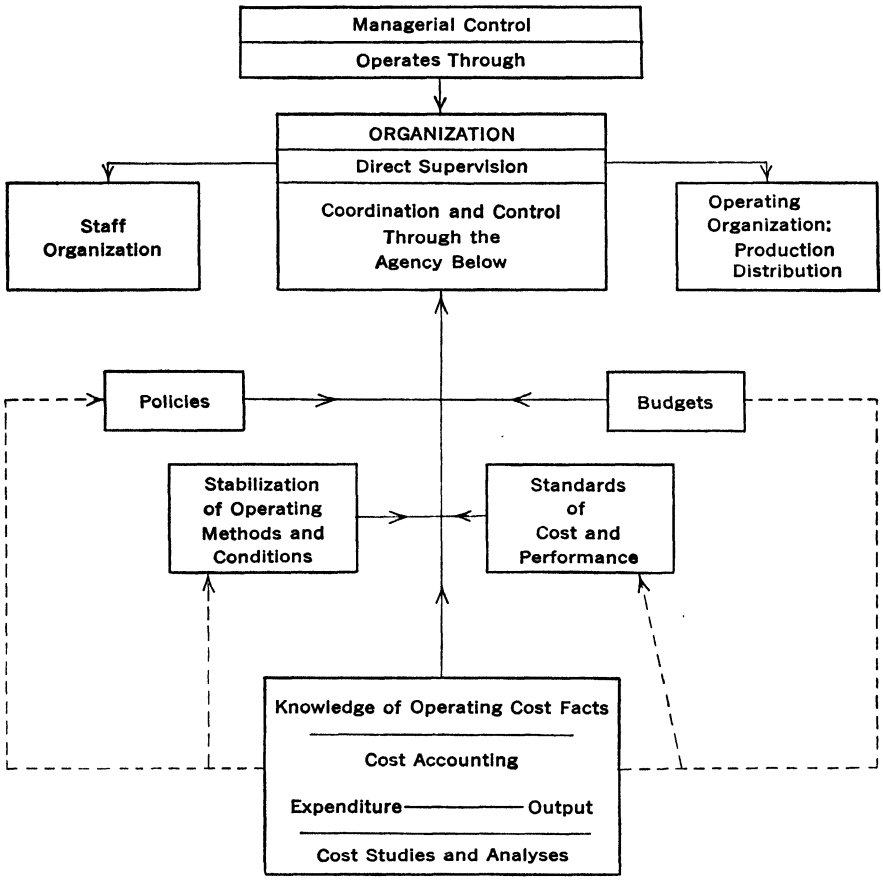
1. Analyzed to display expenditures and output separately by each division of the organization, so that responsibility and accountability may be measured and placed.
2. Summarized so as to display individual product costs.

The cost methods, properly designed, will accomplish both of these objectives. The first requirement is the more important from the managerial control standpoint. Therefore the major objective of cost accounting is to supply management with all necessary actual cost data relating to expenditures and output for the whole organization and for each of its parts.

For the other instruments of managerial control the cost accountant has no direct responsibility. He does not formulate the policies of the business although he may participate in their formulation. This is a function of the board of directors and the higher executives. He is not responsible for the planning and coordinating efforts associated with budgeting, although the controller is often the chief budget

officer. He is not responsible for standardizing and regulating the operating conditions. This is a function of the engineering and operating executives. The cost accountant is not solely responsible for the determination of cost and performance standards. These are based upon quantitative factors present in engineering data.

CHART I



Showing the Place of Cost Accounting in Managerial Control and Its Relationship to Other Instruments of Control.

Cost accounting is nevertheless involved in and related to all the instruments of managerial control. Cost data must be considered in policy formulation and in standardizing operating conditions. Budgets and performance standards are expressed in money and must be based upon historical and engineering cost analysis under defined operating conditions and methods. The cost accountant therefore is concerned with the *cost aspects* of setting up all these other managerial control instruments.

Cost accounting also finds itself involved in a third relationship to the more narrowly defined "cost control" instruments—namely, budgets and standards. To

give these instruments greatest effectiveness they must be associated and compared with the actual, current cost data. The cost accountant, therefore, finds himself impelled to employ cost procedures which will not only accumulate actual costs, but will also relate these costs to standards and budgets. In this sense, although the individual instruments other than his own are outside of his direct responsibility, the cost accountant finds himself, in using them to supply management with information, at the center of managerial cost control efforts.

The cost accountant does not exercise managerial control. His responsibility is to provide the data, properly summarized and interpreted, to actuate the managerial control instruments. The decision and action, the regulation and supervision implied by the word control, are supplied by the various general, divisional and departmental executives, not by the accountant. The frequently used expression, "control through accounts" is unfortunate in that it does not convey this distinction, and also in implying that with accounts a degree of control is more or less certain and automatic.

Managerial control is supplied by management's use of the instruments described above—direct supervision, policies, standards, budgets, and knowledge of current, actual cost facts. The cost accountant cooperates in collecting, summarizing, and interpreting the latter information, frequently showing these data in comparison with standards and budgets, and by supplying cost facts pertinent to the establishment and use of the other control instruments.

A Definition of Cost Accounting

The major aspects of cost accounting described above may be summarized by presenting a definition.

Cost accounting is that section of the principles, theories, and techniques of accounting that concerns itself particularly in compiling and summarizing expenditure and performance facts about the various functions, departments, processes, and operations of an enterprise, for the purposes of—

1. Determining actual total and unit costs for the various products and activities.
2. Preparing cost data pertinent to all managerial problems.
3. Presenting and interpreting cost facts—actual, standard, and budget cost data—to management as a basis for managerial control.

The intensive field of cost effort, within the business, is co-extensive with the organization itself. Principal attention in a manufacturing business is naturally concentrated on the production and distribution.

The extensive field of application of cost procedures is indicated by the following classification of industrial and commercial businesses.

1. Producers of goods:
   - Agricultural
   - Extractive
   - Manufacturing
   - Construction
2. Distributors of goods:
   - Jobbers and agents
   - Wholesalers
   - Retailers
   - Mail-order houses

3. Service industries:
   Transportation—railroads, trucks, buses, steamships, canals
   Communication—telephone, telegraph, radio
   Utilities—gas, electricity, water, heat
   Warehousing and storage
   Financing—banks, brokers, discount companies
   Housing and food—buildings, hotels, restaurants
   Publishing—books, newspapers
   Professional—accountants, lawyers, doctors, engineers
   Recreational—theatres, amusement parks
   Hospitals

The conduct of all of these types of business, whether carried on by private enterprise or government, is facilitated by the application of cost technique. In addition to the coverage of cost procedures in Section II of this handbook there is available in published form a large body of information about cost problems and procedures in a wide variety of types of business. The principal sources of this information follow:

1. Monthly bulletins and yearbooks of the National Association of Cost Accountants
2. Publications of trade associations
3. Cost texts directed toward particular industries
4. Articles in accounting and other technical journals

Summary

The matters discussed in this chapter may be recapitulated by restating the importance of cost accounting to management, and summarizing the duties and responsibilities of the cost accountant.

The importance of cost accounting to management is indicated by the following considerations:

1. Division of authority through organization requires the measuring of the manner in which the authority has been used.
2. All of the instruments of control involve cost aspects. Three of them—cost standards, budgets, and actual costs are predetermined or historical statements of cost.
3. Profit is the difference between revenue and the cost of revenue. The latter is to a greater degree within the control of management than the former.
4. Every phase of operating activity requires appraisal from the cost standpoint.

The task of the cost accountant requires him to:

1. Devise and install formal procedures for collecting actual cost data, adapting them to the organization structure, and using in the methods adopted so much of the other managerial control instruments—cost standards and budgets—as is possible and reasonable in each individual case.
2. Supervise and operate the cost system. In doing this he must record and analyze actual expenditures as they are made, trace their transference from one division of operations to another, measure the actual performance and expenditure in the various activities and compare them with expected and standard cost, summarize the cost of product output, and recapitulate the operating results for the period.
3. Aid in the planning, adoption, and use of the managerial control instruments discussed in this chapter.
4. Make, or participate in, special studies and efforts of the company directed toward cost control and cost reduction.

5. Consult with all executives of the company and its professional advisers in matters affecting costs.

6. Study and interpret the cost data collected, whether through special studies or through the formal cost procedures, and present suitable summaries and reports to the various departmental, functional, and general executives. These reports must be addressed particularly to the task and responsibility of aiding management in its problems of securing control and coordination.

Chapter 4

MAJOR COST PROBLEMS IN BUSINESS

By
C. W. SARGENT *

Every phase of business, and of other forms of economic activity as well, is beset by cost problems. Capital costs and revenue costs must be estimated before a venture is undertaken. Cost plans and programs, budgets in one form or another, must be prepared in advance of operations for each period. Amortized capital costs, material costs, labor costs, product costs, must be assigned to period revenue in order to measure the net gain or loss. Acquisition costs must be distinguished from expired costs. Costs must be measured, distributed, allocated, prorated, imputed, to functions of the business—production, distribution, administration, finance; to plants, departments, processes, cost centers, machines; to individual product items, groups, classes, brands, sizes, and qualities; to various factory service and marketing activities; to distribution channels, territories, salesmen, and customers. Costs are described as estimated, budgeted, forecasted, actual, historical, normal, standard, aggregate, unit, direct, indirect, variable, fixed, constant, joint, statistical, differential, alternative, and in many others ways. Costs are pervasive and compelling.

A CLASSIFICATION OF COSTS

Enterprise costs may be classified in many ways. A classification pertinent to the discussion of major cost problems follows:

I. Accounting Costs
  A. Historical costs
    1. Financial accounting costs
    2. Cost accounting costs
  B. Historical cost accounting costs modified by the introduction of
    1. Predetermined or normalized overhead
    2. Cost standards
II. Statistical Costs
  A. Budgeted accounting costs
  B. Adjusted accounting costs
  C. Alternative cost calculations
  D. Differential cost calculations
  E. Analyses of cost-revenue-profit-volume relationships, and other studies

This classification of costs may also serve as a framework by which to classify cost problems.

Accounting cost is rooted in actual expenditure, or outlay. Expenditure is enterprise sacrifice measured in money, and may be evidenced by a disbursement of cash

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or transfer of other assets, or the recognition of liability to creditors or obligation to owners. Accounting costs are therefore historical in the sense that they are associated, strictly speaking, only with completed transactions. Events transpire, and costs arise for accounting recognition, and these costs are actual, historical costs.

This restriction of accounting costs solely to past events represented by completed transactions is obviously a severe limitation for several reasons. What of the future? A most useful management effort is directed toward anticipating, planning, and controlling future costs, and correlating them with output and revenue, so as to protect the investment, maximize the profit, and stabilize the enterprize. Such coordinated plans, when expressed in money, are called budgets. The costs therein are essentially accounting costs; they follow the pattern of accounting costs and are measured usually by the same rules, principles, and conventions. They differ from historical costs only in that they are projections of currently known historical cost factors into the future, supplemented by expected future expenditures. Because they are estimates related to anticipated events they are not accounting costs, and hence are classified above as statistical costs. But because they are molded in the same pattern as accounting costs, and are subject to many of the same restrictions and limitations, they are described above as budgeted accounting costs.

By reason of being rooted in expenditure, accounting costs exclude sacrifices not involving outlay. Hence interest on owners' capital, and the value of owners' services not actually paid for, are not accounting costs. Likewise operating costs are based upon original outlay which, if property and material values have advanced or declined markedly, no longer represent the expenditures that would be required if replacements were made at current price levels. In this event historical costs are out of tune with current values. The business may also be benefiting currently from values that required no expenditure, or from an outlay small in comparison with present worth. So-called discovery value, associated with the exploitation of natural resources, is an illustration. The business may be benefiting, without current cost, by reason of expenditures charged against prior operating periods. Such charges may have been made in accordance with accepted accounting principles. Advertising, for example, is customarily charged to operating cost in the period of the outlay, despite the likelihood, in many cases, of future benefit. Research, engineering, experimental, and product development costs may be accounted for in the same manner. Or charges that should have been deferred have been made solely against prior operating costs contrary to accepted accounting principles, nevertheless with the same result in terms of current operating benefit without current operating cost.

For these reasons, historical costs may not be representative of outlays that would be required under present circumstances, and therefore are not fully informative to management in relation to certain purposes or decisions. In these circumstances cost calculations may be made, in the same pattern as applicable to historical accounting costs, except that amounts are stated on the level of current values for depreciation, depletion, materials, labor, and other cost factors. Such costs, inasmuch as they depart from the accounting anchor of historical outlay based upon actual transactions, are classified above as statistical costs, but because in form and method of computation they often conform to the accounting pattern, they are described as adjusted accounting costs.

Cost standards which attempt to represent what costs ought to be under normal, expected, or ideal circumstances also fall into the category of adjusted

accounting costs, when they are not incorporated in the accounting records. In this event, although usually set in the accounting mold, they reflect as to amounts what costs might be under the defined circumstances, rather than what they have been under actual operations. When costs standards are introduced into the accounts (where they perform the functions of providing a comparison of allowed with actual expenditures for the actual operations, and serve as the basis for dividing the stream of actual costs between inventory accounts and variance accounts), they may reasonably be regarded as accounting costs.

A complete cost system will use all forms of accounting costs, including budgeted costs, and cost standards which may or may not have been introduced into the accounting records. In addition, the cost accountant must prepare other forms of adjusted cost calculations and statistical cost analyses.

Other forms of statistical costs depart substantially from the accounting mold. In some cases the primary objective is to define the variability of costs with changes in volume of sales or output, to describe the cost pattern of a department, plant, or even of the business as a whole. For this purpose statistical procedures which evaluate the degree of variability may prove very useful. Other cost computations, referred to above as alternative and differential cost calculations, take many forms. These calculations disregard the underlying accounting concept of operating cost as total allocated historical outlay, whether the allocation be to the activity, the product, or the period. Alternative and differential cost analyses are concerned essentially with differences in costs rather than with total costs. Before any capital commitment has been made, what are the relative costs of machine A and machine B, either of which may be used to perform a given operation? Which machine should be purchased? Costs common to both machines are not pertinent to this decision. Certain non-accounting costs, such as interest on the relative investments, are pertinent. What are the costs involved in increasing or decreasing the product output, in adding or dropping a product line, a territory, a salesman, a factory? What difference in cost can reasonably be imputed to any of these changes? For many kinds of management decisions the cost facts disclosed by this type of cost calculation are a better guide to action than total allocated financial outlay. In deciding whether or not to take a certain action, management is more concerned with the costs that are affected by the decision than with the costs that are fixed irrespective of the decision.

Financial Accounting Cost Problems

In discussing cost problems in business it must not be supposed that they are confined to the field of cost accounting. Rather, the cost problems encountered in the field of financial accounting, and the treatment of these problems there provided, are basic factors in the accounting solution of all cost problems. Cost accounting cannot proceed without financial accounting, and cost accounting problems can be understood and resolved only in reference to certain concepts and methods that underlie financial accounting and thereby furnish the master framework for all accounting procedures.

The general objectives of financial accounting may be briefly stated as follows:

1. Protection of the enterprise capital through recognition and measurement of the resources committed to the business and its obligations to creditors and owners.

2. Maintenance of enterprise credit standing and provision of over-all accountability of managers to owners and public authority.
3. Determination of periodic profit as a means of
    a. Measuring the over-all performance of management.
    b. Testing the economic stability of the business.
    c. Protecting the investment through prevention of dividends out of capital.

Major cost problems encountered in striving toward these objectives are associated with:

1. The recognition and measurement of acquisition costs, the costs identified with cost factors at the time they are acquired by the enterprise.
2. The determination of the amounts of cost expirations that are to be matched with revenues in estimating period profit. Major problems in this field involve:
    a. The classification of costs at acquisition between capital and revenue—that is, charges to asset and expense accounts.
    b. The amortization of capitalized costs.
    c. The allocation of cost to final inventories.

Subsequent discussion does not include revenue problems involved in periodic profit measurement.

Acquisition Costs

The acquisition cost problem centers on this question: how much total cost should be identified with a cost factor when it is acquired; what is the monetary measure of enterprise sacrifice when ownership or use is secured?

Cost is expenditure and usually its amount is readily ascertainable. Inasmuch as accounting is based upon an equation, the diminution of assets or the increase of liability or capital investment measures the cost, and there must be an exact equivalence between the cost and these associated changes in the equation. Accounting principles do not admit that a recognizable profit or loss arises at acquisition. The amounts of acquisition cost involved when purchase is for cash, on short-term credit. or even under hire-purchase agreements, are normally quite definitely determinable. Questions as to how to classify some of these costs do arise, as indicated below, but the total amount of the expenditure is not uncertain.

If acquisition takes place in any of the following ways, the amount of the total cost may be in doubt:

1. When the consideration is only partly cash or its immediate equivalent.
2. By exchange.
3. Through the issuance of corporate securities.
4. By purchase of an aggregate of assets without detailed itemization.
5. By merger of previously independent or previously affiliated companies.

In any of these circumstances either the amount of total cost or the amount of the cost of particular items, or both, may be in doubt. Even if the question of total cost can be reasonably resolved, the cost of particular factors out of an aggregate may be stated only on the basis of a more or less arbitrary allocation.

Problems arise as to the amount of cost to be associated with cost factors acquired by construction. Direct costs of material and labor usually can be identified with the property change involved, as can items of special overhead, but how much of the regular overhead of the company should be allocated to each construc-

tion job? How much of the engineering planning and development costs should be identified with the job? These and similar questions often bear upon a basic problem of cost classification, which may be put in this fashion: to what extent, if at all, should costs that are normally identified with a period as expense be deferred through capitalization as asset value?

Classification of Acquisition Costs

The amount of total acquisition cost having been determined and allocated if necessary to particular cost factors, how should the total or the particular cost be classified in the accounting records? Is the factor to which cost attaches of benefit or use to the enterprise solely or principally in the operations of the current period and hence charged to expense and, if so, to what expense account or accounts? Is the cost factor surely or probably of use for several periods, and hence its cost should be charged to an asset account at once as a preliminary step to allocating its cost to expense in the current and in future periods, and if so, to what asset account or accounts? Is the cost one that is divided (often as a matter of accounting convenience due to the difficulty of assembling total cost from several sources) between asset and expense accounts? The problem indicated by these questions is often referred to as that of capital versus revenue expenditure.

Some costs are charged to the period, as expenses, at the time of acquisition. Other costs are first deferred, as assets, to be allocated to the current and future periods on the basis of assumptions as to use or benefit. Under financial accounting procedure, usually only the costs of the most obviously long-term assets—tangible property such as land, buildings, machinery and equipment; and some services, such as insurance protection—are capitalized at acquisition. Other costs—for materials, supplies, and most services, labor, for example—are charged to expense at acquisition. Deferment of some of the cost of these items is brought about at the end of the period through adjustments for final inventories.

Some costs are particularly difficult to classify in either the asset or expense category because the period of benefit is difficult to evaluate. Repairs, viewed broadly, are of this nature. Expenditures for repairs are irregular in occurrence, and the changes effected in property range from minor adjustments or replacements to substantial rebuilding. All such expenditures improve the property from the short-run viewpoint, but is the property improved over its original state or in such a way as materially to extend its period of usefulness? No hard and fast criteria have been evolved to indicate with certainty in all cases which costs are expenses, charges to depreciation reserves, or charges to asset accounts. Working rules are formulated, which frequently follow a pattern of conservatism, favoring expense charges except in the event of the clearest indications to the contrary. Other examples of costs on the borderline between capital and revenue are plant relocation and rearrangement costs; research, experimental, process and product development costs; and advertising. In connection with the latter expense, as well as selling and administrative expenses in general, a widely accepted accounting convention assumes that these expenditures benefit only the period in which the expenditure is made. Such expenditures are regarded as neither deferable nor inventoriable.

Periodic Cost Expirations

The re-occurrence of the word "period" in the foregoing discussion indicates the predominant role played by the segmentation of time in accounting for costs. All cost factors that are subject to diminution by use, consumption, the passage of time, or departure from the business in the course of earning revenue, must be examined so as to establish the allocation of their costs to one or more accounting periods. Financial accounting is predominantly period accounting. This statement is merely another way of saying that the central problem of accounting is that of periodic profit determination which involves processes of matching period costs and period revenues. Looking to the cost aspect only, period profit determination demands the careful measurement of cost expirations. The financial accounting solution to this problem requires:

1. Deciding at acquisition to charge expense immediately, or to defer the charge to expense by capitalizing the cost involved.
2. Allocating previously capitalized costs to current expense.
3. Adjusting the periodic costs for cost factors discovered at the end of the period not fully to have been consumed in earning revenue.

Capitalized costs are allocated to period cost, which in this case may be called expense, by processes of amortization. Buildings and machinery are depreciated; natural resources are depleted; other capitalized costs are written off proportionately. Difficult cost problems are introduced which require the:

1. Determination of the total span of usefulness of the asset.
2. Selection of the basis and the methods of allocation to period cost.

The span of usefulness of tangible depreciable property may be set by physical or economic factors, either of which may fix the upper limit, and neither of which is readily or exactly determinable in advance. The usefulness of intangible fixed assets is limited by legal and economic considerations. The content of deposits of natural resources must be estimated. In addition to these perplexities is the question whether the enterprise itself will survive to exploit its resources to their full physical, legal, or economic limits. Despite uncertainties, specific quantities of usefulness must be stated in terms of the bases to be used in allocating capitalized cost to the periods benefited.

The usual bases of allocation to periods are time and production units. Time is the almost universally used basis except for natural resources and, rarely, machinery. This basis obviously assumes that benefit is in proportion to time, irrespective of output. The result is that unit costs vary inversely with output. The time basis of allocation having been selected, methods of proration are usually employed which assign an equal amount of expense to equal periods of time. This result follows the use of the straight-line depreciation method and other customary amortization procedures.

Classification of Period Costs by Functions

Simultaneous with the classification of acquisition costs as assets or expenses, and with the reclassification of a portion of capitalized cost as expense, a sorting of these expenses by functional groups—production, marketing, and administration—has been proceeding. These functional groupings usually do not require many redis-

tributions of costs common to all functions. Unlike cost accounting procedures, where minute assignments within a functional group may be undertaken, functional cost classification encounters the problem of common costs only in minor degree. Some items, such as property taxes, rent, or other representation of occupancy expense, insurance, and depreciation, (if property accounts are not detailed) may first have to be accumulated as objective totals and then distributed to functional expense accounts.

Within each functional division, as a means of knowing more specifically what is acquired for each expenditure, costs are described by reference to the object or service for which the expenditure is made. Thus, in the production division, costs are incurred for raw materials used, direct and indirect labor, operating supplies, repairs, steam, power, light, taxes, depreciation, and insurance.

Valuation of Final Inventories

The measurement of period cost is not complete without recognizing that:

1. Some materials and supplies purchased in the period and charged to expense have not been used.
2. Some cost attaches to goods started, the manufacture of which is not complete at the end of the period.
3. Some units of finished products have not been sold.
4. The cost of some other cost factors, expensed during the period, should be deferred.

Materials, supplies, work in process, and finished goods must be inventoried at the end of the period. This involves the dual problems of physical count and unit valuation. Unfortunately financial accounting procedures provide no reliable information on unit product costs. Therefore estimates of the costs of goods in process and finished must be used to state the amount of cost to be transferred from the current to the succeeding period. The accuracy of these estimates obviously affects both the balance sheet and the income statement. Cost accounting originally had as a main purpose the removal of this deficiency of financial accounting.

Financial accounting, in its cost aspects, is essentially a procedure for measuring expenditures and classifying them into two categories:

Cost deferments which appear in the balance sheet as assets, and
Cost expirations which appear in the income statement as operating costs and expense.

The amount of period revenue less the amount of period cost expirations measures the amount of period profit. The cost of goods sold is an aggregate cost, not attached to particular products, orders, customers, or any segment of the period revenue.

Cost Accounting Problems in General

Some Broad Aspects of Cost Accounting

The main objectives of cost accounting are (1) to provide individual unit product costs for use in pricing manufactured inventories, costing shipments, and other purposes; and (2) to provide management with information about responsibilities for expenditures and accomplishments so that the costs incurred may be in reasonable relationship to the output produced.

Cost accounting is founded upon financial accounting. It is tied to the concept of historical outlay as the basis of measuring cost. It does permit the intro-

duction of predetermined or normalized overhead and cost standards for the purpose of stating product costs at amounts that are considered more representative, from the longer term standpoint, than figures derived solely from current (usually monthly) outlay. In resolving the financial accounting task of measuring period costs, cost accounting first recognizes the amounts of cost that attach to each product manufactured; then, as a separate step, it records cost attaching to units of product sold. In effect, cost accounting recognizes two stages in accounting for period costs in the manufacturing division:

1. Period costs for materials used, and for labor and other factory services utilized, are first recognized as attaching to segments of the product output. At this stage these period costs are classified as capital expenditures resulting in asset values.
2. Period cost of goods sold is established by processes of direct matching. As products are sold and produce revenue, the deferred cost allocated in the first stage to the units manufactured is recognized as the goods cost of the revenue realized.

Although cost accounting may make elaborate analyses and distributions of period selling and administrative costs, the period allocations as measured by financial accounting procedures are not usually changed. In the production division, however, product cost allocation is added to the techniques of period expense allocation as a means, among other purposes, of arriving at a more reliable segregation of deferred and expired costs, both of which are still rooted, exactly or approximately, to the financial accounting concept of cost as historical outlay.

If unmodified historical cost procedures are used, the total period outlay in the production division is allocated in full to the product output, except possibly for a portion that is viewed as a loss and is left as a period expense charge solely. Except for the possible recognition of this element of loss, the aggregate cost of products manufactured equals aggregate period manufacturing costs. If predetermined overhead rates are used, the amount of overhead allocated to product costs differs (usually not greatly) from period expense. This difference is normally closed out as a debit or credit to the cost of goods sold at the end of the period. Variances from standard costs are similarly accounted for. Obviously there may be a change in the split between deferred costs and revenue costs, in a given period, introduced by the use of predetermined rates or cost standards (when these provide unit costs for inventory valuations) in comparison with the non-use of these procedures. This difference may well be unimportant, and it is temporary. Some slight shift of revenue cost between periods may result. Probably any such change is not as great as that involved in using financial accounting procedure on the one hand, with its unavoidable reliance on unit cost estimates in valuing final manufacturing inventories, in comparison with using cost accounting procedure, on the other hand, with its more accurate allocations of cost to products manufactured and hence more accurate division of period cost between goods sold and goods on hand.

Modification of Financial Accounting Problems

Major financial cost problems were listed above as:

1. The measurement of the outlay attaching to cost factors at acquisition.
2. The classification of costs at acquisition into deferred and period categories, between capital and revenue expenditures.
3. The amortization of deferred or capitalized costs.
4. The allocation of manufacturing costs to final inventories.

Under cost accounting procedure the first and third problems remain unchanged. The cost accounting procedures for identifying costs with products manufactured, for compositing the costs of goods made, are substituted for the end-of-period inventory allocations of financial accounting. The solution accorded the second problem is also greatly changed.

Under financial procedures, among the numerous cost factors purchased, in general costs of tangible fixed properties and intangible long-term rights are the only costs capitalized at acquisition. The costs of other factors are immediately expensed, subject to periodic deferment by adjustment or inclusion in final inventory valuation. Under cost procedures, the costs of many other production cost factors are capitalized by being charged to inventory control accounts, properly supported by perpetual stock records. Accounting for raw material cost, for example, takes place in three stages: (1) acquisition; (2) use, represented by transfer to the manufacturing division for embodiment in product; (3) disposition, or cost expiration, when the finished product is transferred to the customer in the process of earning revenue. The cost of direct labor also is charged at acquisition to in-process or departmental accounts which accumulate product costs. These are capital accounts. The period cost of other service and overhead items are usually called expenses, but unlike manufacturing expense in financial accounting, they are not looked upon immediately as costs of revenue. They become so only after they have passed through the finished inventory account into the cost of goods sold. It may be said in general that costs relating to production cost factors are kept in the deferred cost category by being made to flow through a series of inventory accounts —raw materials, in process, and finished—until, having been associated with goods shipped to customers, they become cost of revenue. These facts indicate that the simple disposition of costs at acquisition into deferred and current categories, with later amortization of deferred cost, subject to final correction and adjustment for inventories on hand—procedures characteristic of financial accounting—is not adequate for product cost determination.

A Classification of Cost Accounting Problems

Cost accounting problems may be classified in many ways depending upon the purpose and the viewpoint. A broad classification which attempts to indicate some of the more important problems is given below:

A. Problems of Adaptation
    1. Adjustment to production methods and circumstances
    2. Defining the products to be costed
B. Problems of Cost Analysis and Accumulation
    1. Recording the underlying quantity data
    2. Allocating period production costs to products
C. Providing Control Information

This classification indicates that there are, in a sense, three broad types of cost problems. The first is that of adapting cost methods to the productive circumstances in which they are to function. The second and third involve operating the cost system that has been so adapted. Not only the latter group of problems, but the former group as well, demands continuous attention. Problems of adaptation are, in a way, system installation problems. This does not mean, however, that once conclusions have been arrived at, these problems may be forgotten. Products are

added or dropped; production machines and methods are in a constant, although not necessarily rapid, state of change. Conclusions about costing methods must therefore be continuously reviewed, both to correct earlier errors or compromises and to effect adjustment to new manufacturing conditions.

Adjustment to Production Methods and Circumstances

This problem is essentially individual to each cost installation and therefore can be worked out only when the physical circumstances are known in detail. A principal point is that the cost accountant must know his plant—its machinery, methods, layout, and flow of work. Production is essentially a process by which materials introduced at the initial, and in some cases at subsequent, stages of manufacture are changed in form, combined or broken down, through the activities of men and machines organized in a sequence of departments. With a knowledge of the materials, the sequence of the converting operations, and the manner of the flow of the materials through the productive departments, the cost accountant is in possession of essential background information to develop the necessary costing mechanism.

The physical characteristics of the products made, the types of processing required, the nature of the production flow in terms of whether given facilities are continuously used on a specific product or whether several products are intermittently processed on these facilities, the available kinds and capacities of equipment —all of these matters have a bearing upon the factory layout and the departmentalization employed, and therefore upon the nature of the cost problems encountered, the difficulties of cost analysis and even upon the reliability of the product costs accumulated. Cost accounting must operate within the framework of the productive and service department structure, and therefore the cost accountant must not only know that of his own company but he must try to adjust or modify it if thereby he can improve the quality of his computations or reduce their cost.

The term department, as applied to a factory, indicates a section of a plant in which usually a particular type of operation or processing takes place under the supervision of a foreman. The bases for defining the department are twofold: the similarity of the operations or products; and the limitations of a given foreman's authority and responsibility. The departmental separation of factory equipment and activities serves the costing purpose of providing a basis for the analysis and accumulation of figures relating to outlay and output, and the management purpose of establishing limits of authority and accountability for costs and performance. The department, therefore, is both an administrative unit and a section for the collection of cost data. If the units of equipment or the activities of a given department bear only a general similarity one to another, a further subdivision may be necessary for cost accounting purposes. This is accomplished by separating the administrative department into cost centers. The cost center is the most minute section of the plant for which costs are analyzed and accumulated. Within the cost center, activities are homogeneous as to cost, that is, all units of a given activity may be assumed to have an equal cost during a given accounting period. The quantitative factor, the units of activity over which costs may reasonably be averaged, may be expressed in a variety of ways—in product units, in activity units, and in units of time. The work done in a department or cost center may be homogeneous as to cost on a time basis, although in a physical sense the activity applied to one product or job differs from that of another.

Proper departmentalization of the plant is obviously a major problem to the cost accountant in planning the adaptation of cost methods to each individual situation. Departmentalization provides the framework for the analysis of production costs and accomplishment, and for the determination of unit process and operations costs that are homogeneous. Hence proper departmentalization furnishes the bases for product cost accumulation and for measuring performance and responsibility for operating results. In adapting cost methods to each productive situation, if the cost accountant finds an existing departmental organization which is ill-adapted for cost purposes, he must assume the responsibility of working toward the adjustment of the departmental setup so as to facilitate the costing process.

Defining the Products to be Costed

Many industrial companies make a variety of products. These products differ from one another, in a physical sense, in the materials from which they are fabricated, in the operations required, in appearance, and in use. If products are thought of as groups or classes of similar items, differences exist in terms of size, color, or other physical factor, as well perhaps as in selling price and cost. In addition to finished products, most factories make intermediate products—products that are partially finished, and require separate unit cost determination, either as a step in ascertaining final product cost, or because the parts, subassemblies, or whatever form the intermediate product may take, may be sold without further processing.

The cost accountant has a major problem in deciding what products require separate cost recognition. This problem appears when the cost system is set up, and it must also be reexamined from time to time as the product items change in order to review the correctness of earlier decisions. The major question is this: What product items require separate unit product cost determination? Does each distinct kind of item, in a physical sense, require this separate measurement? May product items be grouped for cost purposes, so that physical distinctions of size, color, or style may be to some degree disregarded? Is equality of selling price for a group of items a factor that may be relied upon in grouping items for costing?

A product from a manufacturing cost standpoint is a segment of the factory output, intermediate or final, that is given separate cost recognition and unit cost determination. From the standpoint of optimum costing, a product is a segment of output within which all units normally have, in view of the materials and productive efforts required, substantially an equal unit cost. The characteristic of a product from this standpoint is that it includes only units that are naturally homogeneous as to cost.

This principle of homogeneity of unit costs as the basis for determining what items or segments of output require separate unit cost determination is subject in practice to two limitations: (1) negligible differences may be ignored; and (2) expediences involving the cost of costing, particularly under historical procedures, may require the combined costing of product items that in strict observance of the principle would require separate cost determination. These considerations tend to reduce the number of products recognized for cost purposes.

Having decided upon the number of products, an associated problem relates to the scope of the averaging to be done in determining the unit cost of each product. This question is distinct from the matters just discussed. There the question was raised as to whether distinct physical products might reasonably be combined to be

regarded as one product for costing purposes. The products having been decided upon, the question arises: shall the costing mechanism secure the total cost of (1) each unit of each product separately; (2) each group of identical units made as a lot on a specific production order; or (3) all the identical units of each product made in a specified period of time, such as an hour, day, week, or month? This is a question of averaging: shall there be no averaging, as would be the case were the individual unit of each product to be the basis of cost accumulation; or shall unit costs be averaged on an order basis or upon a time basis? Individual unit costing is normally rejected in manufacturing enterprises as being both unnecessary and undesirable. Both the order and the time bases accumulate the total cost for a group of units, which total cost divided by the number of units gives an average unit cost. If a particular unit in the lot required more or less material or productive effort than the others, these differences are ignored in stating unit cost. Occasional or accidental differences in cost among the units of the group can normally be disregarded without unreasonable violation of the principle of homogeneity.

Recording the Underlying Quantity Data

Cost is always composed of two factors—quantity and price. Inasmuch as final expressions of cost are stated in money units, it is sometimes overlooked that these figures are dependent upon and are derived from underlying quantity measurements. Even unit costs involve one as the quantity factor.

Manufacture is a physical flow of materials through a sequence of operations measurable in physical units alone without involving money values. This physical flow can be expressed as:

1. The input of
   a. The pounds, gallons, pieces, or other measurement of direct materials introduced at the first and later stages of production.
   b. The hours (of direct labor and machine time), number of operations, or other unit measurement of productive effort used in transforming the direct materials into finished products, and in providing the auxiliary services required in this process.
2. The output of the various items of intermediate and final product items, also measurable in physical units.

Product costs follow and accumulate with the physical flow of materials and the productive activities required for their conversion. In accordance with the principle of cost transference discussed in Chapter 2, the cost of a product at any stage is the value sum of the increments of material and productive effort required for its manufacture. If the cost accountant can determine the quantities of materials and productive efforts required to manufacture a product, and the unit costs reasonably associated with these materials and efforts, then the product cost is easily ascertained by summation.

It is no exaggeration to say that historical product cost determination and standard cost procedures are both impossible without adequate analysis of the quantity factor. All basic cost records—records of material acquired and used, of labor time or accomplishment, of product output—are primarily quantity records. The recording and measurement of this factor are so important in relation to the objectives of cost accounting that they must be regarded as constituting a major problem. This phase of costing, essential in historical procedures, is even more

indispensable in standard costing which employs what may be called dual quantitative analysis, the comparison of the actual quantities of the cost elements consumed in attaining a given manufacturing result with the quantities allowable for this same result.

Cost procedures and cost conclusions can be no better than are permitted by the analysis of the underlying quantity factors.

Measuring quantity is on the whole a much simpler problem than allocating outlay to the various divisions of operating effort but it does present some difficulties, particularly as to output. In some cases the degree of completion of unfinished units must be estimated. The effect of defective and lost units, and of changes in volume by reason of shrinkage or expansion, must be allowed for. From the beginning to the last step of manufacture, adequate records must be made of the measured input and output.

Product Cost Problems

Product Cost Allocation Problems in General

Cost is an attribute, a characteristic of productive processes. It attaches to (1) the materials, labor, and other factory services that are utilized in manufacturing, and (2) the results of production, the output of finished and semi-finished product units. The costs attaching to the instruments of production are transferred to the results of production. The main function and problem of historical cost accounting are to recognize and identify this transference by processes of direct measurement and association, and by procedures of indirect allocation, distribution, and assignment. Cost accounting theory and practice have not yet adopted standardized terminology which clarifies and exactly describes these processes, although the methods employed by historical procedures are well understood.

The allocation of period production costs to products, described in broad outline, requires:

A. Provision of methods by which direct material and direct labor costs can be analyzed and related to individual product items.
B. Provision of methods by which factory overhead costs can be accumulated and allocated to individual product items. This requires:
    1. An analysis of overhead expenditures in each factory department, both those that work directly on the product and those that provide services to facilitate production.
    2. An apportionment of service department costs to producing departments, which necessitates:
        a. The selection of a quantitative basis on which each individual apportionment can reasonably be made.
        b. The apportionment of the actual, budgeted or normal service costs on the bases selected.
    3. The allocation of the producing department overhead costs (which now include apportioned service costs) to the individual product items. This requires:
        a. The selection of a quantitative basis for each producing department upon which the allocation of its overhead costs can reasonably be made.

b. The allocation of the actual, budgeted, or normal overhead costs of each producing department to the products worked on in each department on the bases selected.

C. Provision of methods for recording the quantity of the output of each product.

D. Provision of methods by which the costs of each product can be:

1. Summarized for the lot, order, or period.
2. Expressed as a unit figure, through division of total cost by the appropriate output quantity data
3. Transferred out of the pool of factory costs in process upon completion of manufacture.

The cost of a product, under these procedures, is made up of:

1. The costs attached to the direct materials of which it is composed.
2. The costs attached to the workers who with tools and machines directly effect the changes in the materials which take place in the manufacturing operations.
3. A portion (assuming more than one product is made) of the overhead costs of each producing department that works on the product. These overhead costs of each department include costs of various kinds arising in the department and costs apportioned to the department from all service departments whose facilities have been utilized or whose expenditures are assumed to benefit the producing department.

Product costs therefore are composited of direct costs, and indirect costs. A special kind of indirect cost, called joint, also requires recognition. Direct costs—normally limited to materials and labor which may be thought of as physically embodied in the product, but also including the nonapportioned costs of machines and facilities used exclusively in the manufacture of a single product—are capable of relatively exact assignment to products. They can be recognized quite definitely as pertaining to specific products, and they can be measured quite satisfactorily. Indirect costs cannot be recognized as applicable solely to a particular product. These costs are common to a group of products. Some of these costs in a given plant are common to all or many of the products made; other such costs are common to a few products only. Responsibility for such costs is recognized as belonging as an aggregate to the group of products whose manufacture they facilitate. Therefore, these costs, not capable of direct identification and measurement so far as any one product is concerned, are allocated to each product composing the group regarded as responsible for these common costs on some quantitative basis thought to represent the use, benefit, or facilitation enjoyed.

Directness or indirectness of cost, from a product standpoint, is to some extent a result of a number of factors, such as the nature of the production departments, whether they are set up on a product or a functional basis, and, if the latter, whether the various products flowing through the department are worked on concurrently or sequentially. Directness is to some extent also a function of the degree of analysis applied to objective costs. If all the expenses of a factory are lumped together, none of them can be direct to any product. If salaries paid to all foremen are combined into one amount and charged to general factory overhead, instead of being charged directly to each department, then this cost would have to be apportioned and therefore becomes one step further removed from direct assignment to any product. An important principle of cost accounting requires that that degree of analysis shall be employed, within practical limits, as will disclose the directness of the relationship to the product or department of all important items of cost, so that

so far as practicable no items of cost that are direct to either product or department will be recorded as indirect. In other words, a major problem of product costing is to reduce the area of common costs. When this is done so far as possible, there will still remain a segment—frequently a large one—of costs that must be allocated to the various products made on some basis of imputation, as distinct from direct identification.

Joint costs may be regarded as a special type of indirect cost. When joint costs are present, there are no direct costs. All costs are common to the products manufactured, at least in certain phases of the productive process. Joint costs are particularly prevalent in the so-called analytical industries, in which a single raw material or invariable combination of such materials, is broken down into several end products, all of which incur an aggregate of costs up to a certain processing point, after which distinct products are recognizable. This aggregate or joint cost up to the separation or split-off point must be allocated to the several end products on some more or less arbitrary basis such as market value at the split-off point, final market value less subsequent separate processing costs, or the number of units or number of weighted units of output.

The major problem of historical product cost determination is how to reduce the area of common costs, how to allocate the irreducible minimum of common and joint costs, and how to employ procedures of direct attachment of costs, so as to result in the most accurate and usable individual product costs. General factors in this problem have been discussed above. More limited and individual problems, relating particularly to the several elements of cost, are discussed below.

Material Cost Problems

A number of major problems are associated with the direct material element, and somewhat similarly with operating supply items. These problems are:

1. The acquisition cost problem—how much of the total cost of acquisition, both direct and indirect, should be attached to materials acquired?
2. The pricing problem—how much acquisition cost should be attached to material units put into production in a period?
3. The problem of identification with product output.
4. The problem of inventory record, check, and valuation.

Several questions arise in relation to acquisition costs. In addition to the direct cost of items purchased, which may be stated gross or net after cash discount, other costs are incurred—transportation, receiving, moving to storage, and operating the purchasing function. These matters raise the problem of what is the purchase cost to be attached to materials acquired. How much of this cost should be charged to inventory and how much to overhead expense? How should the joint cost of ungraded lots of material be allocated to the several grades included?

The pricing problem arises particularly when several lots of identical and interchangeable materials, acquired at different unit costs, are available for use at the same time. Such lots are not normally marked or identified as to unit cost. Whether the units used in a given period came from one lot or another, and how many from each lot, are not readily determinable. In these circumstances, what unit cost and how much total cost should be attached to the units transferred to the factory? Usually some assumptions are made that cost should attach in accordance

with the first in—first out; last in—first out, or one of the several average cost methods. These procedures must be recognized as methods of cost allocation rather than of specific identification.

Other pricing problems arise in relation to storage costs, changes in weight or volume due to moisture content, breakage, deterioration, and other factors. What costs should be associated with these factors? And how should they influence period costs and final inventory valuation?

How should costs attaching to material units embodied in product units be attached to the product units? Normally specific material units are not tagged so that they can be traced to a single product unit; therefore an exact identification in a physical sense is not possible. Were such a physical identification possible, it would doubtless not be carried over to the processes of transferring cost from material to product. Costing relies normally upon establishing an average relationship. The limits within which the averaging is done are important, as pointed out in an earlier section. The material cost attaching to a given unit of a specific product is determined by first finding the total material cost attaching to a given lot of the specified product, whether made on a single production order or within a period of time, and dividing this total lot cost by the number of units made. The lot cost may be thought of as representing a process of direct measurement. The ascertainment of unit cost is a process of imputation or allocation, an assignment of cost under circumstances where there is not an exact measurement of identified cost. The costs of the lot are common to all units in the lot.

In connection with the material cost of the lot another question arises concerning residues of scrap and by-products. What costs should be attached to these segments of material once identified with the lot but later given separate recognition?

Inventory problems include, in addition to matters of physical check and verification, questions of the disposition of cost attaching to units of material no longer on hand and still included in the inventory accounts, the cost recognition to be given to deterioration and obsolescence, and the recognition to be given to market value changes.

Labor Cost Problems

Labor cost problems involve such major matters as (1) the detailed recognition of liability to each worker, including compliance with governmental regulations as to hours, rates, tax deductions, and other matters; (2) the detailed analysis of direct and indirect labor cost so that these types of cost may be identified in full with department, operation, and product, specifying exactly the services received. Many questions arise as to the proper disposition of important segments of the labor cost. What disposition should be made of night-shift premium, overtime bonus, certain incentive bonuses, idle time, spoiled and defective work costs, training costs, and the extra cost of high-pay workmen on low-pay jobs? The major question, from a product-costing standpoint is this: can these costs most reasonably be associated with product costs through processes of direct identification, real or attempted, or by inclusion in overhead? In some instances, of course, the entire labor cost is combined with overhead to arrive at total conversion cost.

As with direct material costs, direct labor costs are not normally so recorded that they can be identified with a single product unit. Identification is, rather, with the lot. The product unit labor costs are average costs.

Overhead Cost Problems

Overhead cost problems in historical cost procedures may be divided into three groups relating to:

1. Analysis and accumulation by departments.
2. Apportionment of service department costs.
3. Allocation to product.

In order to fix accountability for overhead costs as well as to aid in their absorption into product costs, overhead expenses should be analyzed so as to permit the accumulation of the overhead costs of all producing and service departments or cost centers. Costs of operating supplies, indirect labor, depreciation, insurance, taxes, supervision, and other items should be identified with these operating divisions. Provision of adequate analysis and record is the chief requirement. The proration of previously deferred asset costs, distinguishing between capital costs and period costs for certain current outlays, such as for maintenance—these and other problems of determining period costs, discussed under financial accounting—are the main difficulties in overhead accumulation.

In analyzing and accumulating department overhead it is most desirable to distinguish between variable and fixed expenses. The separate recording of these categories will aid subsequently in budgeting, in studying the cost pattern of the department and plant, in break-even studies, and makes it possible to use separate absorption rates for each type of expense if desired.

Reference has already been made to the problem of disposing of service department costs, as a step in product cost determination. A major question arises as to whether such costs are best disposed of (1) by treating these departments as if each of them was a producing department and providing for each an independent absorption basis and rate; or (2) by combining all service department costs, for purposes of absorption into product cost, into a combined aggregate with a single basis and rate of absorption; or (3) by apportioning service department costs to producing departments, as previously mentioned. Should such absorption, if done directly, or such apportionment, be made in the amount of the actual costs of the current month, or in budgeted or normal amounts? Should fixed and variable expenses be segregated in this absorption or apportionment, and the fixed expenses be disposed of on a normal capacity basis, and the variable expenses on the basis of current demand? In what sequence should service department apportionments be made? Should some service department costs be apportioned to other service departments? How can reapportionments of such costs be avoided? What bases should be used for these apportionments?

A remaining group of problems relate to the allocation of overhead costs to product items. These problems arise whether all overhead is concentrated on producing departments, as is usually the case, or service costs are absorbed directly. Decisions must be made relative to these two problems:

1. The nature of the bases to be used in allocating overhead to products—how is allocation to be effected?
2. The nature of the amount of overhead to be allocated—how much total overhead is to be allocated in a given period.

Some attribute of the product, which is subject to a quantitative measurement identifiable with the product and is independent of the overhead cost to be assigned, must be selected for each segment of overhead (usually that of each department or cost center) to be allocated. Time—direct labor hours, machine hours, or department hours—and direct labor cost are bases commonly used. Overhead of a given department is allocated to the products processed there in a given period in proportion to the time spent there on each product or the direct labor cost incurred there by each product. The arithmetic of allocation usually reduces the cost of a unit of the basis to an amount or a per cent, either of which may be called a rate, which when multiplied by the number of units of the basis applicable to each product gives the amount of overhead to be allocated to that product.

This method of allocating overhead assumes that each unit of the basis has, or is responsible for, an equal amount of overhead cost. This is of course an arbitrary assumption. Some overhead costs are fixed, and are incurred even if no units of the basis are present, that is, if no products are made in a given period. Also, as output increases, it is not difficult to prove in many cases that overhead increases more than proportionately to the increase at some stage and less than proportionately at another stage. These increments of increase of output may reasonably be thought to be the cause of the associated increases in overhead costs. This conclusion is, however, not drawn or used in allocating overhead costs to products. The total overhead of the department being allocated is averaged over the total number of units of the basis for a given period. Each unit of the basis assumes the presence of all other units for that period. The basis is regarded as a simultaneous aggregate of use. The rate is an average rate per unit of the basis.

The second question concerns the amount of overhead to be allocated to products in a given period. Should the amount allocated be:

1. The actual overhead, the historical outlay, applicable to the month?
2. An amount based upon the budgetary expectancy of overhead for the year? In this event the effect of seasonal fluctuations both of outlay and of output are "normalized," that is, averaged out.
3. An amount based upon a forecasted expectancy for a business cycle? In this event the effect of both seasonal and cyclical fluctuations both of outlay and of output are normalized, averaged out over several years.
4. An amount affected by a separation of overhead into fixed and variable, with fixed overhead allocated on the basis of normal capacity or use, and with actual variable overhead allocated on the basis of actual use in the current period?
5. An amount based upon cost standards, which may themselves involve amounts determined in accordance with 2, 3, or 4 above.

If any one of the last four procedures is used, product cost obviously departs somewhat from actual outlay. The problem of disposing of the difference between actual and allocated overhead, the so-called over-or-under-absorbed overhead, is introduced. In effect these methods split the stream of actual overhead costs into two parts. One of these parts is attached to products manufactured, and may be greater or less in amount than the actual outlay. The other part, which may be positive or negative, is not attached to any product. Instead it is usually used as a correction of the period cost of goods sold, or more rarely prorated over the goods in process and finished goods inventories and the cost of goods sold.

Other questions relating to how much overhead should be allocated to product may arise under abnormal operating conditions—during war, reconversion, strikes, depressions, and periods of extensive plant construction or relocation.

Let it be repeated again that the main problem of the cost accountant in relation to overhead is to use his influence in modifying plant layout and use of facilities so far as may be done without increasing operating costs, and to arrange his costing procedures so as to reduce the area of common overhead costs.

Summarizing Historical Product Costs

The above discussion has been concerned with problems related to determining what amounts of material, labor, and overhead costs should be attached to each lot, or group of units, of a specific product as it passes through the factory. It is not sufficient to identify these amounts in detailed time tickets and requisitions. They must be recapitulated. This task is performed by some type of product cost sheet. This sheet is designed to fit the needs of each cost installation and takes on many different appearances, but whatever its form, it has these functions to perform:

1. To summarize the total costs allocated to the product it represents.
2. To state the output produced for the costs incurred.
3. To indicate the amount of the average unit cost for the lot.

Cost sheets are sometimes identified as being order or process sheets, depending upon whether they summarize the costs allocated to a specific production order, or the costs of a given processing department for a stated period. In either case the functions of the sheet are identical. It brings together outlay and output so that a conclusion may be drawn about unit cost.

A major problem, particularly of the order cost sheet, is the matter of inclusiveness—how much detail should be shown. Should each requisition and time ticket be posted, or may these be posted by group totals for the day, week, or month? Need only final totals be posted? These questions relate to problems of journalization and the preliminary summarizations that intervene between the original records and entry into the ledgers, discussed in Chapter 15. More detailed discussion of problems and methods of product cost summarization is found in Chapter 17.

Standard Product Costs

The above discussion of product costing problems has been concerned with historical procedures, modified perhaps by the use of overhead costs estimated in advance for the year or normalized for a longer period. Another form of modification involves the predetermination of all elements of product costs, that is, the establishment and use of cost standards.

There are a number of types of cost standards and of standard cost procedures. These differ primarily in the nature of the standards themselves and in the manner and extent to which they are introduced into the formal accounting records. If they are not introduced into the formal records at all, they may be looked upon as statistical costs only. If they are introduced into the records, particularly if they provide the basis of valuation at least for the in-process and finished inventories, they may reasonably be called accounting costs. Introduced in this way cost standards become in effect the means of splitting the stream of period costs into two

parts, one of which based upon the standards flows through the inventory accounts, and the other of which, identified as variances from the standards, becomes a special kind of period loss or gain, to be combined finally with the standard costs of goods sold. In any one period the residuum of cost left in the inventory accounts, and hence also the amount of cost that has been matched with period revenue, can and ordinarily does differ from these amounts as they would appear under historical cost procedures. This difference in result is in many ways comparable to differences that would appear as the result of other choices in the product costing process, for example the choice between use of the first in—first out pricing method, or the last in—first out method. In the long run the difference in the over-all allocation of the stream of costs between assets and expense may well be negligible, as it may be also in shorter periods.

In simplest terms, standard cost procedure, once the standards have been established, involves these phases:

1. Recording, both in quantity and in cost, the actual input of materials, labor, and overhead, as is done under historical cost procedures.
2. Measuring the actual product output of the various operations and departments.
3. Determining the quantities and value of materials, labor, and overhead that manufacture of the actual output should have required at the predetermined standards.
4. Comparing the allowed quantities and values with the actual quantities and costs of material, labor, and overhead consumed in producing the actual product output. Any differences between the actual costs put in and the standard values produced are cost variances.

The principal task of historical procedures is to allocate period costs to the various product items manufactured. In some standard cost systems, product costs are compiled in advance on the basis of the theoretical standards and this is the only computation of product costs. In this case the task of product cost compilation is entirely removed from the routine of period accounting. This removal results in a major shift between the two principal objectives of cost accounting. The emphasis is shifted from product costing to the development of cost control information. The principal task of standard cost procedure becomes the disclosure of cost variances so that their existence may be known, and the analysis of these variances so that the persons and conditions responsible can be held accountable and the causes corrected.

The problems of product cost allocation are present in standard costing as in historical procedures. Two main differences appear:

1. The allocations are made occasionally, and in advance of manufacture, rather than continuously for each lot (whether related to a production order or a period) actually produced.
2. The amounts allocated under standard product costing are based upon theoretical quantity factors which involve concepts of operating efficiency or capacity, and upon price factors that are partly historical and partly anticipatory or theoretical.

Problems of allocations of joint and common costs to particular products—the major source of difficulties and perplexities under historical cost procedures—are not essentially modified or avoided under standard cost procedures.

Special problems of standard costing are discussed in detail elsewhere in this volume. Some of them are set down in brief summary below:

1. Deciding what type of standard shall be used.
2. Determining detailed quantity and price standards for each phase of activity and product. In the quantitative aspects of this problem the cost accountant must depend upon reliable underlying engineering data.
3. Determining the extent to which the standards shall be introduced into the formal accounting records.
4. Recording the actual period costs and the associated standard costs.
5. Analyzing and reporting the variances.
6. Following up on corrective measures designed to reduce unfavorable variances.
7. Reviewing the cost standards.

Cost versus Loss

Standard cost accounting directs attention to a major accounting problem, present but not so much emphasized in historical cost procedures. This may be called the problem of cost versus loss, although these words are somewhat inaccurate and inadequate. The problem might perhaps better be described as that of recognizing, isolating, and recording costs which expire without benefit to the enterprise, without contributing anything to the realization of revenue or income. Such expirations must be accounted for in some manner in the period in which they are recognized as having happened. If they relate to costs normally associated with the manufacturing processes, should they be allocated to product costs, to some expense charged directly against period revenue despite the fact that no contribution is made to the earning of this revenue, to non-operating expense, or to earned surplus? Should a distinction of responsibility be made between the effect of internal and external circumstances? In the internal category should a distinction be made between losses that are viewed as inescapable and unavoidable, and those that are ascribed to negligence, incompetence, and inefficiency?

Questions of cost versus loss relate obviously to spoiled and defective work, to idle labor time, to unused capacity, to temporary shutdown costs, seasonal or otherwise, strike costs, underabsorbed overhead, standard cost variances, costs of unsuccessful experimentations and research, vacation allowances, inventory losses, and perhaps also to the value diminution measured by the application to inventory items of market values that are less than cost.

The Inclusiveness of Product Costs

Brief mention is made here of the problem that occasionally arises of deciding precisely where the manufacturing operations that are to be included in product costs end, and distribution activities begin. Among other things, packaging and container costs, and the costs of aging or storing may be involved.

Another question of inclusiveness is involved in the problem whether any part of the general administrative costs should be apportioned to the production function and allocated to the costs of particular products.

The Nature of Cost Accounting Product Costs

Various indications have been given in earlier sections about the nature of cost accounting product costs. A recapitulation of the characteristics of these costs is given below.

1. They are essentially historical, that is they include only prorations of long-term capital costs and actual current expenditures. Some modifications are introduced in some

cases through the use of predetermined overhead rates and cost standards. By contrast with the implications of the word historical, cost accounting costs are not current costs. Current replacement values of plant, materials, and other factors are not substituted for actual outlays. Also the aggregate of the historical outlays of the period applicable to manufacturing is absorbed into the aggregate of the product costs, except for a portion that may be temporarily deferred in an effort to equalize seasonal fluctuations or may be recognized as a loss.

2. Product costs are average costs. Under historical procedures the material element may be priced at an average unit cost. Service department costs are apportioned on bases all units of which are treated as having an equal and average unit cost in each period. Producing department costs, which may include direct labor as well as direct and apportioned overhead costs, are allocated to products on bases all units of which are treated as having an equal and average unit cost in each period. A number of units of a given product are normally produced together as a lot or batch. Product costing procedures identify costs with the lot rather than with the individual unit, so that the final unit cost is the average cost of all items in the lot. These procedures obviously totally disregard the idea of differential responsibility for cost incurrence, the recognition of which would lead to cost allocations quite at variance with those of historical procedures.

Under standard cost procedures product costs may be entirely predetermined and no effort may be made to attach actual outlays to the various lots of individual products made. The unit product costs are nevertheless average in the sense of being typical or representative of what the costs are expected to be or ought to be under the assumptions of average operating efficiency, normal use of facilities, and price, that lie behind the unit standards.

3. Product costs, whether historical or standard, are only approximations. Historical outlay even on a period basis is impossible of exact measurement. Period cost is ascertainable at all only on the basis of assumptions—for example, about the costs attaching to materials used or left unused at the end of the period, and about the serviceability of the long-term cost factors. If these inexactly measurable period costs are allocated to individual products, further uncertainties are introduced. Direct costs may be quite definitely attachable, on the average, and any question of material pricing may reasonably be solved by assuming a certain sequence of use. The indirect costs, the amounts of joint cost, and the overhead costs common to some or all the products made, are assigned to individual products on the basis of assumptions as to aggregate causal responsibility which, although they may be reasonable from the standpoint of the expected uses of the resulting product costs, must also be admitted to be arbitrary.

There is therefore no such thing as an "actual" product cost in the sense of absolute authenticity and verifiability. The cost attached to a product is an amount assigned by the costing methods used—an amount controlled by the circumstances, the assumptions, and the limitations of the method under which it was compiled. Products are fabricated out of various materials converted through manufacturing efforts. Product costs are composited out of historical outlay, perhaps modified by estimates or standards, by processes of assigning and prorating expenditures to periods, tracing the direct costs and allocating the indirect costs to particular products so that the total period outlay is spread over the aggregate output, or recognized as lost.

Despite these limitations these product costs are useful in valuing inventories, in comparing price and total manufacturing unit cost, in measuring current profit or loss, and in indicating the minimum amount (disregarding distribution and other costs) below which selling price cannot go on the average in the long run. These costs are however not usable without confusion for many management decisions.

They do not indicate, for example, the minimum price, below total unit cost, at which in a given set of circumstances additional business may be accepted with a resulting increase of total profit or reduction of total loss.

Distribution Cost Problems

Distribution cost problems can be mentioned only very briefly. It is obviously desirable, and if preferential treatment is to be given certain customers it may be necessary, to know the costs of selling particular products, territories, and customers. If the analysis of the period distribution costs is to be anything more than an arbitrary proration in proportion to dollars of sales (which assumes that each dollar of sales incurs the same amount of cost), it is necessary to proceed in much the same way as in the analysis of factory costs. An appropriate procedure for analyzing distribution costs in terms of products and territories would recognize that some costs are direct and others are indirect and must be allocated, the allocations to be made on the basis of service performed, measured quantitatively in terms other than the dollar of sales. In general, for those items that must be allocated it is desirable to proceed as follows:

1. Define the activity involved in, that is secured for, the outlay made. Expenditures are made for accomplishing something. Define each activity homogeneously, so that each unit of the activity will be as far as possible like every other unit.
2. Find the period cost for each activity that has been separately defined.
3. Measure quantitatively the accomplishment of the activity for the period. How many units of activity were secured by the period expenditure? Avoid so far as possible the measurement of any activity in terms of dollars of sales. Suitable activity units are the weighted or unweighted salesman's call, the travel mile, the invoice line, the order item, and many others.
4. Calculate the unit activity cost.
5. Allocate the total activity cost to products or territories in proportion to the number of activity units involved in each segment of the business to which a distribution is to be made.

This type of apportionment achieves results comparable to historical product cost calculations in the manufacturing division. It has limitations and it has uses. The procedure can normally be expected to encounter problems somewhat harder to solve in its distribution application for the following reasons:

1. It is more difficult to measure accomplishment for distribution activities than for factory operations. The activities are less tangible and open to exact specification and are less capable of measurement in terms of homogeneous units.
2. A greater proportion of the costs are indirect to the product or the territory than is the case with factory costs. Therefore the area of allocation in contrast with direct assignment is larger. Joint costs are not only not unusual, they are almost always present. The area of common costs is large.
3. The assumption of aggregate responsibility for cost, as distinct from the differential approach, seems less creditable.
4. An approach that does not attempt the allocation of all costs may be more acceptable.

The procedures outlined above may be used also in allocating costs to customers and orders. Having found the number of activity units—both direct and indirect—involved in the business of any customer for a period of time, or applicable to a

particular order, costs may be imputed to the customer or order by multiplying the number of activity units by their respective unit costs. One must recognize, however, that this imputed cost bears little if any relation to the change in total cost that might have occurred had no business been done with the customer or had the order been rejected. Again what has been computed is the average cost applicable to the kind of customer or order that has been under consideration, rather than the differential cost applicable to a particular customer or order.

Other distribution cost problems involve:

1. The use of cost standards as a means of controlling costs, and the extent to which they shall be introduced into the accounting records.
2. The more exact matching of distribution costs with revenue, discarding the financial accounting assumption, still generally accepted, that distribution costs are not deferable.
3. The collection of adequate data to prove if necessary that differences in prices made to competing customers are no greater than are justified by difference in applicable costs.

Providing Control Information

The place of cost accounting as an instrument of management control has been discussed in Chapter 3. Other aspects of the management uses of cost accounting are more thoroughly developed in Part II and in later descriptions of costing procedures used in particular industries. Major problems in the control aspect as distinct from the product costing aspect of cost accounting are:

1. Adaptation of the cost fact-collecting phases of the cost system to the administrative structure of the business.
2. Coordination of the cost system with the budgetary procedures and with the development and use of cost standards.
3. Development of an adequate system of cost reports.

Managerial control has little need or use for the cost apportionments and allocations that are necessary in summarizing product costs. Therefore cost compilations that show administrative responsibility for the incurrence of period costs in the first instance, and the relationship of these costs to accomplishment, are more important from a control standpoint than the combinations of costs applicable to the product output. These statements of original responsibility must be made in terms of the administrative organization. Two aspects of this matter of establishing administrative responsibility for cost incurrence require brief comment:

1. Some costs are much more amenable to management control than others. Current property costs in the form of depreciation, insurance, and tax expenses are dependent upon past management decisions as to capital investment and other factors and circumstances now beyond the possibility of management influence.
2. It must be remembered that every cost is a compound amount, the product of a quantity factor and a price factor. The quantity factor, representing for example the amount of materials used or time spent, is much more directly within the range of management control. The foreman of a department, or even the general manager, has little or no capacity for influencing the prices paid for materials or for labor. He does have a direct relation to consumption and efficiency.

Therefore cost analyses made in terms of administrative responsibilities must give recognition to the segregation of costs that are relatively fixed and noncontrollable and costs that are variable and also perhaps controllable, at least in their

quantitative aspects. These analyses should be comparable with corresponding budget figures, and tie in with cost standards.

Cost reports constitute a major problem to the cost accountant. They are in a sense the most important part of his work because primarily through them he makes the control phase of his efforts effective. To be effective they must (1) be prompt and timely; (2) be adjusted to the psychological attitudes and needs of the executives who are expected to use them; (3) be dominated by a spirit of cooperation and helpfulness; (4) be directed toward the accomplishment of a specific objective or purpose; (5) have a significant content that is arranged in accordance with the requirements of any good exposition so as to possess unity, coherence, and emphasis unimpaired by insignificant and irrelevant details; (6) be adjusted to the various levels and scopes of executive authority; (7) point to a conclusion consonant with the evidence submitted, and indicate any corrective action contemplated or taken.

Statistical Cost Calculations

Some General Aspects

Cost computations outside of formal accounting records take on a variety of forms and are made for purposes too numerous for complete recapitulation. Inasmuch as they are not tied in with the accounting records, although they may make extended use of data therefrom, they are not tied down to the limitations of historical outlay, nor to the necessity in prorations of disposing of the exact aggregate of period costs, nor to the responsibility and duty of recognizing and measuring cost in a manner to satisfy legal requirements of profit determination.

The costs used in statistical calculations may therefore depart in lesser or greater degree from historical representations of cost, as indicated below.

1. They may merely project historical cost factors into the future and anticipate future expenditures.

2. They may include costs, which are in the nature of opportunity as distinct from expenditure costs, that are not recognized in accounting. Interest on the investment is an example. Interest, on a compound basis, is often considered an indispensable factor in arriving at the relative costs of alternative capital commitments when time is an important factor.

3. These cost calculations may include the same cost factors as do accounting records but include them on a different price basis. Property costs, through depreciation, and material and labor costs may be included at current levels. Equipment replacement cost studies may disregard, as sunk costs, the historical costs of property units whose replacement is being considered, substituting current realizable value in calculating the relative operating cost of continued use of the old unit in comparison with the estimated operating cost of a new unit.

4. Statistical cost calculations may exclude costs used in accounting. They are under no obligation to have total costs used equal aggregate period costs. These calculations are often concerned only with differences in costs between alternatives, and all costs that are equal for the alternatives have no significance. In general, these computations can exclude all costs not pentinent to the decision they are intended to elucidate.

5. Statistical cost calculations often use, in allocating costs to segments of the output or to any operating change, condition, factor or policy, an entirely different assumption of causal responsibility for cost, one not used in accounting cost allocations. The latter are made upon the assumption of aggregate responsibility for cost incurrence, under which each unit of operating effort or output for a given period is said to have an equal

responsibility for the total cost attached to the group to which the unit belongs. Statistical cost calculations often assign costs on the basis of incremental or differential responsibility.

Budgeted Costs

Budgeted costs normally represent the least degree of departure from historical cost computations. In calculating operating costs they merely project the amortization of capital cost factors, and anticipate what is expected to be the actual expenditure attaching to cost factors to be used in the near future but not yet acquired. They represent an effort to define the extent to which amounts that will become historical cost are to be allowed to be incurred. They are particularly concerned with the proper analysis of, and the establishment of responsibility for, period costs, and do not ordinarily involve the allocation of period costs to products. They can be extremely useful to management in coordinating the varied activities of the business and in providing an integrated program and carefully considered plan for both capital expenditures and operating costs.

Adjusted Costs

This title is intended to indicate the many cost calculations that have to be made in business which follow essentially the accounting pattern for cost allocation but depart from historical outlay in some respect. This group is composed of a multitudinous array of computations, varying, for example, from the estimated product cost that may be the basis for quoting sales price to the computations that may be made by a trade association to summarize cost aspects of its industry. Often these calculations substitute other cost amounts for historical outlay or recognize costs not admitted to financial records.

Alternative Cost Calculations

The computations here referred to are sometimes called engineering economy studies. They compare the capital and operating costs of machines, methods, processes and ways of doing business that may be substituted one for another; of various alternative capital commitments in buildings and equipment; and other cost-factors. The field for this type of calculation is co-extensive with business activity because all phases of business continuously present choices, one of which must be selected. An important factor in selection, in the exercise of preference and discretion, is relative cost.

The need of a company for the performance of a certain operation or function having been defined and the capacity required having been determined, which of the several ways of meeting this need in the required volume should be adopted or installed? Questions of this type may arise in two kinds of circumstances:

1. When the adoption of, or capital commitment in, the alternatives is merely prospective. No capital is yet committed to any alternative. Freedom of choice is still complete, theoretically, except for such limitations as cost or other conditions may impose.
2. When capital is already committed to one alternative, and the question is should the method, process, or machine represented by that alternative be continued in use or replaced by some other method, process, or machine.

If capital has not yet been committed to any alternative, but the requirements of the business have been appraised and alternatives have been selected which sat-

isfy the operating needs of the company, then cost calculations should be made to show the relative capital investment and annual operating cost required by each alternative. These calculations can be expected to indicate a cost answer to questions like the following:

What type of building construction should be employed?
In building a bridge, what span length will result in the smallest capital investment?
Is treated or untreated lumber more economical for a stated purpose?
What height of building should be used to develop a given urban site?
Should a company purchase or manufacture its electrical power requirements, and, if the latter, which of several makes of equipment should be selected?
Are hand methods, or semi-automatic or automatic machines preferable for stated operations?
Should a specified part be purchased or manufactured?
What is the effect of various product designs on manufacturing cost?
Should more durable equipment having a greater initial cost be selected in preference to less durable equipment?
Should the equipment offered by Supplier A be selected instead of that offered by Supplier B?

When capital has already been committed to one alternative, the useful life of which has not expired, the question becomes: Should the existing facility be scrapped and a new facility be purchased which is believed to be superior to the old in some aspect of performance? What are the relative capital and operating costs of continuing the old machine or process in comparison with the costs that would be incurred if the new one were acquired? Similar questions arise in connection with rearrangement of plant facilities and relocations of plant relative to sources of materials and labor, or to markets.

In many cases of alternative capital investment one alternative requires a larger first cost and incurs lower operating costs, while another requires smaller initial investment and larger current outlays from period to period. One alternative may be capable of rendering service over a longer total period of time. The problem of alternative cost calculation in this field is: How may these factors of greater or lesser capital amortization and lesser or greater current operating outlay be equated and stated so as to result in a fair cost comparison? Because of the difference in initial outlay among alternatives and the different time distribution of other outlays, it is often considered necessary to introduce compound interest factors into the computations. Implicit interest becomes a significant cost factor. Several methods are available for using compound interest in calculating the annual cost, the present worth or the capitalized costs of alternative capital commitments. If the time periods involved are short, interest may be neglected as a cost factor. Calculations may also be made to show the length of time required for the savings of the more economical alternative to "pay for itself." A rule of thumb may be adopted as company policy that replacement of usable equipment will be made only if the replacement will pay for itself in, say, two years.

Other questions relative to capital commitment the solution of which may be aided by cost calculations are:

How much more can economically be paid for one piece of equipment, in comparison with another of identical usefulness except for a known or carefully estimated difference in length of life?

With a stated difference in cost for alternatives, alike except for length of life, how much longer life must the alternative involving the higher initial cost possess to justify the greater investment?

What is the maximum investment, in stated circumstances, that can economically be made in labor saving equipment?

How much value does an old machine have, the work of which can be performed more economically by a new one?

What extra investment can economically be made at a given date in anticipation of future needs?

The above problems relate to the relative costs of alternative capital investments. Relative costs are an important factor in choosing between such alternatives. It must be realized, however, that cost is only one factor; sometimes it may not be the deciding factor in choosing between alternatives. Questions of availability of capital, company reputation and prestige, trends of business and future prospects, and other intangibles must be considered, although it is impossible to give them a monetary evaluation.

Similar calculations, not involving capital investment, are numerous and applicable to all phases of business. The establishment of minimum cost points, and tests of the diminishing returns from the increased application of any productive factor, are examples. Very often as operations are changed some unit costs increase, some decrease and others are constant. The problem is to find the minimum cost point where all costs blend to the best advantage. Problems of economic lot size, of manufacture or of purchase, are of this nature. As the manufacturing lot size is decreased, setup and preparation costs may increase in total and per unit; processing costs may be constant; and storage costs may decrease. In view of these conflicting trends, what lot size in a defined set of circumstances is the most economical in satisfying a stated annual requirement? A somewhat similar problem arises when a number of machines can be tended by one operator. Assuming the availability of machines, if an operator is assigned to, say, two machines, his capacities are not fully utilized; if he is assigned to eight machines, machine time or product is wasted or quality is sacrificed. At some point there is an optimum combination of men and machines from a cost standpoint. In extracting the sugar content of beets, if larger and larger quantities of water are used, the sugar extracted more nearly approaches the total available, so that the sugar lost in the pulp is reduced. But increased quantities of water in extraction increase later evaporation costs. Where is the break-even point, at which the value of sugar saved just equals the additional water and evaporation costs of saving it?

These and many other questions of alternative processing are elucidated by pertinent cost information.

Differential Cost Calculations

Differential cost calculations depart from the concept of average responsibility for cost used in cost accounting allocations, and attach cost to any change on the so-called differential, or incremental principle. With a given set of circumstances or a status quo in relation to operations and operating cost, assume a given change in these operations, of any character desired; then the variation in cost that takes place is the cost imputed to the change made. This type of cost allocation assumes a causal connection between the change and the cost addition or deduction associ-

ated with the change. The change, which may be actual or contemplated, may affect any aspect of operations or investment, and may be something added or taken away; for example:

What are the costs of an increase or decrease of volume of output; the addition or withdrawal of a unit or group of units of product, or of a produce line?

What are the costs of changing a policy, or a process or operating method; of adding or cutting off a sales territory, salesman, or customer?

What change in cost is brought about by undertaking the manufacture of another product to absorb unused capacity in the off-season of the present line?

Which will bring the lesser loss in certain circumstances, to shut down or to operate on a greatly reduced volume?

How much would the cost of a building be changed by adding or removing one floor, or modifying the size?

What change in operating costs will be associated with a program of plant expansion?

In relation to sales price:

Should a price below total cost be accepted for some part of the total volume of sales?

How much can a company, in defined circumstances, afford to cut prices in order to hold a given volume of business?

If a decrease in sales price will increase the volume of business, how far is it economical to cut price, if (1) the cut will affect the entire volume of business, or (2) only a specified part of the total volume?

The modifications to which costs may be imputed by means of the differential technique cover a wide range; some of them are minor; others may effect a substantial readjustment of the framework within which the business is conducted. Some of them may be viewed as short-term changes, and the differential costs imputed to them tend to approach the so-called out-of-pocket costs. Other changes, for example a contemplated plant expansion, have a long-term effect upon the cost position of the business, and the differential costs imputed thereto must include also the modification of the so-called fixed expenses.

Management, in making a decision, needs to know the cost effect of the decision, the amount of cost that is added or deducted by the decision. Historical costs, being average apportioned outlay, usually do not give the right answer. The average cost of operating a machine for 100 hours may be quite different from the cost saved by not operating the one hundredth hour or the costs added by operating the one hundred first hour. In disclosing costs pertinent to making many decisions, reliance must be placed on the differential principle.

Studies in Cost Patterns

Studies in cost patterns are studies of both total and differential costs. They are studies in the variability of cost, with volume as the independent variable and cost as the dependent variable. Cost is a function of volume; a causal relationship exists between the two; as volume changes, cost also changes. There is a positive functional relationship of total cost to volume, and a negative functional relationship of unit cost to volume. Just how cost changes as volume changes it is the purpose of this type of cost calculation to disclose.

In these cost-volume studies the latter factor may be represented in a variety of ways. If a single product is being studied, product units may be assumed to be homogeneous and can be used as the measure of volume. If more than one product

is involved, volume must be expressed in some measure common to all products; a weighted product unit basis, or total direct labor hours, standard direct labor hours, machine hours or the sales value of output can be used. The underlying basis having been selected, it may be converted into percentages of capacity. Costs may be stated in total for a given number of units of the volume base, or they may be stated at given amounts per unit of the base, separated between fixed and variable costs. The costs that are fixed in total vary on a per unit basis as the volume changes. Variable costs may remain fairly constant, on a per unit basis, over a considerable range of volume.

Cost-volume studies may be made at all levels of the organization. Each individual kind of expense may be studied separately in a given operating department to establish its variability with changes in volume. The entire overhead of the department, the division, or the plant may be analyzed. The variability of the total operating costs of the company may be studied over a period of years. Some very interesting work has been published in this field. Professor Walter Rautenstrauch, "The Economics of Business Enterprise," (John Wiley & Sons, Inc., 1939) has described the cost characteristics of a considerable number of major American businesses. The hearings of the Temporary National Economic Committee, Part 26 (United States Government Printing Office, 1940) contains extensive data on the relationship between costs of operation and volume of business of the United States Steel Corporation and subsidiaries for the period 1927 to 1938.

Studies of this type may analyze the experience of the company in the relationship of cost and volume over an extended period of time, adjusted if necessary to current price conditions. The data, after tabulation, may be plotted on a chart as a scatter diagram. The X-axis of the chart represents volume, and the Y-axis represents cost. Statistical processes for calculating the regression line and for determining the standard error of the estimate may be used. Very often a satisfactory medial line may be drawn by inspection without use of the least squares method. The inclination of the regression line indicates the average or typical variation in cost with changes in volume. The relationship may be a linear one; a given increase in volume results in a constant increase in cost. This type of relationship may be expressed by the equation for an arithmetic straight line, as $y = a + bx$, where a is the cost when output is o, and b is the average increase in cost per unit of volume. This expression of cost variation may not be strictly accurate over all ranges of output and yet it may be a satisfactory empirical description of cost-volume correlation even if it is not an exact representation of functional variation. The relationship of cost and volume may be curvilinear and hence be better represented by a geometric straight line, a second degree parabola or a U-shaped curve. Although the latter type of representation of cost-volume relationship may be more accurate, the arithmetic straight line representation is much simpler and is usually considered sufficiently accurate within the range of normal variation of volume.

Knowledge of the existing cost-volume relationships of individual cost items, groups of costs relating to a department or a product, and the total operating costs of the company, is of great value in budgeting and all forecasting, and in comparing current performance with past experience. The effect of changes in the assortment of products on total operating cost can be measured. Other causes of changes in the degree of variability of costs can be studied, and the effect of alterations in the amount of fixed cost can be appraised. Knowledge of the spread between the vari-

able costs and the sales price of a single product, a group of products, or the total product line of the company can be secured. This spread, or ratio of variable costs to sales price of a product, is a measure of its potentiality to aid in meeting fixed costs and in contributing to profit.

When the sales revenue line is added to a cost-volume graph, the result is called a break-even chart or profitgraph. The break-even point may of course be calculated by formula, but its visual presentation is usually more effective. This type of chart may be made to show significant points in addition to the one depicting no gain—no loss from operations. The cost-revenue-profit-volume representation is particularly helpful in evaluating the effect of changes in the amount of fixed costs, in the rate of variability of variable costs, and of sales price, on the amount of profit, and in indicating the variation in volume required to restore profit to the level existing before any of these changes were introduced. Every proposed major adjustment of company affairs, such as a program of plant expansion, must be studied in the light of its probable effect upon fixed and variable costs, upon the marginal ratio of variable cost to sales price, upon total revenue, and upon the location of the break-even point. Questions such as the following are more readily answered with the aid of cost-revenue-profit-volume analysis:

What is the effect of an increased investment on the fixed costs and upon the break-even or profit points? What are the similar effects of increases of fixed costs from other causes?

What additional volume is needed to offset a reduction of price, fixed costs, and the degree of variability of other costs remaining constant?

What increase of price is needed to offset a reduction of volume, fixed costs, and the degree of variability of other costs remaining constant?

What additional sales volume at a specified price is needed to yield the same profit as before, after fixed or variable costs have been increased?

What increase in selling price for a specified volume is needed to yield the same profit as before, after fixed or variable costs have been increased?

The understanding of the behavior of operating costs—individual items, groups, and totals—is a most important factor in controlling costs. The cost accountant must accumulate the experience of his company in cost volume, and cost-revenue-profit-volume relationships. Only in this way can he be in position to appraise the cost effect of operating changes made in the past and to predict the cost effect of changes proposed for the future. He must know his cost patterns.

Conclusion

Many kinds of costs and of cost problems are encountered in business. The cost accountant must understand all kinds of cost, and be willing to undertake the solution of all types of cost problems. Only in this way can he attain the greatest usefulness to his company.

Chapter 5

COST ACCOUNTING AS AN INSTRUMENT FOR PRICING

By
CARL THOMAS DEVINE *

Many accountants and economists feel that the results of cost accounting should not be used as a determinant of sales prices. Undoubtedly there are other considerations which are more useful for setting prices, yet many businessmen do use such costs for this purpose. The problems of price setting are so complicated that a careful examination of the role of cost in this connection is a business necessity.

Pure or Perfect Competition

Firms are said to operate in pure competition when the action of any one firm has no influence on price. Price is set by the interaction of numerous suppliers and demanders, and the influence of an individual manager is so small that no change in price results from his decisions. Clearly, a manager operating in pure competition has no control over selling prices and costs for the individual firm are not a determinant of price.

Nevertheless, improper or inadequate costing methods by a large number of firms may have an important effect on price. If costs are understated by firms comprising a large segment of the industry, reported profits should be overstated. This overstatement of profits may induce expansion of existing facilities or encourage the establishment of new firms. This expansion tends to increase the supply and unless demand increases sufficiently, prices should fall. In a similar manner, if costs are overstated by a number of firms, the understated profits may lead to ultimate contraction of output and a higher long-run price. In either case there is an improper allocation of economic resources.

While improper costing methods, if practised by a number of firms, may influence prices, an individual enterpriser should find an adequate costing system useful chiefly in the field of cost control.

Imperfect Competition

The distinguishing feature of imperfect competition is that the output decisions of a particular concern influence the price of its products. The firm's demand is not perfectly elastic. The problem of profit management requires for its solution a careful balancing of pricing policy, output decisions, and sales effort. Under pure competition a particular firm is able to sell all of its output at the prevailing price, and sales promotion is not necessary. When the product is differentiated, increased output can be sold only at reduced prices or with the aid of sales pressure.

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If no sales effort is exerted, larger outputs can be sold only if they are offered at lower prices. With a "one-price" policy for each product, the businessman must realize that a lower price will apply to all units sold and that the total revenue may actually decrease. For practical purposes the demand for a product may be said to be elastic if a change in price results in a revenue change in the opposite direction. An inelastic demand implies a change in the volume of revenues in the same direction of the price change.

Selling costs are incurred with the purpose of increasing demand, i.e., enabling the firm to sell more at the same price or to sell the same quantity at a higher price. The demand for certain products is sensitive to sales pressure and is said to be highly expandable.

If work is done on special order, the ordinary rules of economists must be modified. Each job is a product, and producers compete with one another on a price basis. This type of competition may be pure in the accepted sense, or it may be imperfect due to differences in quality of work, time of delivery, etc. It is in this area that cost accounting makes its greatest contribution. The restrictions of a single-price policy no longer apply, and the guideposts offered by proper costing may become important.

Economist's Approach to Pricing

For maximum profit in the short-run the businessman should produce until the marginal cost of a unit is equal to the marginal revenue of that unit. For practical purposes marginal cost may be approximated by using the accountant's variable cost.

The marginal revenue is the amount of the increase in total revenue brought about by the disposal of one additional unit. In pure competition the marginal revenue is equal to the sales price of a unit. The optimum output for a producer of a single product is at the point at which variable cost equals price. Average costs, as compiled by the cost accountant, are irrelevant for pricing or output policy.

If competition is imperfect, if the producer manufactures only one product, and if no selling pressure is applied, the equality of variable cost and marginal revenue indicates the output that yields maximum profits. The price at which this output can be sold is shown by the demand schedule. It should be remembered that marginal revenue in imperfect competition must offset the lower revenue on all other units against the selling price of the added unit. Selling effort should be applied as long as the added revenues from the additional sale of a unit covers its variable costs plus the added selling cost necessary to dispose of it.

Criticism of the Economist's Approach

It is clear to businessmen that accurate estimates of demand schedules are impossible. The businessman knows only the demand at the prices actually charged. The remainder of the schedule is almost entirely conjecture. If demand estimates are inaccurate, estimates of marginal revenue are also inaccurate, and the output that is thought to be optimum may not produce the maximum profit.

The economist usually relies on the assumption that businessmen use a single price over a definite time interval for each product. This simplifying assumption obviously needs modification when some units are sold at reduced or special sales prices and when special-order jobs are undertaken.

The fact of the matter is that businessmen have not been impressed with the economist's pronouncements on pricing policy. The marginal approach to maximum profits is based on demand and cost estimates for a definite period of time. It does not follow that maximizing profits for each of these periods by the marginal method will maximize a firm's profits over a longer period of time. Businessmen realize that the prices they charge today often influence the demand of their products in the future. A low current price may satiate the market for some time, and it may lead to loss of the good will of customers who purchased at higher prices. Consumers may be induced to speculate in the price movements of the product and, to the extent that they are successful in their speculation, the producer sells larger quantities at lower prices and less at higher prices. Moreover, if the demand for the product of the industry is inelastic, a lower price during depression may lead to smaller profits than would result from a policy of high prices.

The Businessman's Approach to Pricing

Unit costs accumulated by the accounting department are essentially averages which include a portion of fixed costs. The typical treatment of fixed costs means that higher overhead costs per unit are shown when output is low, and lower overhead unit costs are reflected when output is high. Inasmuch as direct materials and direct labor cost per unit tend to vary directly with output over the business cycle, the accountant's factory unit costs are usually more stable than factor prices. The degree of stabilization depends to some degree on the importance of fixed overhead costs relative to variable costs. It should be noted that the use of overhead rates based on normal capacity tend to reduce the stabilizing factor.

To the extent that businessmen relate their prices to typical accounting costs, the resulting prices are more stable over the business cycle than those recommended by the economist through the marginal approach. Many academic economists have assumed that existing pricing policies result from the businessman's ignorance of the marginal pricing rule. In many cases, no doubt, current policies are based on ignorance, but many business managers who are well trained in economics prefer to set selling prices according to a flexible formula based on average costs.

The demand schedule, in diagrammatic form, is not a curve but is instead a surface with time as the third dimension. Businessmen realize that prices charged at one date may raise or lower the demand schedule of the future. As a result they may be willing to forego some immediate profits so that the possibility for future profits will be greater. Such a policy may result from an unrealistic appraisal of the relative importance of certain demand factors, but such decisions are not ridiculous nor are they necessarily based on the businessman's failure to understand the economist's recommendations.

Accountant's Contribution to Special-Order Pricing

If bids are offered on special-order jobs, the determinants of pricing policy are somewhat different. Producers compete with one another and hope to maximize their profits by securing contracts that will cover variable costs and contribute the largest amount for covering fixed costs and profits. If operations are at less than full capacity, a firm is better off to accept a job which covers its variable costs and makes a small contribution toward fixed costs than to refuse the work. As long as each manager realizes this obvious principle and is willing to follow it, and as long

as each manager realizes that competitors will pursue a similar policy, there are no resistances to keep the bids from falling to variable costs. From the bidders' point of view, operating results are little better than shutdown.

Businessmen are fully aware of the effects of cutthroat competition and obviously wish to avoid them. Active collusion is unlawful, but some of the benefits of collective pricing can be secured by uniform costing and by influencing competitors to quote prices on the basis of average costs. If operations with this policy are so unprofitable that shutdown is preferable, the monthly reports should indicate the fact. The results of quoting from average costs are seldom worse than those resulting from unrestrained cutthroat competition; they may be considerably better.

If the cost accountant uses normal capacity for overhead rates, the resulting job costs should indicate to management that a pricing policy covering such costs permits the firm to recover its fixed overhead over the business cycle. When expected actual or actual overhead is applied to job costs, a price covering the derived cost should provide for fixed charges period by period. Such guideposts may be an aid to management in setting prices. Distribution of selling and administration costs may be useful in a similar manner. Still further information may prove to be useful. Informal additions to job costs to indicate various rates of return on cost may also be of benefit. In some cases businessmen add a standard rate of profit to their costs and are reluctant to sell below standard selling prices.

If firms are operating at full capacity, competitors wish to secure those bids which yield the highest return over variable costs. In a very real sense the sacrifice (cost) of taking Job A is the gain over variable costs that is foregone on other jobs that must be rejected. The economist's scheme of pricing expects producers to take full advantage of the seller's market. Businessmen who base prices on costs may increase the margin somewhat, but the use of costs should be a stabilizing influence on prices. The relative profitableness of the two approaches to pricing is difficult to determine, but there is no reason to believe that the economist's recommendations are always superior. The social consequences, especially with regard to employment, are equally difficult to assess, but again the superiority of the economist's approach is not established beyond question.

At full capacity operations the accountant's allocation of fixed costs may prove especially useful. The assignment of space cost, for example, according to man or machine hours, is more than a cost assignment; the resulting charges to jobs indicate the relative time usage of scarce facilities. Perhaps direct estimates would be more useful in this regard, but overhead allocated in this manner may be viewed as an index or measure of utilization of scarce resources. The resulting charges to jobs may, therefore, be viewed as rough indexes of the scarce factor (capacity) utilized by each.

The Cost Accountant Can Approximate Marginal Costs

There is a common misunderstanding that cost accountants deal entirely with averages and with historical costs. But as one speaker has put it, the cost accountant has removed the pencil from his ear and has moved into the front office.

The flexible budget indicates clearly the variable element of overhead cost. It is true that "use" depreciation is based on original cost and that budgeted repairs and maintenance are often on an expenditure basis rather than on a responsibility basis. However, the over-all results may be used to approximate the economist's

marginal overhead cost. In fact, the cost accountant is well in advance of the economist in several ways. The unit of capacity is usually the per cent of capacity, so that estimates of variable costs may be made for diversified products. The factory is departmentalized to aid in determining the variable (and average) cost of products that require different operations. With a given level of activity in each department or for each operation and with knowledge of the increased activity necessitated by a particular job, the marginal overhead for the job may be approximated without difficulty.

Direct materials and direct labor may be considered variable in most cases. This assumption may be rejected in a few instances, due to the desire of management to retain certain key employees or to consume an existing supply of materials, but such cases are rare. Many businessmen assume that the total prime cost of a job is roughly equivalent to its variable cost, but such crude approximations are not necessary when an adequate cost system is available.

It is probably safe to say that accountants were intimately familiar with differential and variable cost analysis long before economists began to emphasize the usefulness of marginal calculations.

Prices Are Influenced by Competitor's Costs

Some economists have argued that businessmen will increase their prices only when competitors' costs have increased so that the rival firms will concur by increasing the prices of competing goods. This argument has substantial merit. If one manager increases prices and the prices of competing goods remain unchanged, the innovator may find that his competitors have practically all of the business. Moreover, if prices are raised by all firms and if costs have not increased, the additional profits, if any, may encourage new firms to enter the industry.

On the other hand, Reynolds and others have argued that if costs throughout the industry are lower, businessmen may wish to lower prices to keep new firms from entering the field.

To the extent that these arguments are valid the accountant's cost calculations throughout an industry are important determinants of price. In many cases the cost accounting practices of competitors may be a more important factor in an individual's pricing policy than his own cost records.

Chapter 6

COST ACCOUNTING AS A MEANS FOR CONTROL OF INVENTORIES AND STOREROOM

By
CARL THOMAS DEVINE *

Kilduff and others have pointed out that the problem of inventory control is not solved adequately by a system of stock records. Effective inventory and asset control involves careful studies of purchasing, receiving, storage, wastage, and utilization.

Control of Materials Purchasing

Few businessmen probably realize the tremendous cost of purchasing, receiving, handling, and storing materials and other assets. Various estimates indicate that annual storing and handling costs alone may exceed 25% of the value of the inventories carried. Interest on investment must be treated as a cost regardless of the source of funds. Storage costs, additional insurance and taxes, provision for materials handling, obsolescence, deterioration, and other factors must be considered as costs of carrying inventories.

In the typical case, profitable operations cannot be carried on without some inventories and other agents of production. Management is therefore faced with the problem of balancing stocks with production so that the net gain is maximized. The first step in materials control is the determination of minimum and maximum quantities for each item of stock.

In order to set these limits properly, the following considerations must be given attention:

1. Time between placing order and receiving goods.
2. The average periodic consumption.
3. Amount of materials required for regular or irregular orders or batches.
4. Dependability of vendors and delivery agents with regard to promptness, so that a margin of safety can be established.
5. Discounts available for large lots.
6. Production policy with regard to possible changes in the rate of production or sales.
7. Transportation and handling economies associated with large lots.
8. Costs (variable and average) of carrying stocks.
9. Cost of placing purchase order, receiving, etc.

A somewhat simplified formula has been presented for determining the most

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economical quantity to purchase at one order. The following formula (Davis) yields the lowest unit cost of purchasing and storing.

$$Q = \sqrt{\frac{2GS}{CI + B}}$$

In this equation:

Q = number of units in most economical order size.
G = cost in dollars of placing and following an order.
S = number of units consumed in one year.
C = purchase price, net plus freight and receiving.
I = interest rate per annum.
B = annual cost of storage per unit of materials.

It is essential that maximum and minimum quantities be established for each type of materials carried in stock, and that proper procedures for initiating requisitions be adapted.

In most cases it is desirable to have a centralized purchasing department. This arrangement permits better coordination of materials procurement and places specialists in charge of the function. The purchasing agent's duties and responsibilities may be summarized:

1. Signing purchase contracts and representing his firm before vendors.
2. Securing information as to prices, qualities, and possible substitutes by consulting catalogs, interviewing salesmen, etc.
3. Negotiating adjustments, returns, allowances, special discounts with vendors and carriers.
4. Providing a smooth flow of materials, supplies, tools, and similar agents to expedite production at reasonable prices.

Measuring Purchasing Performance

The accounting system should provide means for measuring the performance of the purchasing department. The techniques of standard accounting are best fitted for this purpose.

Failure to provide sufficient materials, tools, supplies, and equipment should be disclosed by a careful study of the causes for the idle capacity variances. Purchase of unsatisfactory materials should be revealed by a study of the materials usage variance.

The purchasing official is responsible for procuring materials at reasonable prices. Many materials are purchased from price lists and catalogs. If wide variations in price are found from vendor to vendor, the purchasing officer must determine which vendors meet the required specifications at lowest cost. Often the agent will wish to confine his purchases to a limited number of established vendors, even if their prices are not always lowest. In many cases this is good administration, and the price standards need not be set at lowest possible prices.

Some commodities have prices that vary widely with market movements. Price standards are difficult to establish for such goods. Daily price reports for basic commodities are often available, and the agent should be thoroughly familiar with such reports. Price standards are therefore provisional and the amount of such variances may be of limited usefulness. If stock maxima and minima are carefully

established and followed, speculation in material prices should not be an important element of the price variance.

Price standards for special job-order materials are still more difficult to set. Bids are normally requested, and, unless there are unusual circumstances, the lowest bid should normally be accepted. In some cases objective price standards may be set for this type of stores, but in other instances accepted bid prices may be taken as the standard. Careful auditing of the requests for bids and the responses thereto may be more useful for control purposes than variances from provisional price standards.

In general, cash discounts should be deducted from the standard list cost to determine materials price standards. Furthermore, discounts taken should not be treated as modifications of the variance. The purchasing department is certainly not responsible for the acceptance or rejection of cash discounts allowed. This responsibility rests with the treasurer or with the accounting department.

The ideal procedure enters purchases net of all discounts, and materials price standards should be set in the same manner. The account with purchase discounts is, of course, a variance account. Good performance should take all discounts offered, and the account with discounts not taken should bear a debit or unfavorable balance.

The traditional method of showing cash discounts on purchases as a credit implies that standard performance takes no discounts and that the credit is a favorable variance. This type of accounting is inconsistent with the objectives of standards and should be condoned only when the inconvenience of using the alternative is prohibitive. A few cost accounting systems credit cash discounts taken to the materials price variance account. There is no justification for this procedure, as the variance is then no longer correlated with functional responsibility.

It is usually more convenient to isolate materials price variances as the goods are purchased than to separate the variance upon issue. Stores records may then be kept only in physical quantities and the intricate computations of first-in, first-out, averages, and last-in, first-out are avoided. Separation of the variance at purchase yields a better correlation of variance with activity. The usual objection—that materials inventories should be stated at actual cost—is not serious, for the price variance may be isolated on receipt, and if some of the receipts have not been issued at the end of the period, a proportionate part of the variance may be retained as an adjunct or contra to the inventory figures at standard.

Stores Control

The cost accountant's contribution to stores control may include the determination of economic order sizes and the setting of quantity limits, but it certainly covers the designing and keeping of records that disclose quantities, shortages, inventory costs, and cost of issues.

The least that can be expected from stores records is that they yield information as to available quantities and disclose shortages. The usual device for this purpose is the stores card, which is prepared for each type or class of materials, except those that are specially ordered for particular jobs.

The balance-of-stores clerk records the receipt of all materials. The evidence for these entries may be the receiving report, a receipted copy of the purchase order, or even the invoice. The receiving department counts, inspects, and tests incoming

goods. Discrepancies in quantities due to errors in shipping or to over or under runs by the vendor, should be reported immediately to the purchasing department for action. Goods damaged in shipment should also be reported for adjustment claims.

The stores clerk should also record materials on order and in transit. These entries are usually informal and are often canceled by marking through the entries upon receipt of the goods. Materials on reservation for planned jobs are usually treated in a similar manner.

The entries for issuance of materials are usually based on requisitions or consumption reports. Only authorized personnel should have the authority to withdraw materials, supplies, and finished stock. All withdrawals should be supported by written receipts—requisitions—prepared by authorized individuals. Requisitions should indicate the jobs, departments, or operations requiring materials and supplies. A copy of the sales invoice is often used as the shipping order, which is authority for the release of finished stock.

Materials that are not normally carried in stock are sometimes required for special work orders. Such materials are often charged directly to appropriate job-cost sheets and are not passed through the stores records. There is no serious objection to this procedure, but the bookkeeping routine is somewhat simplified if all materials are handled in a similar manner.

Materials returned from the workrooms to stores should be evidenced by a formal receipt. Scrap is normally returned to the storeskeepers for physical control, and complete records should be kept of these items by the stores clerk. Scrap receipts and sales tickets should be prepared and recorded.

Spoiled work may be returned to the storerooms, but more often it is transferred to the finished stock room. Its disposal should be supported by shipping orders.

Physical Inventory

Stores control, to be effective, should be supported by physical inventories. Perhaps the most efficient method of performing this task is to provide for continuous checking. Copies of purchase requisitions may be routed to the inventory takers. The volume of work may be greatly reduced by performing the count when the number of units is small. When this method is used, some items of inventory may be counted several times during the year, while others may not be checked. The inventory staff may secure better control by surprise counts from time to time and by making sure that all items are covered at least once each year.

The periodic physical inventory is still widely used. Tags or sheets showing all information, except quantities, are prepared in advance of the actual counting. Cards and summary sheets are usually prenumbered, so that none are omitted when the data are assembled. Receipts, shipments and interdepartment transfers, if made while inventory is being taken, should be segregated and marked. Materials at the machines are returned to the storesrooms or are inventoried on separate sheets. Mechanical devices, such as calculating machines, balances, and counters, should be made available before the counting work begins. Personnel should be thoroughly familiar with the items of inventory and should be instructed in the routine of taking inventory. If feasible, a member of the firm's public accounting organization should take part in planning and executing the work. Obsolete or deteriorated materials and stock should be recorded on separate tags for special costing. At best, some quantities are poorly estimated or are definitely in error.

After the count is complete, the tags or sheets should be "pulled" and quantities should be costed, tabulated, and summarized.

Discrepancies between actual and book quantities should be investigated and discussed with the superintendent of stores. If evaporation or deterioration is a factor, standard lossage should be determined and compared with actual shortages. A schedule of shortages should normally be compiled. Book quantities must be adjusted to conform with actual amounts.

Inventory Control Without Requisitions

In some industries the cost of inventory control by requisition may be larger than the gains derived. If the products are standardized and the number of inventory items is small, shortages may be approximated by formula. A candy manufacturer, for example, may estimate the utilization of sugar and other ingredients from production reports. Standards are determined by test runs and recipes, and are applied to actual production to determine the quantities of materials that should have been used. Receipts of materials are recorded, and periodic physical inventories are used to determine actual quantities used.

If the inventory items are small in number, weighing reports may be prepared for each batch or for each day's production. The weight tickets are, of course, requisitions.

Control of Finished Stock

Finished goods, like materials, are controlled by the exercise of judgment based on accurate facts. The usual accounting records are employed, but supplementary records are usually desirable to indicate the types of stock that are moving. Periodic schedules should indicate which products are moving at current prices. Maximum and minimum quantities should be established for each product, and a routine for initiating production orders should be devised.

Changes in production costs should be scheduled, and profit margins for each line should be reviewed periodically. Reports of damaged, shopworn, deteriorated, and obsolete goods should be submitted. These reports should be investigated to determine causes and to seek remedies for losses of this type.

Sales returns and allowances should be scheduled, and attempts should be made to determine the responsibility for these unfavorable developments. In some cases the salesmen are to be blamed for over-selling or for their failure to list special specifications and conditions. If delivery is not made within the customer's time limit, the responsibility may be that of the salesman, or production officials may have been lax. In some cases, the responsibility for returns and allowances rests with the shipping and delivery divisions.

Storesroom and Stockroom Efficiency

The accounting system should disclose information that may be used to appraise the efficiency of storesroom operation. This problem is especially difficult, as the storing function is combined with the handling function.

The flexible budget may be used to indicate allowed costs of handling differing volumes of goods. As a rule, a large element of warehousing costs is fixed. The functional unit is usually the hundredweight handled, but this unit is hardly satisfactory. The cost of the storesroom is a function of the number of receipts, the

number and regularity of issues, and the type of materials handled as well as the quantity handled.

The most effective control device is probably the flexible budget with an over-all budget variance. A capacity variance may be isolated, but the usefulness of this variance is not clear. Actual costs classified according to object within the department should be compared with allowed costs arranged according to the same classification. A search should then be conducted for the causes of variations in each cost.

Control of storekeeping implies systematic studies to determine the most economical methods of performing the work. The cost accountant may be expected to prepare schedules showing the comparative cost of handling stores by machines, conveyor belts, etc., as opposed to hand methods.

A typical formula for determining the maximum investment in labor-saving machinery in order to effect a saving has been derived by the Materials Handling Division of the American Society of Mechanical Engineers.

$$Z = \frac{(S + T + U - E)X}{A + B + C + \frac{1}{h}}$$

Legend: S = annual saving in direct labor cost.
T = annual saving in overhead and operating costs.
U = annual increase in earnings due to increased production.
E = annual cost of operating the machine.
X = part of year (percentage) that machine will be utilized.
A = annual rate of interest.
B = annual cost of insurance, taxes, etc. (Percentage of cost of equipment)
C = annual cost of upkeep of machine. (Percentage of cost of equipment)
$\frac{1}{h}$ = allowance for depreciation: h = number of years of expected service.

If stores control, in the broad sense, is to be effected, studies of this kind may be numerous. Studies to determine the most desirable arrangement and location of bins and materials may also be necessary. Materials cost control certainly implies more than disclosure of discrepancies. The responsibility is worthy of a major executive.

Chapter 7

COST ACCOUNTING AS A MEANS FOR MAKING MOST EFFECTIVE USE OF MEN AND MACHINES

By
CARL THOMAS DEVINE *

A. CONTROLLING LABOR COST

Control of Hiring and Training

In materials accounting the purchase requisition is evidence that materials are needed. Departmental foremen, or other authorized individuals, normally issue hire requests, which are essentially requisitions for personnel. These slips indicate the type of job open, the department needing the employee, and perhaps other information.

The personnel officer in charge of labor procurement is the functional counterpart of the purchasing agent. He should be thoroughly familiar with job specifications, wage rates, and sources of labor supply. Active files of applicants, properly classified, should be kept. Contacts should be established with government and private employment agencies, training schools, and other sources. Response to newspaper and magazine advertisements for help should be analyzed for effectiveness. The traditional "Men Wanted" sign posted at the office door is outmoded but is still used effectively by some organizations.

The personnel officer should interview the applicant and, if negotiations are successful, a hire slip should be issued. A copy of the hire slip should be sent to the timekeeping department to aid in the preparation of time-clock cards and floor check sheets. A copy of the hire slip should be routed to the payroll department for inclusion on the payroll sheets.

The new employee should be given a badge number and should be introduced to the timekeepers, foremen, assistant foremen, and others with whom he will be working. In many cases training is a simple operation that may be conducted by the departmental foreman or his assistants. In other instances employee training is a time consuming and expensive operation. Special training rooms with separate equipment and instructors may be justified.

The accounting staff may be required to compile statistics of labor turnover, separations, replacements, and absenteeism. If hiring and training costs are considerable, a high rate of turnover may prove expensive. Turnover standards for each type of job may be established from past experience and from the experience of similar firms. The average cost of training each type of employee may be estimated, and a turnover variance, expressed in monetary units, may be derived. Causes for turnover should be determined and, if practicable, they should be abolished or reduced.

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The cost of absenteeism and tardiness may also be approximated. If workers operate in groups, the cost of these factors may be enormous. Time tickets should indicate idleness and should be tabulated as to causes. Penalties may be effective, and outright dismissal of habitual offenders is sometimes justified.

Control of Attendance-Timekeeping

Control of attendance is facilitated by an efficient timekeeping organization. Employees are usually required to punch clocks upon entering and leaving the plant. A member of the timekeeping division is usually assigned to observe the clocks as workers punch their cards. At least once during the working day timekeepers contact each worker and make a notation on the floor check sheets. As a further check, workers remaining at the plant during the lunch period are sometimes required to punch their clock cards.

Overtime should be properly authorized by foremen or others, and authorization slips should be available for the use of the timekeeping department. If more than one shift is used, care should be taken to provide for rapid entrance and exit from the plant.

The timekeeping department usually extends the daily and weekly time on the clock cards. Rates of pay are applied and the usual payroll deductions for payroll and withholding taxes are made on the clock cards. Many firms also record the hours worked on the floor check sheets, so that tampering with the clock cards may be revealed.

Timekeepers may also keep the job time tickets. Job order systems require detailed information regarding the direct labor on each job. In some cases daily time sheets are kept by the individual workers. Each sheet indicates the worker's time spent on all jobs and on "unproductive" activities—for example, machine repair and setup, and stores handling. Often a separate time ticket is prepared for each job or duty performed. Time sheets and tickets may be prepared by the employees themselves, by the foremen or their assistants, or by the timekeepers.

Job time records are rarely accurate to the minute. Fifteen-minute intervals are sometimes used, but the six-minute interval has the advantage of using multiples of ten and is gaining in popularity.

The Payroll Department

Clock cards, floor check sheets, and other timekeeping records are usually turned over to the payroll department.

Names of employees, rates of pay, and other pertinent information, are taken from the personnel records and entered on the payroll sheets. This precaution should disclose errors committed by the timekeeping department as to employees and rates. Often cards are punched from the information shown on the hire slips, and are used to expedite the detailed work.

Payroll deductions other than taxes are normally made by the payroll department. Completed payrolls are used as the basis for drawing checks. In some cases completed clock cards are presented to the workers before the paymaster distributes the checks. This procedure permits employees to examine their cards and raise any objections. The cards are then returned and signed in the presence of the paymaster as receipts for payments. The checks themselves are, of course, receipts and contain signatures, but a separate receipt is often desirable.

The payroll department prepares the employee's earnings records and calculates the tax liabilities. Departmental seniority records and group insurance data are sometimes compiled by the payroll department.

Setting Labor Standards

Labor efficiency undoubtedly offers the most opportunities for effective labor control. The starting point for this type of control is the determination of standards for each operation performed by the working staff. The accountant's field embraces the disclosure of significant variations from standard performance, but the modern accountant is expected to be familiar with related functions, including the determination of standards.

The setting of labor standards requires a breakdown of jobs into their operations and motions. This preliminary study should include the advantages and disadvantages of alternative methods of operation. Machine setup and location, material arrangement, inspection techniques, and work transfers should be studied carefully.

Actual and alternative operations should be divided into fundamental motions. Time studies are then made of the motions and standard time allowances for the entire operation are determined. Undoubtedly there is some unnecessary mysticism and a trace of nonsense in the procedures actually followed by time and motion study experts, but the results are usually worthwhile. Essentially the procedure involves timing several good operators at their tasks and "leveling" the results to form the basis for standards.

Incentive Payment Plans

The usual piece-rate wage plan compensates the worker in proportion to the volume of acceptable work completed. This method of payment has the merit of yielding a constant direct labor cost per unit of product, but it is subject to severe limitations.

The incentive plans attempt to compensate the exceptional worker at a rate that increases more rapidly than output. The justification for incentive plans is that the expert worker utilizes the equipment and plant facilities more effectively, and it seems to follow that the saving in cost should be shared with the worker.

There are several acknowledged disadvantages of piece-rate and incentive wage plans. The cost of inspection usually increases considerably, and the loss on spoiled and defective work is greater. Clearly, these plans should not be adopted for precision work with emphasis on craftsmanship and quality. The clerical work in connection with payroll preparation is increased considerably. It is more difficult for employees to estimate their earnings and to verify the amount of their pay. In some cases the incentives may be too effective in that workers speed up their operations beyond the pace that they are able to sustain without injuring their health. Machine breakdowns and accelerated depreciation may result from frenzied activity.

Some labor specialists feel that substandard workers should receive a basic wage rate regardless of productivity. The original Taylor Plan was formulated so that the compensation of the substandard worker would be so low that he would be discouraged from continuing with that type of job. It is certainly true, even in a socialist state, that incompetent workers should not operate society's machines when

better operators are available. If productivity is reduced below standard because of poor scheduling of work, shortages of materials, machine breakdowns, and other reasons beyond the control of the employee, the basic wage rate is justified.

Some Incentive Plans

The Taylor Plan utilizes two piece rates. For workers who fail to attain the standard, the rate per unit of output is relatively low. Workers who attain or exceed standard are paid a considerably higher rate per piece on all units completed. Conditions of work are carefully standardized and each task is carefully defined. Wage calculations may be made on an hourly, daily, or weekly basis.

The Gantt Plan assures the worker of a minimum daily wage rate and adds a bonus to the basic rate for standard and above standard work. The bonus is usually a percentage (often 20%) of the normal piece rate at standard. For example, if the standard is six units per day and the minimum wage is $6.00, the wage for standard performance is $7.20. For seven units the wage is $8.40.

The Emerson Plans pay small bonuses for substandard performance, and increase the bonus rapidly for efficiency in excess of 100%. Tables are used for determining the amount of the bonus, and a basic daily wage is assured all workers.

The Halsey Plan guarantees the worker a minimum wage rate and shares the time saved with the worker. Standards are based on past records, but the scheme may be used in conjunction with time and motion studies. A typical adaptation shares the wages for the time saved by an exceptional worker on the basis of one third to the employee. The bonus is, of course, added to the basic wage. If the day rate is $8.00, and a worker saves two hours, that is, does ten hours of standard work in the eight-hour period, he is paid $8.67.

The Rowan Plan is similar, but the calculation of the bonus is slightly different. The worker is paid the basic rate plus full wages for the percentage of time saved. If the basic day wage is $8.00, and if the worker performs work that would require ten hours at standard, he saves 20 per cent of the allowed time, and his daily wage is $9.60.

Incentive plans may be based on hourly, daily, or weekly, standards. If a basic minimum wage is allowed, the longer periods are desirable. Workers may work at a pace that cannot be sustained in order to get the day's or hour's bonus, and then attain far less than standard while they recuperate.

Group bonuses are desirable when tasks are performed by groups rather than by individuals. A number of variations are in use, but the foreman is usually entitled to a portion of the bonus.

A newer development is essentially a profit-sharing arrangement. Some companies have reported rapid increases in productivity by the use of a plan substantially as follows. All workers are paid basic wages according to classification. If total labor cost is less than say 30% of the sales price of the product, the difference is shared equally with all workers. If labor cost is equal to or exceeds 30% of sales value, no bonus is paid.

Unions have, on the whole, not been enthusiastic about incentive plans for wage calculation. In part, this attitude has been based on the feeling that standards are constantly increased so that earnings remain practically at their former levels. Careful time and motion studies, combined with responsible management, should dispel that fear. In fact, some unions employ their own specialists in this field.

Unions have also sought to protect their workers by seniority and other rules. While it is no doubt true that workers with long service are less versatile at getting work elsewhere, and they often have greater family responsibilities, the seniority principle does not further the cause of efficiency.

Labor Control with Time Rates

Numerous cases have been reported in which the change from time rates to piece rates has resulted in increases in output of 50% or greater. Yet it is possible to test and control efficiency and still retain the time-rate procedures.

Time and motion studies should be made to determine allowed time for each operation. Work orders should be analyzed carefully to estimate the operations necessary. Daily work requirements or schedules can then be prepared. Hourly or daily quantity reports, indicating actual production, should be compared with standard production requirements to aid in appraising the ability of foremen to meet the schedules. Allowed labor hours for each operation may be calculated from the actual production reports. Actual labor hours may be compared with standard hours to determine the hourly or daily efficiency variance by operation centers.

Cumulative schedules of actual and allowed hours may be prepared on a monthly basis. Conversion of the efficiency variances into monetary units may be made daily, weekly, or monthly.

Cost accountants are prone to overemphasize the importance of variances as reflected in the double-entry records. It is probably important for a works manager to know that the monthly direct labor efficiency variance is unfavorable by 800 hours at the standard rate of $1.50 per hour, but effective control requires more detailed data. Management must know which operations give rise to the variances and the reasons for the unfavorable showing. Clearly, this information should be available immediately, and daily summaries of variances by operations are desirable.

Needless to say, considerable tact and even salesmanship may be necessary for effective labor control. In some cases the loss in worker morale has more than offset the advantages of carefully devised plans for control, and the net result has been lowered employee efficiency.

Control of Wage Rates

The careful analysis and classification of each grade of labor is a necessary preliminary step. Education experience, skill, training, and special abilities are factors that should be given attention. Uniform classifications have been worked out for many lines of activity.

The determination of standard rates of pay for each grade constitutes the second step. Many industries operate under contracts with unions, and their rates are determined in advance for the term of the contracts. Schedules of rates for experience and seniority within the grade classes are often included in these contracts. Inasmuch as unions usually object to the shifting of workers to related jobs, the wage rate variance should not be large or important. If activity is below normal, employees with less seniority and lower rates of pay may be discharged, so that in such times the variance may show an unfavorable deviation from average standards.

If wage rates are set by individual bargaining, there may be wide variations within each grade. In most cases standards are little more than averages, and the resulting variances are of little aid in control.

Periodic schedules should be prepared of actual rates within each grade of labor. Such schedules often reveal a wide range of rates that should be investigated. Adjustments of out-of-line rates sometimes result in better employee morale. Comparisons should also be made with rates paid by other concerns for similar work.

B. Control of Plant and Machinery

The control of plant and machinery acquisitions should be sharply distinguished from the control of ordinary overhead costs.

The authority for purchasing expensive machinery and structures is normally vested with the directors. In many cases acquisitions costing less than agreed amounts may be authorized by the officers of the corporation. The responsibility for purchasing these items should be definitely designated in the by-laws of the organization.

The responsibility of departmental foremen, superintendents, and sales officials for the utilization of existing facilities is not independent of that of officers and directors, and in practice the separation is often difficult. In some cases the existing facilities are legacies from former officers and boards for which the existing personnel is in no way responsible. Many accountants, therefore, recommend analysis and appraisal of plant properties, with appropriate adjustments of the records when top-management replacements are contemplated. In any event the lines of responsibility for additions should be carefully defined.

The financial aspects of control are aided by the use of a budget. The typical business receives a flow of receipts from customers and disburses a stream of payments for the agents of production. With no profit or loss, operations should therefore provide a net increase in liquid assets equal to the depreciation, depletion, and amortization charges charged against operations. If there are numerous property units, the manager of a season plant may find the periodic cash requirements for replacement to be roughly equal to the periodic charge for depreciation.

Some concerns prepare special capital budget requests only when the cost of expected replacements exceeds depreciation and related charges. This procedure is objectionable. Budget estimates should be prepared for all expected capital replacements and additions, and all additions should be justified by careful replacement studies. The provision of funds is a problem for the treasurer and board, and should not influence the engineering studies except in so far as interest on investment must be considered. An intelligent approach requires the planning department to schedule desired replacements and additions according to necessity and expected profitability. The treasurer is then able to allocate available funds among the functional departments in a rational manner.

Machine Profitability Studies

It is the duty of production and cost executives to prepare studies indicating the desirability of asset exchanges and additions. In many cases careful estimates of expected demand are a necessary preliminary step.

When the problem involves a decision as to the profitability of acquiring either property A or property B, each of which performs similar tasks, the following factors must be given attention:

a. The relative cost of each unit.
b. Interest on the investment in each case.

c. Depreciation on each property.
d. Operating cost of each.
e. Output of each.
f. Possibilities of disposing of the differences in output.
g. Space and installation problems peculiar to each.
h. Expected outputs spoiled or damaged by each.
i. Differences in setup and other technical requirements.

Accountants are often perplexed by the factors required for the decision to exchange an existing asset. Careful studies indicating cost of operation, spoiled work, etc., of the existing machine are essential. These studies may be prepared as special assignments or they may be compiled from cost records. Many firms keep detailed cost records for each major machine. Labor and power costs, spoiled work losses, idleness from breakdowns, and other pertinent information must be collected and analyzed by units of machinery. Many managers feel the additional clerical work necessary for continuous records of this kind is justified. Other executives argue that studies of this nature are important only when improved units are available, or when specific existing units are defective and inefficient. In many cases foremen should be able to isolate inefficient productive assets without detailed records, and should be instructed to report such units for special observation and study.

It is sometimes difficult for accountants to understand that the book value of the existing machine is irrelevant to the exchange decision. Yet it should be obvious that mistakes in past depreciation charges, or even lack of any formal depreciation records, do not affect the decision. Some businessmen may, in fact, be influenced by the type of depreciation methods employed by their accountants, but, if so, they are not guided rationally.

Depreciation must be considered on the prospective unit and some depreciation may be required on the existing machine. If the existing unit has an exchange value at the calculation date of $5000, and if the exchange value a year later is expected to be $3600, depreciation of $1400 must be considered if the cost comparison covers a period of one year.

The comparative cost schedule may compare the profitability of exchanging at the present with exchanging one year in the future, or the schedule may be made to indicate the desirability of a current exchange compared with retaining the existing asset until it is normally exchanged or until major repairs are required.

Some accountants also fail to understand the use of interest in the comparative cost calculation. Interest should be calculated on the additional funds required to effect the exchange. For an accurate solution interest should also be included on the larger expected out-of-pocket cost of operating the old unit. In many cases the interest factor is relatively unimportant, and the refinements of compound interest are not justified. For practical purposes interest on the added investment at the current borrowing rate is probably sufficient.

For a simplified illustration, consider the following example. As the result of careful operating studies and estimates the following information is available.

It should be observed that the figures of $8000 and $6720 are not actually operating costs and are valuable only for comparative purposes. If there are no special space or financing problems, it seems desirable to make the exchange.

The above illustration is based on the assumption that the output of the new

	Existing Asset	*Prospective Asset*
Cost (New)	$10.000	$19,000
Depreciated to Date	4,000	——
Estimated Life (If New)	9 years	9 years
Exchange Value (at Present)	$ 2,000	——
Exchange Value (One Year from Date)	1,600	——
Scrap Value (at End of Nine Years)	1,000	$ 1,000
Operating Costs (Annually)	6,000	3,000
Loss on Spoiled Units (Annually)	1,600	700
Suitable Interest Rate—6%		
Annual Output	10,000* units	10,000 units

The following type of schedule is recommended:

	Existing Asset	*Prospective Asset*
Operating Costs (Yearly)	$ 6,000	$ 3,000
Loss on Spoiled Work (Yearly)	1,600	700
Depreciation (Yearly)	400	2,000
Interest on Additional Investment (6% on $17,000)	——	1,020
	$8,000	$6,720

machine is equal to that of the old. In many cases the capacities of the two differ widely. The usual procedure is to reduce the comparative costs to a unit basis, but such an approach neglects demand factors. If, for example, the existing machine produces all the units required to satisfy peak demand, larger capacities should not be considered in the calculation.

Demand factors complicate the accountant's work, but realistic solutions must consider such factors. The following procedure is recommended. The number of units of product needed each year over the remaining life of the existing machine must be estimated. The amount of revenues that will be lost if the old asset is retained should be determined. (The possibility of manufacturing for stock must be considered.) The excess of the expected additional revenues over the expected additional variable costs represents the "contribution" available for profits and fixed cost recovery that the larger machine makes possible. In the comparative study, as illustrated above, the "contribution" may be added to the "cost" of the existing asset, or it may be subtracted from the costs of the prospective installation.

Installation and removal charges offer further problems. Certainly interest on this kind of investment should be considered. If, as the result of making an immediate exchange, it becomes necessary over the life of the enterprise to make an installation and removal that would otherwise not be necessary, the cost of such activities should be prorated and included in the calculation. The proration period should ordinarily be the interval between the date of calculation and the date of usual asset retirement.

Plant Expansion

Decisions regarding plant expansion are usually the responsibility of the directors. Accountants are sometimes asked to prepare calculations to indicate the profitability of expansion and to provide the details for budgetary control.

Before the addition has been undertaken, all estimated costs to be associated with the work may be considered variable. The net increase in the concern's total revenues as a result of an expansion may be compared with the total costs of the addition. This approach is essentially economic and requires the use of discount formulas. An alternative procedure is based on an estimated annual stream of revenues compared with estimated annual additions in cost (including depreciation). If the excess of revenues is sufficient to provide a reasonable return on the additional investment, the expansion may be justified. A common modification computes the "pay out" period. Estimated annual revenues may exceed estimated costs (exclusive of depreciation) by an amount which is one sixth the cost of the expansion. If interest is neglected, the pay out period is six years.

In most cases requests to the budget department for authorization to make expenditures should include schedules showing estimated cost, estimated savings or profitability, sales value of salvaged and retired properties, and estimated cost of depreciation, taxes, etc.

Needless to say, periodic schedules should be prepared to indicate budget appropriations, expenditures, unexpended balances, overdrafts, etc., for each plant extension.

Control of Plant Repairs and Maintenance

The effective life of practically all depreciating assets depends on the repair and upkeep policy adopted. Depreciation rates and maintenance expenditures are not independent. During periods of unusual activity or restrictions, maintenance is sometimes curtailed. In some cases maintenance may be deferred without changing the useful life of depreciating assets. In other instances, curtailment of maintenance leads to accelerated depreciation.

The responsibility for maintenance is often divided. Production foremen are responsible for the efficient operation of their equipment and are responsible for reasonable care of their operating facilities. The maintenance foreman normally has little control over the usage of equipment, but he is responsible for keeping machinery and other facilities in sound condition at minimum cost and with minimum delays.

Some concerns establish standard costs and time allowances for each type of repair work. The performance of the maintenance foreman is measured against these standards. Normal repair work may be estimated and included in the flexible budgets of operating and service departments. In this manner it is possible to gauge the effectiveness of each function.

Repair orders should be initiated by the departmental foremen, and the charges should have their approval. Analysis of repair costs by machines is often desirable.

Plant Ledgers

Treasury Decision 4422 placed the responsibility for supporting depreciation charges directly on business management. Normally such a decision should not be a cause for excitement, but typical property records were unbelievably inadequate and slipshod, and the decision focused attention on a segment of accounting that was badly in need of rehabilitation.

The necessity for conforming to income tax decisions is one of many reasons for careful plant records. Records indicating asset locations and transfers are clearly

desirable. Repair and betterment costs scheduled according to units of property should prove useful. Original cost figures, estimates of useful life, and schedules of regular and accelerated depreciation should aid management to reach rational decisions. Records of installation and relocation costs form an integral part of property accounting. References to acquisition and retirement orders should simplify the work of the auditor.

Machine Idleness

Machine idleness offers an excellent opportunity for managerial control. Departmental idle capacity variances are useful in this connection, but the principal source of information is the idle machine report. Daily, weekly, or monthly records may be prepared to indicate the idle hours for each machine and to show the reasons for such idleness.

Responsibility for idleness is often diversified. Machine breakdowns may be due to faulty operators, to poor maintenance and upkeep, to improper materials, or to normal inefficiencies. Insufficient maintenance may be the responsibility of the maintenance superintendent, or it may be due to the inability of management to attract skilled maintenance men and proper supplies. Inferior materials may result from purchasing or engineering policies. Unskilled operators may be the result of the personnel policy for hiring and training, or the responsibility may be traced to lax foremanship.

Improper scheduling of work is often an important cause of idleness. Materials, dies, jigs, and other necessary agents are sometimes delayed and result in machine idleness. In other cases, the sales department is unable to procure sufficient orders to keep operations moving at capacity. Responsibility for lack of orders may rest with the sales department, but other possibilities should be investigated. The treasurer may have erred by limiting the advertising budget; top management may have adopted a policy of high prices and low output; directors may have over-expanded the facilities on the basis of optimistic expectations. The threads of responsibility are tightly interwoven, and the functions of modern business are interdependent.

The accounting department should keep careful records of idleness and should insist on explanations for such idleness.

C. Control of Spoiled and Defective Work

In some lines of activity the loss from defective and spoiled work is subject to control. Imperfect units should be examined to determine whether it is profitable to rework the product or whether it is desirable to dispose of the units as seconds or as scrap. For a general rule, imperfect units should be reworked if the variable cost of reworking is less than the difference between the sales revenue of perfect units and the revenue as spoiled work. If the calculation indicates that it is profitable to rework the units, the product is said to be defective. If it is unprofitable to incur reoperation costs on imperfect work, the units are "spoiled" and should be sold or scrapped. "Waste" and "scrap" are used interchangeably, but "waste" is often reserved to indicate scrap without value.

Typical cost accounting techniques sometimes fail to isolate the cost of spoiled work. Process accounting methods often automatically bury the cost of lost or spoiled units by adding such losses to the cost of the perfect units. Even if lost units are to be expected, it seems desirable to charge the cost of spoiled work to a separate account. This account may be closed to the regular production accounts if

the amount of spoilage is not excessive. The balance of the account should be treated as an outright loss unless some spoilage is a normal consequence of production.

Standards aid in the control of spoiled work. As a preliminary step management should make careful studies of normal spoilage and lossage, and these studies themselves should focus attention on the controllable features of production. The cost of allowed spoilage for each operation may be added to the standard cost of perfect units. The charge to the succeeding production account is made for the cumulative standard cost, including the cost of a standard amount of lost units. The credit to the current production account is composed of the actual units transferred at the standard unit cost without the allowance for lossage. The difference—standard cost of standard lossage—is credited to the lossage variance account. The standard unit cost (without an addition for lossage) of the actual units lost is charged to the lossage variance account. A debit variance is, of course, unfavorable, and a credit variance balance is favorable. Cumulative daily departmental scrap records often indicate variances from standards. Graphic comparisons of actual and standard lossage are sometimes presented.

The accountant's scrap and spoiled work report is sometimes objectionable. The typical calculation subtracts the sale or usage value from the cost of producing the units. For control purposes a modified calculation is recommended. In a very real sense the "loss" on spoiled work is not measured by the accountant's cost of such work. The loss, from a managerial viewpoint, is properly measured by the difference between the adjusted sales value of perfect units and the sales value of seconds or scrap.

To illustrate, suppose that 2000 units are spoiled during a cost period. The sales value of 2000 perfect units exceeds disposition costs by $6000. The average cost of 2000 units is $4000, and their sales value as scrap is $1000. Workers and foremen should be able to understand clearly the nature of the $5000 "loss." From the economist's point of view the cost—sacrifice—for which the foreman is responsible is certainly $5000.

The basic document for spoilage control is the spoiled and defective work ticket. These tickets may be prepared by the inspectors, cost clerks, foremen, or by personnel of a waste control section. The signature of the foreman responsible for the imperfect units should be required. In some cases responsibility must be shared by several foremen, but in all instances causes should be stated and investigated.

If reworking is a possibility, the superintendent, or other authorized individual, should be held responsible for the decision, and a reoperation ticket should be issued for defective work. A copy of this ticket should be sent to the department that is responsible, and another copy should be routed to the cost department. When reworking must be done by several departments, defective work orders should be sent to each, and operations should be scheduled so that the defective units join the regular work when reclamation is complete.

In some industries statistical programs for quality control have been developed to discover tendencies toward imperfections before they actually develop. Inspection by periodic sampling is a usual feature. Tolerances are established and the digression of actual samples from desired dimensions is examined carefully. In many cases it is possible to observe the tendency toward imperfect work from poor materials, machine drift, etc., before the units become defective or spoiled.

Chapter 8

VARIATIONS FROM STANDARDS AND TECHNICAL CONSIDERATIONS OF VARIATION ANALYSIS

By
CARL THOMAS DEVINE *

A. VARIATIONS FROM STANDARDS

As devices to aid in cost control the development of standards and the flexible budget are without equal. The cost accountant has had an important part in this development.

For some time there has been a strong tendency toward the incorporation of variances in the general ledger accounts. It is, of course, desirable to bring variations within the scope of trial balance control, but this feature alone is not important. The cost accountant's primary duty is to gather and to present variations so that the sources of both efficient and inefficient activity may be quickly ascertained and responsibility definitely determined. The accountant's work begins with gathering the fundamental tickets, reports, invoices, etc. Detailed summary sheets and reports must be compiled and presented to interested executives. The over-all variations that appear in the accounts of the typical cost system may be useful to top executives, but the detail that sharply correlates results with individual responsibility is usually found in the supporting schedules.

The materials price variance should be supported with schedules showing the variation for each type of material. Sometimes schedules are also prepared to show variations for important items according to purchase dates.

The materials usage variation may be supported by schedules showing the types of materials saved or wasted. Other schedules may indicate the workers responsible for the variance. A further report may indicate the losses in storage, in handling, and in operating departments. Those elements of the variation due to changes in product design, machinery changes, and differences in methods of processing may be shown. In certain industries a mix or yield variance may be isolated.

Some accountants isolate only one labor cost variance for each department or plant. Others prefer to use one variation for rates and another for efficiency. In both cases further detail is desirable, and the least that should be shown either in the accounts or in the supporting schedules is one variance for each department.

The wage rate variance may be caused by changes in the rate structure or changes in the grades of labor used. If a central personnel department is employed, reports showing the variations for each job classification may be more useful than a

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departmental breakdown. If considerable substitution of grades is permitted, a schedule of variances by departments is necessary.

A labor efficiency variance should be shown for each department, or appropriate departmental schedules should support the variation account. Additional reports may analyze the account according to types of labor.

Causes of labor inefficiencies are numerous. Changes in machine or product design may be important factors. Policies governing selection and training of personnel are sometimes responsible for large variances. Labor turnover must be considered. Fatigue and change-over factors are important.

In some cases output (quantity) reports are made hourly for each operation. Actual labor hours are compared with allowed hours and variations are shown for each department for each hour of the working day. Cumulative reports, covering days, weeks, and months, may be presented to foremen, superintendents, and other executives.

Labor standards may be applied to special orders. Operations should be standardized, and the allowed units of each operation should be specified for each order. The standard cost of each operational unit is determined from the standard operation rate sheets. The standard cost of the job should be determined by accumulating the standard cost of materials and operations required. If special orders require unusual operations, the actual cost may be compared with the estimates used in the bids.

Labor efficiency variances arising from special jobs may be reported for each job worked on during the period. Job cost sheets at standard with information as to variances may be summarized and reported. In many cases it is more important to support the over-all departmental efficiency variance by schedules indicating the types of labor or individual laborers responsible for the variation.

Overhead Variances

The flexible budget is the primary tool for overhead control. This type of budget usually includes only departmental burden items, and is prepared to cover operations at different levels of output. Moreover, a flexible budget is more than a forecast of burden costs; it is a schedule of allowed costs for different levels of output. This type of budget is, in fact, a set of standards arranged according to the natural or object classification of costs. Often the translation of budget standards into unit-cost standards is of less importance than careful analyses of variations from budget allowances.

With regard to the influence of capacity on variances there are several possibilities. Many accountants use standards based on expected actual operations. This procedure has some merit, but it has serious shortcomings. Unless production is unusually stable, expected actual standards require the use of flexible budgets to determine allowed overhead costs. A further disadvantage arises because of the necessity for revising the standard operation rate sheets each time the expected activity is changed. The measurement of overhead variances from allowed costs at expected levels of activity is especially objectionable when differences between actual and expected operations are important. It borders on the ridiculous, for example, to measure a departmental spending or budget variance from the allowed costs at 80% of capacity when actual operations are 100% of capacity.

Normal standards, set with regard to expected operations over the business

cycle, are also objectionable if they are not accompanied by a flexible budget. Long-term standard capacity estimates permit some stability in operation rate sheets, and they lose none of the advantages of expected actual standards if they are combined with flexible budgets. Basic standard cost systems of the earlier type have the advantage of showing both normal and current capacity estimates, but many systems do not recognize the presence of fixed costs by incorporating the sliding budget.

Several alternatives are available for isolating burden variances. Some accountants show a spending (budget) variation, an efficiency variation, and a capacity or utilization variance. Others prefer only a capacity variation and a controllable cost variance. A few isolate no figure for capacity, but show efficiency and budget variations. Some systems present only an over and under applied burden on the double entry records and reflect the variances as supplementary information.

As usual, variations should be correlated with responsibility and authority. Efficiency variances may be due to improper maintenance of machines, to inefficient workers, to inferior materials, or to other reasons. The efficiency variance is often assumed to be a measure of the foreman's stewardship, but in most situations it is necessary to analyze the variance for other influences.

Accountants are not in agreement as to the proper measure of the factory or departmental efficiency variation. If variances are not shown in the accounts, the efficiency reports may be expressed in hours or other units of time. Perhaps the most common measure is calculated by multiplying the hours saved or lost by the standard hourly burden rate. This measure includes an element of fixed cost and does not represent the direct overhead gain or loss due to efficient or inefficient factory operations. A third method of measure expresses the variance in terms of variable costs saved or lost.

Responsibility for the capacity variance is usually diversified. Calendar variations are perhaps not controllable. Changes in the demand for products and unbalanced plant capacity may be controllable in some degree. Controllable factors usually include lack of workers, instructions or tools, machine breakdowns, and inefficient scheduling.

Some accountants do not use an account to reflect the capacity variance. The allowed cost, as shown in the flexible budget, is ascertained for the actual hours of operations. The standard hourly rate is found by dividing the allowed burden by the actual hours. Efficiency and budget variances are shown in the accounts. Immediate efficiency control is facilitated by hourly or daily summaries of standard and actual hours. Other accountants feel that standard overhead cost rates should be established in advance for some level of capacity and that an account should indicate the amount of the capacity variance.

When three overhead variances are used in conjunction with a flexible budget, the volume (capacity) variance is usually measured in terms of fixed costs only. This variation may be interpreted as the proportional amount of fixed costs that were not utilized or were over utilized in the period. A debit balance of $1000, for example, may be explained as that part of the fixed costs which idleness failed to utilize. It may be argued that this type of measure is worse than useless because it obscures the nature of the variance. The important essentials of this variation may be shown clearly by schedules indicating the hours wasted and the causes of such waste.

If a volume variance is used, the calculation may be made by comparing the

allowed overhead for actual hours with the overhead applied—actual hours multiplied by the standard rate at the agreed capacity. The efficiency variance may be found by multiplying the difference between the allowed hours to produce the actual output and the actual hours by the standard burden rate at the agreed capacity. Inasmuch as the burden rate includes some fixed costs, the efficiency variance does not indicate the direct saving or loss resulting from efficiency factors. An alternative calculation measures the efficiency variance by the difference between the budgeted figures for actual hours and for allowed hours. This approach increases the capacity variance by the amount of fixed costs in the standard burden for the hours wasted. The budget variance is found by subtracting the actual overhead costs from the allowed overhead for the actual hours of operation.

The budget (spending) variance is often a composite of price and quantity variations. Detailed schedules should be prepared to show differences between allowed and actual costs for each object (natural) classification. The composite nature of the variance may be illustrated through the analysis of the heating cost. An unfavorable variation may be due to higher fuel prices, to failure to regulate temperatures, or to abnormal weather conditions. The variation for each type of cost should be analyzed carefully to isolate the underlying causes for the unexpected results.

A third procedure for presenting overhead variances uses only a volume variance and a "controllable expense" variance. The efficiency variation is actually combined with the budget variation. The allowed overhead cost is taken from the budget for the allowed hours to do the actual work. This allowed cost is the key to the solution. It is compared with actual burden costs to determine the controllable expense variance and is compared with the allowed hours at the agreed capacity standard rate to determine the volume variance.

The net effect of this type of two variance accounting is that the efficiency variation measured in terms of variable costs is combined with the budget variation. Supporting schedules should show necessary details for each object of expenditure.

Separate burden rates for fixed and variable overhead costs have been widely used by cost accountants. The fixed burden rate is established at estimated, normal, ideal, or some other level of capacity. The under-applied fixed burden is clearly the idle capacity variance measured in terms of fixed costs. A few accountants still insist that all costs should be charged to production, but an increasing number are insisting that management is better informed if only a portion of total costs is assigned to production and a portion is considered to be the cost of idleness.

The variable burden analysis should prove to be an effective instrument of control. A preliminary study should indicate the fixed core and variable element of each factory overhead cost. Further study may reveal standard allowances for each variable cost. So long as allowed variable costs remain constant per unit of output, the applied variable burden should represent the standard variable cost of actual output. If variable costs do not remain constant per unit of output, the usual procedure based on flexible budgets should be adopted.

B. Variance Analysis: Technical Considerations

Materials

The Overall Materials Variance for each item of stores is the difference between standard usage at standard prices and actual usage at actual prices: (SQ $\times$ SP —

AQ × AP). The quantity variance is found by multiplying the difference between standard quantities and actual quantities by standard prices. In equation form the materials quantity variance equals SP(SQ — AQ). The price variance is determined by multiplying the difference between standard prices and actual prices by actual quantities, that is, AQ(SP — AP). In each case total variances are found by adding similar variations for each type of direct materials. A convenient method of presentation follows:

(1) Type	(2) Standard Unit Cost	(3) Actual Unit Cost	(4) Standard (Allowed) Quantity	(5) Actual Quantity	Variances (6) Over-all (2) × (4) — (3) × (5)	(7) Quantity (2) × (4) — (2) × (5)	(8) Price (5) × (2) — (5) × (3)
1–17	$1.00	$1.02	5000	5100	* — $202.00	— $100.00	— $102.00
1–18	2.00	1.90	1000	980	+ 138.00	+ 40.00	+ 98.00
1–19	0.60	0.58	3000	3200	— 56.00	— 120.00	+ 64.00
					— $120.00	— $180.00	+ $ 60.00

* + indicates favorable variation.

Ratios may be used in connection with materials accounting. The over-all materials cost ratio is found by dividing actual cost by standard cost. The materials price ratio is computed by dividing actual unit cost by standard unit cost. The usage ratio is the result of dividing actual quantity by standard quantity. The over-all ratio is equal to the product of the price and usage ratios. If two are known, the third may be calculated without additional information. The over-all materials variance (in dollars) may be found by multiplying the standard materials cost by one minus the over-all ratio. A similar procedure yields the usage variance. The determination of the price variance by ratios involves an additional step. First, it is necessary to multiply the standard cost by one minus the price ratio. The product is then multiplied by the quantity ratio. The necessity for the additional multiplication may be demonstrated by simple algebra.

The definition of any price variance (as shown above) is AQ(SP — AP). One minus the price ratio multiplied by the standard cost may be expressed:

$$\left(1 - \frac{AP}{SP}\right) SC = \left(1 - \frac{AP}{SP}\right) SQ \times SP = SQ(SP - AP).$$

This is different from the definition in that the difference between standard price and actual price is multiplied by standard quantity instead of by actual quantity. But when SQ (SP — AP) is multiplied by the quantity ratio $\left(\frac{AQ}{SQ}\right)$, the expression becomes AQ(SP — AP), the definition of price variance.

A convenient form for showing materials variances and ratios follows:

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	Variances		
Type	Standard Unit Price	Actual Unit Price	$\frac{AP}{SP}$	Standard Quantity	Actual Quantity	$\frac{AQ}{SQ}$	Standard Cost	Actual Cost	$\frac{AC}{SC}$	Over-all (8) × [1 − (10)]	Quantity (8) × [1 − (7)]	Price (7) × (8) × [1 − (4)]
1–17	$1.00	$1.02	1.0200	5000	5100	1.0200	$5000	$5202	1.0404	− $202.00	− $100.00	− $102.00
1–18	2.00	1.90	0.9500	1000	980	0.9800	2000	1862	0.9310	+ 138.00	+ 40.00	+ 98.00
1–19	0.60	0.58	0.9667	3000	3200	1.0667	1800	1856	1.0311	− 56.00	− 120.00	+ 64.00
										− $120.00	− $180.00	+ $ 60.00

Labor

The over-all direct labor cost variance is equal to the standard cost less the actual cost, that is, SR × SH — AR × AH. The labor effectiveness (efficiency) variance for each type of direct labor is found by subtracting the actual time from the standard time and multiplying the difference by the standard rate: SR(ST — AT). The wage rate variance for each class of labor is determined by multiplying the difference between the standard rate and the actual rate by the actual time: AT(SR — AR). A convenient form for accumulating the information is given below.

(1)	(2)	(3)	(4)	(5)	Variances		
Operation Number	Standard Rate	Actual Rate	Standard (Allowed) Hours	Actual Hours	Over-all (2) × (4) — (3) × (5)	Effectiveness (2) × (4) — (2) × (5)	Wage Rate (5) × (2) — (5) × (3)
01	$1.00	$1.03	1000	1050	— $ 81.50	— $ 50.00	— $31.50
02	1.20	1.19	2000	1900	+ 139.00	+ 120.00	+ 19.00
03	1.50	1.52	3000	2800	+ 244.00	+ 300.00	— 56.00
					+ $301.50	+ $370.00	— $68.50

Ratios and basic standards may be used to aid the analysis of direct labor costs. Variances in dollars may be measured from basic or current standards. The following illustrations show variances from current standards and reflect other useful relationships.

Factory Overhead

The following information is used to illustrate the various methods of calculating departmental overhead variances:

	Department I	*Department II*
Capacity Hours	10,000	5,000
Capacity Overhead Cost	$30,000.00	$10,000.00
Actual Hours	9,000	5,200
Allowed Hours	9,100	5,100
Actual Overhead Cost	$28,000.00	$10,270.00
Allowed Overhead for Allowed Hours	28,050.00	10,150.00
Allowed Overhead for Actual Hours	27,900.00	10,300.00

When three overhead variances are used, the efficiency variance may be found by multiplying the difference between allowed hours and actual hours by the standard overhead rate, or it may be measured in terms of variable costs by taking the difference between the allowed cost for allowed hours and the allowed cost for actual hours.

(1) Operation Number	(2) Basic Standard Rates	(3) Current Standard Rates	(4) Actual Rates	(5) $\frac{CSR}{BSR}$ (3) ÷ (2)	(6) AR ÷ BSR (4) ÷ (2)	(7) AR ÷ CSR (4) ÷ (3)	(8) Basic Standard (Capacity) Hours	(9) Current Standard (Allowed) Hours	(10) Actual Hours	(11) CSH ÷ BSH (9) ÷ (8)	(12) AH ÷ BSH (10) ÷ (8)	(13) AH ÷ CSH (10) ÷ (9)
01	$0.80	$1.00	$1.03	1.2500	1.2875	1.0300	1000	1000	1050	1.00000	1.05000	1.05000
02	0.90	1.20	1.19	1.3333	1.3222	0.99167	2100	2000	1900	0.95238	0.90476	0.95000
03	1.00	1.50	1.52	1.5000	1.5200	1.0133	3200	3000	2800	0.93750	0.87500	0.93333

(1) Operation Number	(2) Current Standard (Allowed) Labor Cost	(3) Actual Labor Cost	(4) Over-all Labor Cost Ratio (3) ÷ (2)	Variances		
				Over-all [100% — (4)] × (2)	Usage [100% — (13)] × (2)	Wage Rate [100% — (7)] × (13) × (2)
01	$1,000.00	$1,081.50	1.08150	— $ 81.50	— $ 50.00	— $31.50
02	2,400.00	2,261.00	0.94208	+ 139.00	+ 120.00	+ 19.00
03	4,500.00	4,256.00	0.94578	+ 244.00	+ 300.00	— 56.00
				+ $301.50	+ $370.00	— $68.50

I. Three Variances: Efficiency Measured by SR(SH — AH).

(1) Department Number	(2) Standard Hours at Standard Rate	(3) Overhead Applied Actual Hours at Standard Rate	(4) Allowed Overhead for Actual Hours Worked	(5) Actual Overhead	Variances			
					Over-all (2) — (5)	Efficiency (2) — (3)	Volume (3) — (4)	Budget (4) — (5)
I	$27,300	$27,000	$27,900	$28,000	— $700	+ $300	— $900	— $100
II	10,200	10,400	10,300	10,270	— 70	— 200	+ 100	+ 30
	$37,500	$37,400	$38,200	$38,270	— $770	+ $100	— $800	— $ 70

II. Three Variances: Efficiency Measured by Variable Costs

(1) Department Number	(2) Standard Hours at Standard Rate	(3) Budgeted Overhead for Actual Hours	(4) Budgeted Overhead for Allowed Hours	(5) Actual Overhead	(6) Applied Overhead	Variances			
						Over-all (2) — (5)	Efficiency (4) — (3)	Volume (2) — (4)	Budget (3) — (5)
I	$27,300	$27,900	$28,050	$28,000	$27,000	— $700	+ $150	— $750	— $100
II	10,200	10,300	10,150	10,270	10,400	— 70	— 150	+ 50	+ 30
	$37,500	$38,200	$38,200	$38,270	$37,400	— $770	0	— $700	— $ 70

III. Two Variances: Efficiency and Budget

(1) Department Number	(2) Calculated Burden Rate Allowed Cost ÷ Actual Hours	(3) Standard Hours at Standard Rate	(4) Actual Hours at Standard Rate (Allowed)	(5) Actual Overhead	Variances		
					Over-all (3) — (5)	Efficiency (3) — (4)	Budget (4) — (5)
I	$3.1000	$28,210	$27,900	$28,000	+ $210	+ $310	— $100
II	1.9808	10,102	10,300	10,270	— 168	— 198	+ 30
		$38,312	$38,200	$38,270	+ $ 42	+ $112	— $ 70

IV. Two Variances: Volume and Controllable

(1) Department Number	(2) Allowed Hours at Standard Rate	(3) Allowed (Budgeted) Overhead for Allowed Hours	(4) Actual Overhead	Variances		
				Over-all (2) — (4)	Volume (2) — (3)	Controllable (3) — (4)
I	$27,300	$28,050	$28,000	— $700	— $750	+ $ 50
II	10,200	10,150	10,270	— 70	+ 50	— 120
	$37,500	$38,200	$38,270	— $770	— $700	— $ 70

Some of the early basic cost systems did not make use of flexible budgets. The following illustrations, based on the foregoing data, combine the use of ratios with the advantages of flexible budgeting.

The volume ratio is found by dividing actual hours at the standard overhead rate by the allowed cost for actual hours. It should be emphasized that this ratio is *not* calculated by dividing actual hours by capacity hours. The budget ratio is the quotient of actual overhead divided by the allowed overhead for actual hours worked. The efficiency ratio is determined by dividing allowed hours by actual hours. This ratio is unusual in that it uses actual hours for the denominator instead of for the the numerator.

V. Efficiency Variance with Ratios

(1) Department Number	(2) Actual Hours at Standard Rate	(3) Allowed Hours at Standard Rate	(4) Allowed Hours	(5) Actual Hours	(6) Efficiency Ratio (4) ÷ (5)	(7) Ratio of Variance (6) — 100%	(8) Efficiency Variance (7) × (3)
I	$27,300	$27,000	9100	9000	1.01111	+0.01111	+ $300
II	10,200	10,400	5100	5200	0.98077	− 0.01923	— 200
	$37,500	$37,400	14,200	14,200	——	——	+ $100

VI. Budget Variance with Ratios

(1) Department Number	(2) Actual Overhead	(3) Allowed Overhead for Actual Hours Worked	(4) Budget Ratio (Spending) (2) ÷ (3)	(5) Budget Variance Ratio (4) — 100%	(6) Budget Variance (5) × (3)
I	$28,000	$27,900	1.003581	— 0.003581	— $100
II	10,270	10,300	0.99709	+ 0.00291	+ 30
	$38,270	$38,200	——	——	— $ 70

VII. Volume Variance with Ratios

(1) Department Number	(2) Actual Hours at Standard Rate	(3) Allowed Overhead for Actual Hours	(4) Volume Ratio (2) ÷ (3)	(5) Variance Ratio (4) — 100%	(6) Volume Variance (5) × (3)
I	$27,000	$27,900	0.96774	— 0.03226	— $900
II	10,400	10,300	1.00971	+ 0.00971	+ 100
	$37,400	$38,200	——	——	— $800

Grade Yield Variance

The following illustration serves to indicate the method used to isolate variances due to yields below or above expectations:

1. Pounds Purchased		55,000
2. Cost of Purchase		$56,760
3. Expected Yields:		
Grade I	30%	
Grade II	50%	
Grade III	20%	
	100%	
4. Actual Yields:		
Grade I	11,000 lbs.	
Grade II	23,500 lbs.	
Grade III	20,500 lbs.	
	55,000 lbs.	
5. Standard Cost per Pound:		
Grade I	$1.25	
Grade II	1.00	
Grade III	0.70	
Weighted Average	$1.015	

Grade	(1) Standard Yield (%)	(2) Standard Expectation (lbs.)	(3) Actual Yield (lbs.)	(4) Standard Cost per lb.	(5) Standard Quantities at Standard Prices (2) × (4)	(6) Actual Quantities at Standard Prices (3) × (4)	(7) Over-all Cost Ratio (Actual Cost ÷ $51,600)	(8) Actual Cost Distribution (6) × (7)	Variances		
									Composite (5) — (8)	Yield (5) — (6)	Price (6) — (8)
I	30	16,500	11,000	$1.25	$20.625	$13,750	1.10	$15,125	+ $5,500	+ $6,875	— $1,375
II	50	27,500	23,500	1.00	27,500	23,500	1.10	25,850	+ 1,650	+ 4,000	— 2,350
III	20	11,000	20,500	0.70	7,700	14,350	1.10	15,785	— 8,085	— 6,650	— 1,435
	100%	55,000	55,000	$1.015	$55,825	$51,600	——	$56,760	— $ 935	+ $4,225	— $5,160

Gross Profit Variations

Cost analysis has rapidly expanded to include variations between planned and actual profit. The illustration below is based on the recommendations of Camman.

	Basic Standard %	Standard Amounts	Expected Results Amounts	Expected Results Ratio to Basic	Actual Results
Sales	100	$200,000	$199,500	(a) 105%	$204,000
Factory Cost of Sales	60	120,000	102,600*	(b) 90%	109,000
Margin	40%	$ 80,000	$ 96,900	——	$ 95,000
Volume				(c) 95%	
Basic Standard Cost			$114,000		$108,000

(a) Expected Price Level
(b) Expected Cost Level
(c) Expected Volume Level
Unexpected Margin decline to be accounted for is $1900.

The unexpected decline in gross profit is accounted for as follows:

	Favorable	*Unfavorable*
Due to Volume (see Later Comment)		$ 5,277.78
Due to Prices Above Expectations	$15,000.00	
Due to Costs Above Estimates		11,800.00
Incidental: Price	833.33	
Incidental: Volume		655.55
Total Variances	$15,833.33	$17,733.33

Unfavorable	$17,733.33
Favorable	$15,833.33
Margin Decline	$ 1,900.00

The Variations are calculated below.

Ratios:

Volume Ratio = Actual Volume ÷ Standard Volume = $108,000 ÷ $120,000 = 0.900000

Expected Volume Ratio = Expected Volume Ratio ÷ Actual Volume Ratio = .95 ÷ .90 = 1.055556.

Actual Price Level Ratio = Actual Sales ÷ Kindred Sales = $204,000 ÷ $180,000 = 1.13333.
(Kindred Sales = $108,000 ÷ 60% = What sales would have been if standard margins had prevailed)

Actual Cost Ratio = Actual Cost ÷ Basic Standard Cost for Actual Volume = $109,000 ÷ $108,000 = 1.009259.

Expected Margin Ratio = Expected Margin ÷ Basic Standard Cost of Expected Volume = $96,900 ÷ $114,000 = 0.850000.

Actual Margin Ratio = Actual Margin ÷ Basic Standard Cost of Actual Volume = $95,000 ÷ $108,000 = 0.879629.

Volume Variance:

Standard Cost of Expected Sales	$ 114,000
Standard Cost of Goods Actually Sold	108,000
Decrease in Volume (at Standard Cost)	$ 6,000
Actual Margin Ratio (Multiply)	0.8796296
Volume Variance (Loss)	$ 5,277.78

It should be observed that Camman's volume variance is unusual because the actual margin per unit is used to "weight" the difference between expected volume and actual volume. This strange definition of the volume variance makes necessary the use of incidental variances. In the terminology of ordinary standards the volume variance is found by multiplying standard margin per unit by the difference between standard volume and actual volume.

Price Level Variance:

Actual Price Level Ratio	1.13333
Expected Price Level Ratio	1.05000
Price Variance Ratio	.08333
Kindred Sales	$180,000
Price Variance Ratio (Multiply)	0.08333
Variance due to Unexpectedly Higher Prices (Favorable)	$ 15,000

Cost Variance:

Actual Cost Ratio	1.009259
Expected Cost Ratio	0.900000
Cost Variance Ratio	0.109259
Basic Standard Cost of Actual Volume	$108,000
Cost Variance Ratio (Multiply)	0.109259
Cost Variance (Unfavorable)	$ 11,800

Incidental Variances:

Expected Volume at Basic Cost	$114,000.00
Actual Volume at Basic Cost	108,000.00
Decrease at Basic Cost	$ 6,000.00
Expected Margin Ratio (Multiply)	0.85000
Expected Profit Lost by Decrease	$ 5,100.00
Actual Profit Lost by Decrease	5,277.78
Incidental Variance (Favorable)	$ 177.78

The incidental variance is a combination of volume and price variance. The variance may be expressed as follows:

$$(EV - AV)\ [(ESP - ECP) - (ASP - ACP)], \text{ where}$$

EV = expected volume
AV = actual volume
ESP = expected sales price
ECP = expected cost price
ASP = actual sales price
ACP = actual cost price.

The incidental variance is analyzed as follows:

Kindred Sales of Decreased Volume = $6,000 ÷ 60% =	$10,000
Price Variance Ratio (Multiply)	0.083333
Price Variance on Decreased Volume (Favorable)	$833.33
Decrease in Basic Standard Cost	$6,000.00
Cost Variance Ratio (Multiply)	0.109259
Cost Variance on Decreased Volume (Unfavorable)	$655.55

Gross Profit Variations: Discounts and Varieties

Harrison has developed techniques to isolate variances due to the fact that discounts and actual sales by lines are different from the estimates of the master plan. The following illustration is adapted from Harrison's work.

	Line A	Line B	Other Lines	Total
Planned:				
List Sales	$35,950.00	$72,700.00	$111,350.00	$220,000.00
Net Sales, % of List	47%	52%	55%	52.70%
Net Sales	$16,896.50	$37,804.00	$ 61,242.50	$115,943.00
Factory Cost of Sales, % of List	27%	25%	28%	26.84%
Factory Cost of Sales	$ 9,706.50	$18,175.00	$ 31,178.00	$ 59,059.50
(R) Gross Profit	$ 7,190.00	$19,629.00	$ 30,064.50	$ 56,883.50
Gross Profit, % of List	20%	27%	27%	25.86%
Actual:				
List Sales	$37,290.00	$70,150.00	$109,560.00	$217,000.00
(A) Net Sales	$18,570.00	$34,695.00	$ 55,675.00	$108,940.00
(K) Factory Cost of Sales	$10,441.20	$15,783.75	$ 32,868.00	$ 59,092.95
Factory Cost of Sales, % of List	28%	22½%	30%	27.23%
(P) Gross Profit	$ 8,128.80	$18,911.25	$ 22,807.00	$ 49,847.05

Harrison uses the following symbols:

A = Actual Net Sales
C = Planned Sales on Actual List Basis
K = Actual Factory Cost of Actual Sales
O = Planned Factory Cost of Actual List Sales

P = Actual Gross Profit = (A — K)
R = Planned Gross Profit
T = Planned Gross Profit on Basis of Actual List Sales = (C — O)
W = Planned Gross Profit on Basis of Planned Percentage of Lines

Then:

(P — R) = Gross Profit Variations (composite)
(O — K) = Cost Variances
(T — W) = Variety Variances
(A — C) = Sales Price Variances
(W — R) = Sales Volume Variances

And:

$$(P - R) = (Q - K) + (T - W) + (A - C) + (W - R)$$

Of the necessary calculations, A, K, P, and R are given above. The additional requirements are calculated below.

	Line A	Line B	Other Lines	Total
(C) Planned Sales on Actual List Basis, e.g., $37,290 × 47%, etc.	$17,526.30	$36,478.00	$60,258.00	$114,262.30
(O) Actual List Sales at Planned Factory Cost, % of List, e.g., $37,290 × 27%, etc.	10,068.30	17,537.50	30,676.80	58,282.60
(T) Planned Gross Profit on Actual List Sales, e.g., $37,290 × 20%	7,458.00	18,940.50	29,581.20	55,979.70
(W) Planned Gross Profit on Actual List Sales distributed according to the Planned % by Lines *	7,091.56	19,364.00	29,652.40	56,107.96

* Calculation for Line A:
$35,950 ÷ $220,000 = 16.34%
$217,000 × 16.34% = $35,457.80
$35,457.80 × 20% = $7,091.56

	Line A	Line B	Other Lines	Total
Composite Gross Profit Variances:				
(P) Actual Gross Profit	$ 8,128.80	$18,911.25	$22,807.00	$49,847.05
(R) Planned Gross Profit	7,190.00	19,629.00	30,064.50	56,883.50
	+$ 938.80	— $ 717.75	— $ 7,257.50	— $ 7,036.45
Cost Variances:				
(O) Actual List Sales at Planned Factory Cost, % of List	$10,068.30	$17,537.50	$30,676.80	$58,282.60
(K) Actual Factory Cost of Sales	10,441.20	15,783.75	32,868.00	59,092.95
	— $ 372.90	+$ 1,753.75	— $ 2,191.20	— $ 810.35

Variety Variances:				
(T) Planned Gross Profit on Actual List Sales ...	$ 7,458.00	$18,940.50	$29,581.20	$55,979.70
(W) Planned Gross Profit on Planned Lines	7,091.56	19,364.00	29,652.40	56,107,96
	+$ 366.44	−$ 423.50	−$ 71.20	−$ 128.26
Sales Price Variances:				
(A) Actual Net Sales	$18,570.00	$34,695.00	$55,675.00	$108,940.00
(C) Actual Net Sales at Planned Discounts .	17,526.30	36,478.00	60,258.00	114,262.30
	+$ 1,043.70	−$ 1,783.00	−$ 4,583.00	−$ 5,322.30
Sales Volume Variances:				
(W) Planned Gross Profit on Planned Lines	$ 7,091.56	$19,364.00	$29,652.40	$56,107.96
(R) Planned Gross Profit ..	7,190.00	19,629.00	30,064.50	56,883.50
	−$ 98.44	−$ 265.00	−$ 412.10	−$ 775.54

Gross Profit Variation: Period to Period

The analyst is sometimes asked to isolate variances from period to period without the help of standards. The resulting analyses, when applied to manufacturing operations, are subject to severe criticisms. The cost variances are based on the assumption that all costs are variable, and the cost price variance is a mixture of efficiency and cost price factors. However, the following procedures may be useful for executives of departmentalized trading concerns.

The techniques of ordinary standards may be used if the results of the earlier period are considered to be standards and the results of the later period are treated as actuals. It is sometimes convenient to estimate the change in selling prices for each department. In other cases it is more convenient to determine changes in volume. In a few instances, it is less difficult to estimate the change in cost prices. The following illustration assumes that selling prices in 1947 were 120% of selling prices in 1946.

Department		*1947*	*1946*
A	Sales	$240,000	$210,000
	Cost of Sales	180,000	190,000
	Gross Profit	$ 60,000	$ 20,000

Dept.	(1) 1947 Sales	(2) 1946 Sales	(3) Ratio of 1947 Sales Price to 1946 Sales Price	(4) 1947 Volume at 1946 Prices (1) ÷ (3)	(5) 1947 Cost of Sales	(6) 1946 Cost of Sales	(7) Ratio of 1947 Volume to 1946 Volume (4) ÷ (2)	(8) 1947 Volume at 1946 Cost Prices (6) × (7)	Variances				
									Over-all [(1) — (5)] — [(2) — (6)]	Sales Price (1) — (4)	Sales Volume (4) — (2)	Cost Price (8) — (5)	Cost Volume (6) — (8)
A	$240,000	$210,000	1.20	$200,000	$180,000	$190,000	0.95238	$180,952	+ $40,000	+ $40,000	— $10,000	+ $952	+ $9,048

Periodic Gross Profit Analysis: Variety Variation

Throughout the preceding illustration it was assumed that only one product was sold in each department. The following procedures may be used when there is also a variety variation and when sales by units are available.

	Units 1947	*1947 Sales*	*1947 Factory Cost of Sales*
Tables	1,200	$24,000	$18,000
Chairs	2,700	8,100	4,050
Benches	900	9,000	5,400
	4,800	$41,100	$27,450

	Units 1946	*1946 Sales*	*1946 Factory Cost of Sales*
Tables	1,500	$27,000	$23,000
Chairs	3,000	12,000	4,500
Benches	400	6,000	3,000
	4,900	$45,000	$30,500

Volume Variance:

(Gross Profit per Unit in 1946 ($14,500 ÷ 4900) = $2.9592)

1947 Units Sold at 1946 Average Profit = 4800 × 2.9592 =	$14,204
Actual Gross Profit 1946	14,500
Sales Volume Variance (Unfavorable)	$ 296

Cost Price Variance:

1947 Units at 1947 Costs:	
(1200 × $15) + (2700 × $1.50) + (900 × $6) =	$27,450
1947 Units at 1946 Costs:	
(1200 × $15–1/3) + (2700 × $1.50) + (900 × $7.50) =	29,200
Cost Price Variance (Favorable)	$ 1,750

Sales Price Variance:

1947 Units at 1947 Prices:	
(1200 × $20) + (2700 × $3) + (900 × $10) =	$41,100
1947 Units at 1946 Prices:	
(1200 × $18) + (2700 × $4) + (900 × $15) =	45,900
Sales Price Variance (Unfavorable)	$ 4,800

Sales Variety Variance:

1947 Units Sold (Actual Lines) at 1946 Prices:		
Tables 1200 @ $18.00 =	$21,600	
Chairs 2700 @ $4.00 =	10,800	
Benches 900 @ $15.00 =	13,500	$45,900
Less 1947 Units Sold at 1946 Cost Prices:		
Tables 1200 @ $15.33-1/3 =	$18,400	
Chairs 2700 @ $ 1.50 =	4,050	
Benches 900 @ $ 7.50 =	6,750	29,200
Gross Profit for 1947's Units at 1946's Costs and Prices		$16,700
Average Profit on 1947's Units at 1946's Rate (see above)		14,204
Sales Variety Variance (Favorable)		$ 2,496

Summary of Variances:

	Favorable	*Unfavorable*
Volume Variance		$ 296
Cost Price Variance	$1,750	
Sales Price Variance		4,800
Sales Variety Variance	2,496	
	$4,246	$5,096
Total Unfavorable	$5,096	
Total Favorable	4,246	
Net Decrease in Gross Profit	$ 850	

The above analysis is slightly objectionable because volume is measured in terms of units regardless of the nature of the units. Thus, if 100 wrenches were sold in one period and 100 boilers were sold in the following period, no volume variance appears. A desirable modification measures volume changes in terms of dollars of sales. This procedure results in the following volume and variety variances.

Actual Units Sold in 1947 at Individual Gross Profit Rates in 1946		$16,700
1947 Units at 1946 Prices (as above)	$45,900	
1946 Over-all Gross Profit Percentage:		
14,500	0.32222	
45,000		14,790
Sales Variety Variation (Favorable)		$ 1,910
Sales Volume Variation:		
1947 Actual Units at 1946 Prices at Average 1946 Gross Profit Rate		$14,790
Actual Gross Profit in 1946		14,500
Volume Variance (Favorable)		$ 290

Chapter 9

COST ACCOUNTING AS A MEANS OF FORECASTING AND PLANNING

By

CARL THOMAS DEVINE *

The hope for profits is undoubtedly the primary motive for business activity. In view of this simple fact it is difficult to believe that systematic profit planning (engineering) is a comparatively new development. Cost accountants have made substantial contributions to this development and remain today as a major group interested in the refinement of techniques and methods for profit control.

Long-range planning is necessary for the setting of normal burden standards. Markets must be estimated for years in advance, and the economic usefulness of long-lived assets must be appraised. Population and income trends must be examined, and the pattern of competition must be anticipated. The possibility of new and more economical production and marketing methods should be weighed. The cost accountant has important functions to perform in practically all planning of this nature. He is asked to make calculations and estimates, and he is required to keep records to indicate the degree of attainment that has been accomplished.

In many industries long-term markup standards are established for each product. Attention is focused on short-run factors by the use of supplementary standards for current performance. Thus, management is assisted in its planning function by being required to prepare detailed estimates and by having the results and trends of past activity available.

Variety or mix standards for gross profit planning require careful estimates of consumer preferences, purchasing power, competing products, and other factors. The cost accountant's variety variance should indicate which lines are not attaining expectations and which products are gaining in sales appeal. The search for the causes of such variations should carry its own rewards. Finished stock records and distribution costs by lines of products should contribute data to aid in long-term profit control.

Discount variances and distribution costing by sales channels should yield valuable information as to the methods of distribution that are below or above expectations and indicate the profitability of each method.

Controlled studies of the results from various types of selling and advertising techniques are, at least, recorded and summarized by the cost accountant.

Required estimates showing the expected savings resulting from asset acquisitions should lead to more careful consideration of the long-run expansion program of the concern. Cost and other accounting should reflect the sales trends of various products and thus help management plan the direction of expansion or contraction.

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The Budget as an Aid to Forecasting

The development of budgetary control stands as a landmark in the field of administration. The budget sets forth the course to be pursued, and it acts as an effective instrument to direct the activities of the business along that course. Careful planning is a necessary preliminary step, and coordination of the various business functions for the achievement of a common goal is a fundamental requirement. Moreover, the budget serves as a standard by which actual performance may be appraised.

One of the primary functions of a budget is to act as a device to systematize the planning and control features of management. The budget exerts an influence that practically compels management to study sales possibilities, production methods, and financial policies.

In many cases the budget period covers a relatively short interval, usually one season or a year. In a few instances the budget period covers many years, and budget standards are regarded as long-range goals. Many companies operate with long-term budgets modified by current estimates to provide for seasonal and even cyclical influences. This procedure sometimes finds expression, at the accounting level, through the use of basic and current standards. Regardless of the length of the specific budget period the required thinking about fundamental business policies should improve the profit position of the enterprise.

Many small businesses place the responsibility for budget preparation and control on the accounting department. While accountants are willing to accept such responsibilities, they normally do not have the authority to influence the policies of executives in charge of other functions. The accounting department, therefore, should act for the top executive or for a budget committee composed of executives from all major departments.

The duty to coordinate departmental budgets and to insist on conformance with the over-all plan is usually assumed by a budget master or director. The controller, as a staff executive, has recently been assuming additional responsibilities as a coordinator. His technical abilities and his general knowledge of all functional divisions of the business qualify him for the duties of the typical budget director.

Departmental budgets are normally prepared by departmental executives with the advice of the budget director. Each executive should understand the objectives of the major plan and should be encouraged to direct his own activities toward fulfilling this plan. Each executive should derive benefit from planning his operations and should feel responsible for attaining his estimates. Cooperation may be seriously weakened if departmental budgets are prepared by the budget committee without advice from those who are expected to receive guidance from the estimates.

Fixed-Variable Cost Analysis

It is necessary to divide costs into their fixed and variable elements before profit planning is attempted. Some costs are fixed in total regardless of the volume of activity. These fixed costs often change from period to period. Insurance rates on plant buildings can and do change; property taxes vary with the policies of governmental units; officers' salaries are not frozen. From an accounting standpoint the distinguishing feature of fixed costs is that they do not vary with output. The fixed cost concept is confusing in other ways. The fixed costs of keeping a firm

ready for operation are clearly different from those of a concern that is boarded up for a long shutdown. Moreover, changes in plant facilities bring about changes in fixed costs.

Variable costs are influenced by production. Some variable costs remain constant per unit of output; others increase at increasing or decreasing rates as production is stepped up. The accountant usually assumes that all variable costs vary a constant amount per unit of production. This assumption is sometimes justified, but in other cases it fails to represent fairly the estimates of the flexible budgets.

Many costs are composed of both a variable and a fixed element. The amount of the charge varies with production, but the charge does not cease when production is reduced to zero. The fixed element may sometimes be estimated from the data of the flexible budget. Often, however, independent methods must be employed.

The variable element of cost may be related to units of output, to labor or machine hours, to direct labor cost, or to percentages of capacity. If the normal markup is the same for all products, variable costs may be related to revenues. A linear, or straight-line, relationship is usually assumed. Several representative periods may be used as the basis for the calculation. The following information is given for illustrative purposes.

	Indirect Materials Cost	*Direct Labor Hours*
January (1)	$1000	1800
February (2)	700	900
March (3)	1100	2000
April (4)	1050	1950
May (5)	1300	2400
June (6)	1200	2200

The cost to be analyzed is plotted on the vertical axis, and labor hours (or other measures of output) are expressed by the horizontal scale. In most cases the points form a pattern which may be generalized by an estimating line. The intersection of the estimating line with the vertical axis indicates the estimated indirect materials cost at zero activity. The increase in cost for each direct labor hour may be approximated from the chart.

This method of analysis is sometimes used to aid in the construction of departmental flexible budgets. If the results are to be used to determine allowed costs for foremen, more elaborate methods of determining the estimating line should be employed. The method of least squares is often used for this purpose.

Each item of overhead cost should be divided into its fixed and variable parts. Direct materials and direct labor costs are ordinarily assumed to be variable. The cost formula for the organization may be found by combining all elements of fixed costs and all elements of variable cost. The general cost formula is expressed:

$$\text{Total Cost} = \text{Fixed Cost} + \text{Variable Cost}$$

A specific cost formula may be:

$$\text{Total Cost} = \$30{,}000 + \$2.40 \text{ per Direct Labor Hour}$$

If each dollar of sales at standard markup requires one-sixth of an hour of direct labor, the formula may be stated:

$$\text{Total Cost} = \$30{,}000 + 40\% \text{ of Revenues}$$

The above information may be used for many purposes. The general expression for profit planning is:

Required Revenues = Fixed Cost + Variable Cost + Required Profit

The sales volume required for a profit of $15,000, to continue the illustration, may be found from the following expression.

Required Revenues = $30,000 + 40% of Revenues + $15,000

The necessary volume is evidently $75,000.

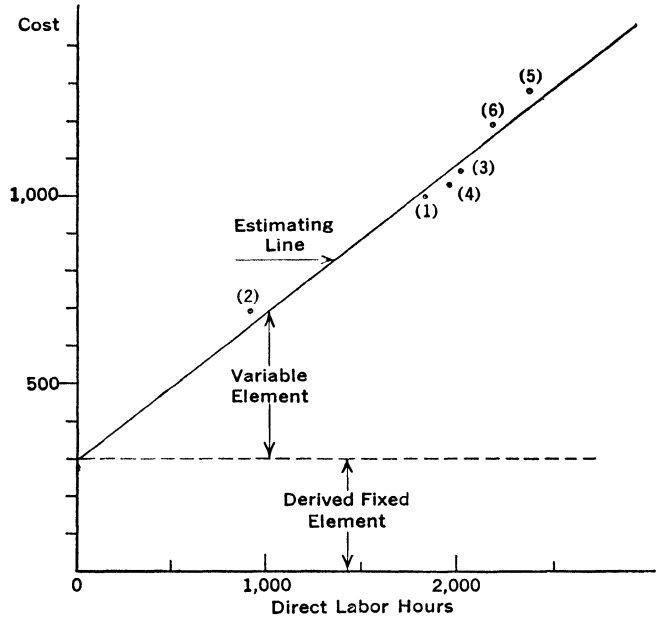

Chart A.

These relationships may be used to aid in the solution of many problems of planning. For example, a contemplated addition to the plant may increase the fixed costs by $10,000 and decrease variable costs to 30% of sales. The expected profit from a sales volume of $75,000 may be quickly estimated by making appropriate changes in the calculating equation. The required sales for any desired profit may also be approximated. The effect of price changes on profit expectations may be found by means of the estimating equation. Only the percentage of variable costs to sales requires modification.

The Profit-Volume Ratio

The well-known profit-volume ratio (P/V) of Stevenson, Jordan, and Harrison is a similar device. A P/V ratio of 30% indicates that each dollar of sales covers its variable costs and contributes $0.30 toward the recovery of fixed costs and the formation of profit. The profit-volume ratio is a useful summary of fundamental relationships and provides a framework for effective profit control. In general a high ratio is better than a low one. Variations in the ratio may be analyzed from the standpoint of products, types of customers, size of orders, methods of sale, and

territories. The ratios may be improved by reducing variable costs or by increasing sales prices. The over-all ratio may be improved by changing the composition of sales so that a larger proportion is accounted for by varieties, territories, etc., that carry higher individual ratios.

The profit-volume approach recognizes that the intricate assignments of fixed costs to territories, products, types of customers, etc., serves little useful purpose. The assignment of the president's salary to sales districts, for example, does not aid in the control of the salary cost nor does it indicate whether the territories should be abandoned or expanded. A given district may show a large loss after distribution of central management costs, but its sales may cover variable costs and make a substantial contribution toward the recovery of general fixed costs. Unless there are more profitable ways of utilizing central management facilities, there is no case for abandoning the district. Furthermore, it does not follow that selling pressure should be intensified in those territories that show a profit after the distribution of fixed costs.

The Profit Chart as a Planning Device

From one point of view the profit chart is a graphic expression of the master profit budget in flexible form. Normal relationships of profit, prices, and volume are presented without detail so that the characteristics of the master plan can be quickly grasped and the probable consequences of changes in the plan can be readily computed.

The simplest form of profit chart shows costs, revenues and profit on the vertical axis and measures volume along the horizontal scale. The following chart is illustrative.

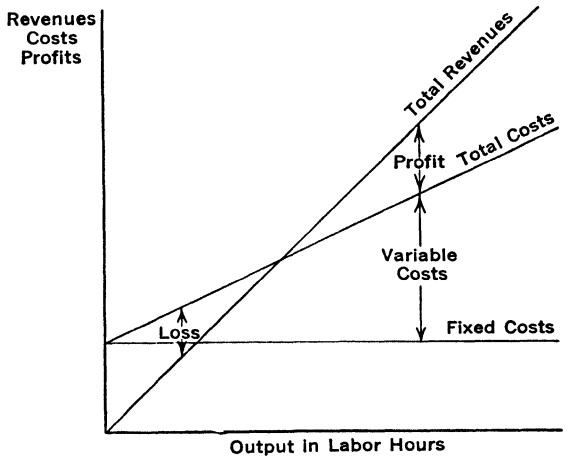

Chart B.

This chart is useful in many ways. The required volume to produce a desired profit is found by selecting the spread between total costs and revenues that represents the desired profit and reading the volume from the horizontal scale. The expected profit for a given volume requires a measure of the spread between total costs and total revenues directly above the expected volume.

The profit chart may be expanded to reflect the factory profit, the usual accounting profit, the profit after bond interest, and excess income above a normal return on investment. The following chart is self-explanatory.

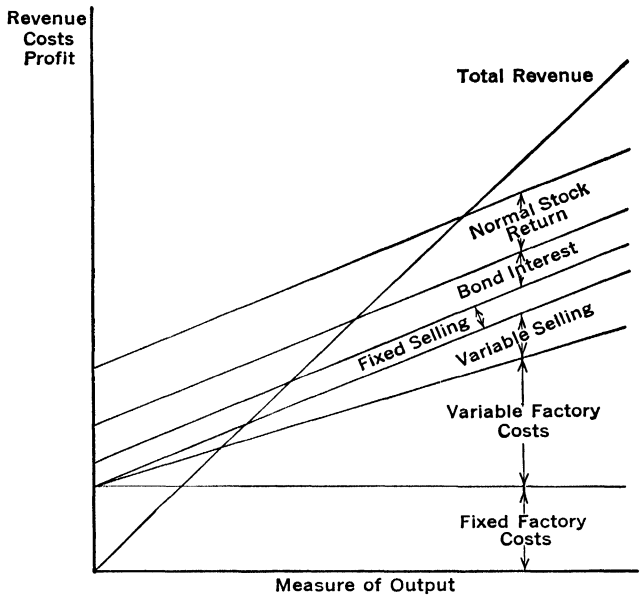

Chart C.

The breakeven point has received considerably more attention than it deserves. Some accountants and businessmen have placed so much emphasis on breakeven volume that profit charts are often known as breakeven charts. It is obvious that there are many breakeven volumes. Moreover, emphasis on no-profit, no-loss operations tends to limit the usefulness of profit charts as planning devices.

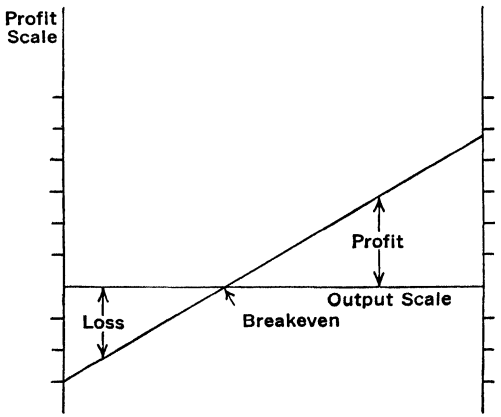

Chart D.

It is sometimes useful to simplify the profit chart by showing only the profit line. The chart above is illustrative.

The simplified graph may be used to show changes in profit possibilities due to increases or decreases in prices. A separate profit line is constructed for each alternative price. At zero operations the amount of the loss is equal to the fixed costs, and all profit lines begin at this point. A similar chart may be used with one price combined with differences in variable and fixed costs. The effects of changes in wage rates may be illustrated by this type of diagram.

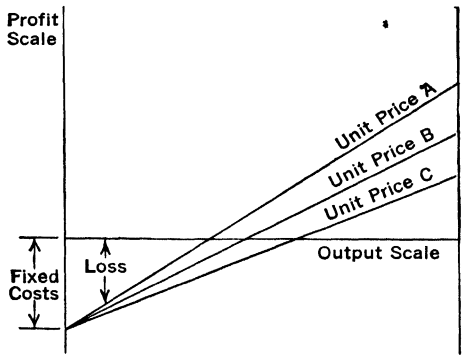

Chart E.

Limitations of Profit Charts

Businessmen often place emphasis on sales volume and disregard the effects of volume on profit. The profit chart should aid in the correction of this attitude, but unfortunately emphasis on volume is sometimes increased by the use of improperly prepared charts.

Practically all profit charts are based on the assumption of a proportional or linear relationship of variable costs to sales. As a result the reader is often justified

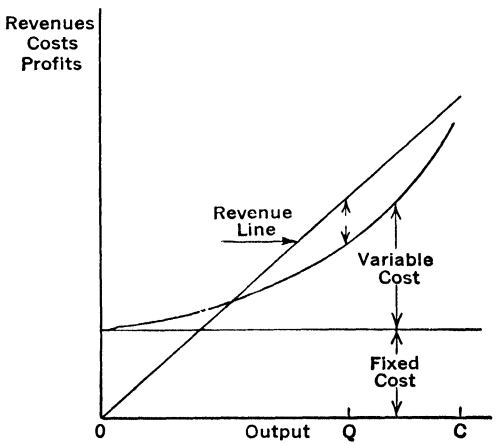

Chart F.

in believing that the largest net profit results from operations at full capacity. It is true that planned selling prices may remain constant, but it must be recognized that large increases in units sold often require reductions in sales prices or substantial increases in selling costs. The effects of reduced selling prices may be shown by profit charts with lines for each probable price. The presentation of variable costs that increase at an increasing rate is more difficult.

The above chart recognizes that variable cost per unit of sales increases rapidly as sales are increased. A constant sales price is assumed. The most profitable output is represented by OQ and not by OC, which indicates plant capacity.

Chapter 10

WHAT COST FACTS MANAGEMENT MUST HAVE

By
C. W. SARGENT *

The purpose of this discussion is to describe and illustrate the nature of the cost data presented to factory, marketing, and general executives. It is not the intention at this point to discuss the problems and principles of proper presentation of cost data, but rather to elaborate on the function of cost accounting in management by showing the kind of cost facts executives find it desirable to have.

The presentation of cost facts to responsible executives is a major responsibility of the cost accountant, and therefore a moment will be spent in discussing the tools of the cost accountant, in order that this main task may be given the proper setting.

The Tools of the Cost Accountant

Cost accounting is a process of reasoning about expenditures and performance in each of the activities of an enterprise. The major intellectual instruments used are:

1. Analysis—the various processes of classification, summarization, distribution, apportionment, and allocation, by which orderliness, form, and arrangement are given to the current cost facts of business operations.
2. Comparison—the process of identifying and contrasting the data of the current period with:
   - Historical facts computed in past periods.
   - Cost standards, compiled in advance of operations as a measuring and control device.
   - Budgets, predetermined as an operating plan and guide.
   - Any other comparable facts arising from special cost investigations, trade association statistics, or elsewhere.

Analysis and comparison are the major faculties required of the cost accountant, as they are in other professions. The cost accountant must compile, examine, sift, and review the facts—historical, current, and prospective—of each cost situation. He must understand, digest, and compare them, and know the operating circumstances and conditions from which they arise.

The major technical instruments of the accountant for collecting and analyzing cost data are:

1. Formal cost procedures—using
   - Historical methods
   - Standard methods
2. Cost studies, outside the formal cost system

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Fundamental differences exist between the two types of formal cost procedure as to the development of the comparative aspects of the records. Cost standards are utilized in the second type of procedure, and are absent from the first. Standard cost procedure, which necessarily involves the accumulation of current actual cost data, is therefore more comprehensive in the material made available for comparison.

Cost studies, made in addition to the formal cost methods, are an invaluable source of cost data. Through these studies the cost accountant cooperates with all phases of management in developing the data for managerial control and cost reduction. Naturally, participation in the preparation and use of budgets and cost standards is a part of the cost accountant's contribution to cost reduction. Any degree of control established by these instruments must result in improving the output, cutting the expenditure, or both. These instruments are so important from the cost control point of view that they are frequently incorporated, to some degree, in the formal cost procedures.

In connection with the development and use of the other control instruments—policies and stabilization of operating practices and conditions—an important opportunity to contribute to the effort toward cost reduction appears. The cost aspects of these instruments are not to any degree incorporated in formal cost procedures. The problem is, through special studies, to arrive at the comparative cost of one policy as compared with another, of one operating method as compared with alternative methods. Data available through formal records are often a starting point for such studies, but they invariably involve the consideration of cost determinants not present in the historical data. Studies of this nature are made usually in cooperation with the engineering, standards, or research departments of the business, and involve, so far as the cost accountant is concerned, determination of the cost aspects of changes in policy or practice, upon such matters as:

1. Products—
   - Design, standardization, simplification of the line
   - Elimination of slow-moving and non-profit items
   - Turnover
2. Material procurement—
   - To buy or to manufacture certain parts
   - Material quality standards
   - Material deterioration and obsolescence
   - Turnover and control methods
3. Manufacture—
   - Centralized or decentralized planning
   - Factory layout and production flow
   - Alternative machines
   - Machine replacement, and maintenance policies
   - Alternative operating methods and sequences
   - Total time in process
   - Lot size
   - Operating interruptions and lost time
   - Material wastes and shrinkages
   - Relationship of volume and cost
4. Personnel—
   - Wage incentive plans
   - Vacation allowances
   - Subnormal individual production
   - Employee's training

These topics are merely suggestive of the diverse matters that require a careful determination of all significant cost facts, both historical and prospective, of all reasonable alternatives before any change in policies, and operating conditions and methods are made. In these investigations the accountant must employ the recognized steps of research procedure: (1) recognition of the problem, and definition of its parts and their relationship; (2) collection and analysis of all factual data bearing on the problem and any of its phases; (3) the determination of conclusions based upon the analysis of the factual data.

Formal cost procedures and cost studies provide the cost facts. These must be presented and interpreted to management. This is accomplished through the cost report.

The cost report is in many ways the most important tool of the accountant. Cost accounting as an instrument of managerial control is valuable only in so far as the cost accountant can transfer his facts and conclusions to responsible managers. The accountant does not exercise managerial control. Nor does the manager go to the accountant's records and assemble therefrom facts pertinent to the problems or matters he has in mind. The accountant must make the transference from records to reports for transmittal to responsible executives, there to be the basis of informed managerial control and intelligent action.

In this sense the report is the most important tool of the cost accountant; it is his final product, which he turns over to his clients, the other executives of the enterprise; it is his formal instrument of expression by which his personal value, and the usefulness he gives to cost analysis in the enterprise, are judged.

This importance of the cost report, and the desirability of understanding something of the aims and results of cost accounting before considering its technical procedures, are the reasons for considering briefly below the interest in and the reports supplied to the factory, marketing, and general executives.

Factory Executives and Costs

Factory executives require a great variety of cost information, the exact nature of which depends upon the nature of the operations supervised and the level of responsibility.

Foremen must be supplied with daily information about the costs for which each is responsible. Examples of types of cost information the foreman will require are:

1. The daily output by workman, operations, and products, in comparison with the budget and standard.
2. The daily actual time by workman, operations, and products, in comparison with the standard time, and the reasons for any "fall-downs" and extra allowances.
3. The absenteeism and late reporting of employees, their daily earnings, and the amounts of any bonuses, premiums, penalties, and overtime allowances.
4. Daily variable overhead budget allowance, in comparison with the corresponding actual figures, and differences for which the foreman is responsible.
5. Material usage, actual in comparison with standard, and the daily analyses of all scrap, spoilage, waste, and reoperations required.

Many of these items of cost and performance will be desired also on a cumulative weekly and monthly basis.

The divisional superintendents and the works manager are more removed from actual operations than the department foremen, and therefore are more dependent upon reports. Reports for these factory executives should:

Summarize the costs and performance of each department and section, showing comparisons with the budget and standards.

These reports should be made promptly, daily in most cases, and be recapitulated in weekly and monthly summaries. They should call particular attention to failure to meet the budgets and standards at any point, should indicate the causes of variations, and point to corrective action.

The reports furnished the factory executives of the Kelvinator Corporation are listed below. The comprehensiveness of this information can be appreciated only by examination of the detailed forms illustrated in the National Association of Cost Accountants' 1932 yearbook.[1] The reports are:

1. Daily Expense Report
2. Daily Payroll Report
3. Daily Expense Distribution
4. Daily Expenditure Report
5. Daily Force Report
6. Daily Group Efficiency Report
7. Daily Material Usage Reports
   (One for each type of bulk material, such as sheet steel, lumber, paint, etc.)
8. Monthly Material Variance Reports
   (One for each of the bulk materials)

Many of these reports are supplemented by graphic presentation as an aid in visualizing the data displayed.

The careful mechanism for the control of overhead used by Delco Products Company is described in the following quotation.

"Analysis has developed the information that an expense labor is a uniform percentage of our total expense each month and we feel that if we can control it, the total will result within the prescribed amount.

"We therefore issue a daily labor budget which operates as follows:—

1. Daily departmental direct and all expense labor is turned into the budget department the morning after the day it occurs.
2. Daily budgets are calculated from the percentage of this direct labor to the total monthly standard.
3. Daily non-variable amounts are figured by dividing the total monthly non-variable by the number of working days in that month.
4. Expense is posted against the proper account.
5. Both the budget and expense are accumulated on each day's report so the departmental head knows each day how he stands up to that time.
6. Variances are shown on each account.
7. Daily budgets are in the hands of the foreman by late afternoon of the day following the expense.

On the fifteenth of the month he is also given a material budget and expense report for the first half of the month based on his direct labor for that period. This gives him an opportunity to correct any excessive material expense before the end of the month."[2]

[1] George F. Smith, "What the Executive of the Production Department Requires of the Accounting Department," and J. J. Timpy, "How the Accounting Department Meets the Requirements of the Manufacturing Executives," in *N.A.C.A. Yearbook,* 1932, pp. 286-319.

[2] W. C. Reese, "How the Accounting Department Meets the Requirements of the Manufacturing Executive," *N.A.C.A. Yearbook,* 1932, pp. 281-282.

An Illustration of Factory Cost Control Data

A more complete illustration of the use of cost data in factory control is presented below, based upon a description [3] of the method in effect at Inland Manufacturing Division of General Motors Corporation. A few of the reports used are reproduced.

The procedure aims particularly at the control of:

1. Indirect expense
2. Direct labor
3. Direct material usage
4. Scrap and rework costs

The control of indirect expense is effected through the use of the following reports:

1. Daily Plant Report (Figure 1)
   This report compares actual and standard total and variable burden for nine major groups of plant expense, for the current date and the month to date. The standard for each kind of variable expense is indicated as a percent of direct labor. Both the standard and actual percentages are shown in the two right-hand columns.
2. Operating Report Summary (Figure 2)
   This report is made up weekly by departments and shows not only the past week but also the month to date and fiscal year to date. The expense analysis is made in terms of seven major groups of items for which the department foreman is responsible. Elements of expense—depreciation, taxes, scrap, power, postage, and other items over which the foreman has little or no control—are omitted. Some of the items are reported daily to the foreman in order to secure a more immediate control.
3. Report of Manufacturing Delays (Figure 3)
   Supplementing the departmental operating report is a departmental Report of Manufacturing Delays.
4. The actual dollars of indirect expense per standard dollar of indirect expense is also calculated for the plant as a whole and presented graphically.[4]

The control of direct labor cost is affected by a comparison of the standard labor cost of producing the day's products with the actual production cost. "The standard labor costs of production were determined in the beginning of the year, and, as a rule, are in line with the estimated cost on which we based our selling price for the product in question. These standards then become our measuring stick against which we compare our performance daily and issue a weekly report by departments. The Daily Plant Report . . . carries the performance on this element of cost as well as the indirect expense. . . . You will note that the savings of burden and productive labor are added together. This is done because in many instances saving in one is made at the expense of the other, but by adding them together the true net saving is shown." [5]

The control of direct material usage is facilitated by means of two reports supplemented by graphic presentation. A weekly report is issued showing usage of

[3] M. A. Lause and F. A. Boettger, "Presentation and Use of Cost Control Data," *N.A.C.A. Bulletin*, Vol. XIX, No. 14, Section I, March 15, 1938.

[4] *Ibid.*, p. 819.

[5] *Ibid.*, p. 800.

materials by product lines. A monthly summary (Figure 4) is also made by classes by products.

The control of scrap and reoperation cost is effected with the assistance of individual scrap tickets, signed by the department head, which are summarized in a weekly scrap cost responsibility report. Comparison by departments is made with a standard unit cost per direct labor dollar. Variance of actual scrap cost from standard allowance is calculated for the week and for the year to date. Supplementing this weekly report is a daily one on any item showing excessive scrap or reoperation cost. Graphic presentation may also be made continuously for any

DAILY PLANT REPORT
General Motors Corporation

Division INLAND MFG. Plant _____ Date _____

	Today					Month to Date		
	Total Burden	Deduct Fixed	Actual Variable	Standard Variable	Saving	Saving	Variable Rate Actual	Variable Rate Standard
Indirect Labor	4,459	972	3,487	3,362	— 125	— 634	40	38
Operating Supplies	661	0	661	973	312	215	10	11
Tools	117	0	117	177	60	115	2	2
Power	1,079	257	822	1,062	240	769	10	12
Maintenance—Labor	734	30	704	885	181	607	8	10
Material	184	19	165	619	454	1,554	3	7
Losses	1,169	0	1,169	973	— 196	— 57	11	11
Fixed Charges	1,086	949	137	177	40	141	2	2
Miscellaneous	— 12	99	— 111	266	377	826	0	3
TOTALS—BURDEN	9,477	2,326	7,151	8,494	1,343	3,536	86	96

	Today	Month to Date	Year to Date
Actual Prod. Labor	8,250	32,932	701,130
Standard Prod. Labor	8,848	35,366	721,025
Saving—Labor	598	2,434	19,895
Saving—Burden	1,343	3,536	— 18,341
Total Saving	1,941	5,970	1,554
Overtime Premiums Paid			

Date Issued Feb. 10, 1937 Time Issued 3:00 P.M.

Signed BY _____
Plant Manager

Figure 1.

INLAND DIVISION

OPERATING REPORT SUMMARY

Department #23—Tool Room Foreman Mr. John Smith Date Issued 4/23/37

Classification of Expense	Week Ending 4/17/37			Period 4/4/37 Thru 4/17/37			8/2/36 Thru 4/3/37		
	Actual	Standard	Saving	Actual	Standard	Saving	Actual	Standard	Saving
Indirect Labor	552	584	32	1,032	1,123	91	17,740	15,148	— 2,592
Supplies	74	100	26	149	190	41	2,836	2,377	— 459
Tools	257	320	63	334	609	275	9,003	7,607	— 1,396
Maint. Labor	77	229	152	122	436	314	3,209	5,441	2,232
Maint. Material	131	201	70	210	383	173	6,018	4,781	— 1,237
Losses	0	5	5	0	10	10	45	130	85
Miscl.	10	46	36	17	88	71	626	1,093	467
Total Expense	1,101	1,485	384	1,864	2,839	975	39,477	36,577	— 2,900
Standard Budget Direct Labor		67,538			128,567			1,605,501	

Fixed Expense 120.24 plus variable expense (.02021 × $67,538 D.L.) $1,364.94 = $1,485.18

Total Department Expense Charged to Div. Budget	123.	123.	1192

REMARKS

Figure 2.

INLAND DIVISION

REPORT OF MANUFACTURING DELAYS

Department #3 Miscl. Vulcanize Date Issued 4/23/37

Today Period Covered 4/9/37

To date period covered 4/4 thru 4/9/37

Cause	Today	To Date
Insufficient Set-up	21.46	96.10
Setup Jobs		
Rearrange Lines	0.46	7.60
Start and Warm-up		23.68
Change Molds	0.09	.83
Clean Molds	10.82	55.96
Repair Molds	13.14	85.86
Repair Tools		
Repair Equipment (Maintenance)	7.49	34.40
Repair Equipment (Tool Room)	0.09	.09
No Stock Scheduled		3.71
No Stock Prepared	11.39	49.14
No Stock Delivered	3.24	15.74
Bad Stock	7.31	25.98
No Inserts	0.54	37.37
No Plated Parts	1.30	2.68
Traffic Delays		
Tests, Tryouts, etc.	0.46	1.48
Missing Cavities	31.08	135.51
Power Off		192.12
Miscellaneous	0.55	11.65

Standard	Today	To Date	Total	109.42	779.90
Direct Labor	1,191.42	5,548.68	Stand.	154.12	717.78
Var. Rate per Direct Labor $	.12936		Var. from Std.	44.70	– 62.12

Hot Weather Relief		
Standard Fixed Amount		
Var. from Standard		
Actual Variable Rate for Direct Labor Dollar	0.09184	0.14056

REMARKS

Figure 3.

SUMMARY OF MATERIAL USAGE COST VARIANCE FROM STANDARD

For Period February 28 to April 3, 1937

	COST VARIANCE		Total Cost Variance		Val. Mat. at Std. 2/28/37 to 4/3/37	% of Var. from Std. 2/28/37 to 4/3/37	Val. Mat. at Std. 8/2/36 to 4/3/37	% of Var. from Std. 8/2/36 to 4/3/37
	Wk. End. 3/27/37	Wk. End. 4/3/37	2/28/37 4/3/37	8/2/36 4/3/37				
Controlled Products Shown on Savings Report								
Running Boards	572	— 3	2,701	11,236	174,155	1.55%	940,002	1.20%
Wheels	19	7	— 43	— 1,060	28,718	— 0.15	158,784	— 0.67
C. V. Strips	191	174	605	832	55,187	1.10	251,704	0.33
W. S. Strips	4	— 30	265	450	35,565	0.75	241,310	0.19
Ice Trays and Grids	47	— 49	52	— 161	28,309	0.18	119,141	— 0.13
Miscl. Products	333	— 93	14	— 296	53,816	0.03	274,919	— 0.11
Antenna	— 1	17	87	581	1,687	5.14	43,653	1.33
Wheel Paint (Black)	— 97	— 19	— 34	— 2,715	4,885	— 0.69	21,423	— 12.68
Running Bd. Paint	34	— 9	208	— 2,007	5,701	3.64	28,656	— 7.01
Hyd. Brake Hose	137	280	1,770	3,076	21,258	8.33	54,607	5.63
Rear Compt. Strip	— 54	12	— 78	— 396	14,644	— 0.54	19,321	— 2.05
Total Variance	1,185	287	5,547	9,540	423,925	1.31%	2,153,520	0.44%
Controlled Products Not Shown on Savings Report								
Miscl. Products	0	0	0	— 858 *				
Wheel Paint (Brown)	— 12	— 43	— 27	— 942				
Total Variance	— 12	— 43	— 27	— 1,800				
Grand Total Variance	1,173	243	5,520	7,740				

* Cost Variance for period 8/2/36 to 8/15/36 before all Miscellaneous Products were shown on Savings Report.

NOTE—Columns for weeks ended 3/6/37, 3/13/37, and 3/20/37 omitted and cents omitted—both shown in the original.

Figure 4.

department, showing actual scrap and reoperation cost per direct labor dollar in comparison with standard per direct labor dollar.

Direct material price, and special tool cost, are covered by other reports.

Preparation and presentation of cost reports do not automatically provide control. This is effected only by managerial consideration and action. In addition to the reports, therefore, a procedure for their consideration should be established. In the company whose reports are described above, this is accomplished through the setting up of a definite cost control administration, centralized in a standards department which is part of the manufacturing division. It is the job of the standards department to set up the standards, to interpret the cost data, and control the costs. This company stresses the importance of establishing the cost control function as a department of the manufacturing division itself. An active instrument of control is the weekly cost meeting at which the performance of each department is reviewed. As a result the foreman is made cost conscious. He has a part in preparing the standard and feels responsible for the cost result.

Sales Executives and Cost Data

The sales executives are interested in cost data bearing upon these major problems of distribution:

1. What products shall be sold?
2. What prices shall be asked?
3. What trade channels and distribution methods shall be used?
4. How shall distribution performance and costs be measured and controlled?

Data pertinent to all of these problems are comprehended in the two basic aspects of cost determination, namely, (1) product cost determination; and (2) activities cost determination; in this case the activities included in the distribution function.

One of the principal interests of the sales manager in product costs is in their bearing upon price determination. The relationship of cost and price is not a simple one. Costs in this case quite obviously must include not only manufacturing cost but distribution cost, administrative cost, and financial cost. Equally obvious is the fact that cost is only one of the determinants of price. Return on investment and profit must be considered. In determining a particular price, the prospective volume of business, individual credit risk, and competition must be recognized. Under competitive conditions, what customers are willing to pay, and what competitors are willing to sell for, are factors as important as cost. Granting the general significance of cost as a long-term price determinant, the question arises as to whose costs are controlling—those of the marginal producer, those of the "representative firm," those of the individual seller in a particular transaction? Granting some significance to the costs of the individual seller in a particular transaction, which of his costs possess this significance—those of the last month, the current month, the normal month? Should he use his actual costs or his standard costs in setting selling prices? Should he use actual or replacement cost of material, actual or normal labor rates, actual or normal overhead expense? The individual producer is confronted with an amazing array of costs—actual, normal, standard, budget, replacement—for the various items that compose production and distribution expenditures. What allow-

ance shall be made for fluctuations in volume? Is the seller justified in the fixing of some prices in considering only his differential costs?

Naturally circumstances differ from industry to industry, from time to time in the same industry, and perhaps from transaction to transaction. Some price policy must be adopted and followed, however. Cost can be of assistance in the establishment of policy as well as in the determination of individual quotations. It should be noted again, however, that the costs useful to these distribution purposes may not be the same costs that are acceptable for balance sheet valuation and income determination. As an indication of this fact, it is quite general in a number of industries—cotton textile manufacture, and the paint and varnish industry, for example—to use replacement value of material, whether higher or lower, in calculating cost for use in pricing. Such replacement cost, at least when higher than actual cost, is not now satisfactory for balance sheet purposes in the light of generally accepted accounting principles. A further illustration of a comparable difference between costs for these two purposes is associated with the question of inclusion in cost of interest on investment.

Despite these complications, the experience of businessmen indicates that a number of conclusions can be drawn bearing upon the relationship of cost and price.

1. The statement frequently made that price cannot be based on cost often means that an inflexible relationship does not exist between the two.

2. Prices usually cannot be set on the basis of cost alone. Exceptions will be found in business done on a cost-plus-profit basis. Special order businesses also not infrequently use cost estimates as the basis of price.

3. Although current costs frequently cannot be used as the basis of current selling prices, a long-term relationship between normal costs at the normal volume of operations, normal investment, and normal rate of return should be determined, as a foundation for the basic price policy.

> "The fundamental price policy of a corporation, once formulated, is completely expressed in the conception of *standard volume* (relationship of estimated long-time average rate of plant operation to practical annual capacity, which rate of operation controls the absorption of burden into costs) and expected long-time average rate of return on investment. An analysis of investment along lines of responsibility, together with accounted costs, makes it possible to establish standard cost and capital factors which in turn permit the expression of the fundamental policy in terms of price of product, i.e., standard price. . . ." [6]

4. Product costs are a useful guide in shaping price policy and in setting particular prices even when they cannot be used as an exclusive basis of price determination.

   a. A knowledge of costs will indicate profitable lines and profitable items and thereby offer a guide to sales effort.
   b. Costs may be used as a basis for intelligent bids even when cost factors must be partially disregarded.
   c. Even when total cost cannot be used as a price basis, a knowledge of the elements of cost, of direct cost, and of differential cost, is useful at least in setting a minimum below which price cannot go.

5. Knowledge of costs, particularly when determined by uniform methods within an industry, makes price competition less violent. One of the important causes of highly competitive prices in some industries is not only a lack of knowledge of costs, but the

[6] Albert Bradley, "Financial Control Policies of General Motors Corporation and Their Relationship to Cost Accounting," *N.A.C.A. Bulletin,* Vol. VIII. No. 9, January 1, 1927, p. 433.

great variety of ways of figuring costs. The tendency of price is to meet the quotations, not of the competitor whose costs are low, but of the bidder whose methods of costing show a low figure, or who lacks cost information altogether.

6. In some cases where costs cannot be used as the basis of price, conversion costs have an equally important use as a means of determining the maximum that can be paid for direct materials.

7. Knowledge of costs is essential in determining the relationship of volume and price, the added volume needed to offset a decrease in price, and the decrease in profits resulting from a reduction of volume.[7]

Although product unit costs may be of limited usefulness as a basis of price determination they are nevertheless of great importance to every company, in that they are the basis of all studies in the gross and net profitableness of different products, types and size of customers, territories, salesmen, trade channels, and methods of distribution.

The distribution manager is also interested in determining the costs of the various units of functional service that are used in his efforts in creating demand, obtaining orders, warehouse handling, delivery, credit investigation, billing, posting, and collecting. The actual, as compared with the standard cost of these functional units, is the basis for the measurement of efficiency, and perhaps also of compensation. The expected quantity of each, in a given period, is the basis of budgeting. The use of these devices is discussed in greater detail at a later point.

An Illustration of Distribution Cost Requirements

The following illustration is presented as an indication of the nature of the problems that confront the sales manager and the types of information useful in their solution.

Some of the problems confronting the sales manager of a particular company are listed below.[8]

1. The product—
   - Is present type of product the right kind for the market?
   - Should a full line be made?
   - Should allied products be used to absorb capacity not taken up by main product?
   - What does the public want in style and design?
   - Is quality satisfactory?
   - What are the profitable items?
2. The type of distribution—
   - Should it be through wholesalers, direct to retailers, direct to consumers, or a combination of these?
   - Should branded, non-branded, private brands, or all of these be sold?
3. The selection of customers—
   - What size of account is profitable?
   - What type of store—department, chain, shoe, specialty—should be sold?
   - In what size city is each profitable?
4. The price—
   - What is the effect of price changes on volume, and profit margins?

[7] Albert Bradley, *op. cit.*, pp. 430-431.

[8] —Adapted from J. Parker Margeson, Jr., "The Problems of the Sales Manager—How Can the Controller Help in Their Solution," *N.A.C.A. Yearbook*, 1932, pp. 108-110.

5. The personnel—
   - Is the personnel efficient?
   - What are the results by territories and salesmen in volume, and profit?
   - What are allowable percentages of sales expense?
   - What sales compensation plans are suitable?
6. The planned volume of sales and production—
   - What should the factory be asked to make, in units of each type of product over the next six months?
   - How may these production schedules be adjusted quickly to changes in sales trends?
7. The performance—
   - How do actual volume and price compare with the budgeted figures?
   - Are distribution expenses being held to allowable amounts?

The reports supplied to the management of this company as an aid in meeting these problems are listed below. Practically all of these reports compare budget and actual figures not only for the month but also for the year to date, and for the same month of the previous year. Quantity as well as value figures are often given.

1. Report of Sales by Products
2. Report of Sales Trends by Styles
3. Production Schedule
4. Customer Analysis by Size of Account
5. Analysis of Sales by Channels of Distribution and Population Centers
6. Summary Report of Sales (Unit prices and costs)
7. Report of Sales and Gross Profit by Divisions
8. Summary Report of Gross Profit before Variances
9. Advertising Expense and Appropriations
10. Condensed Profit and Loss Account for Domestic Divisions and Budget Comparisons
11. Report of Territory Yield and Direct Sales Cost
12. Territorial Coverage and Routing of Salesmen
13. Report of Returned Sales
14. Report of Closeouts
15. Report of Seconds

Only a detailed examination of these reports will convey an understanding of the great amount of information they contain.

General Executives and Cost Data

General executives are interested in cost and other accounting reports as a means of:

1. Disclosing the trends of the business.
2. Coordinating sales, production, research, and product development in accordance with internal and external circumstances and objectives.
3. Protecting the rate of return on the investment.
4. Controlling the flow of funds into inventories, accounts, and plant.
5. Planning expansion and the amount and source of future capital requirements.
6. Knowing the degree to which general and divisional policies, budgets, and standards are being attained.

A great variety of reports are required to supply this information, from daily representation of cash position to monthly budget comparison, income statement,

and balance sheet. King Hathaway recommends that the general manager should regularly receive the following reports as guides in the conduct of the business.[9]

A. Daily Statements of Cash and Related Transactions
   1. *Cash*—previous cash balance, receipts, disbursements, and the remaining balance for each bank
   2. *Customers' orders*—the previous balance, orders received, orders shipped, and the remaining balance of unfilled orders, for each of the major classes of product
   3. *Accounts payable*—the previous balance, reductions by cash or other credits, additions, and the remaining balance
   4. *Notes payable*—(information on balances and changes as above)
   5. *Accounts receivable*—(information on balances and changes as above)
   6. *Notes receivable*—(information on balances and changes as above)
   7. *Purchases*—the previous balance of unfilled purchase orders in dollar value, additional orders issued, reduction by goods received and invoiced, and the remaining balance
   8. Reports to show cash requirements to meet payrolls and other obligations for designated periods in advance.

B. Weekly Statements of Plant Operations

   These reports should make possible comparison of the rate of plant operation with sales and enable the general manager to foresee the need for speeding up or slowing down the tempo. To enable the general manager to see whether the working force is being adjusted from week to week in proportion to the amount of work ahead, a report should be made *for each department,* both direct and indirect, showing:
   a. The number of man- and apparatus-hours ahead
   b. The time that it would take with the existing force and facilities to complete the work ahead
   c. The increase or decrease in the balance of work ahead since the previous report
   d. The number of employees and the amount of the payroll, compared with the previous report

In addition to these daily and weekly reports the general executive will want the regular accounting reports, made in comparative form, and the general budget reports showing the progress of the business toward its current goals.

[9] Adapted from King Hathaway, "Applied Scientific Management, III Organization: Functions of Major Executives, in *Bulletin of the Taylor Society,* Vol. XVIII, No. 1, February 1933, p. 8.

Chapter 11

TECHNIQUES, CONTROLS, AND PROCEDURES EMPLOYED IN COST ACCOUNTING

By
T. H. PATTERSON *

One of the inherent characteristics of cost accounting is its emphasis on detail. Cost accounting serves its primary functions when it concerns itself with the sources and logical distribution of cost in the operating functions of a business; when it classifies, analyzes, and brings the pertinent facts to light; when it interprets accounting figures to management language and takes a hand in initiating corrective action. Although it justifies its place in industry through its ability to supply a sound accounting basis of control, cost accounting, to be effective, must be controlled itself. No matter how sound in conception and in execution a cost system is, its detailed findings must be tied in with the general accounts of the company to give it authority and credence. Controlling accounts, therefore, should always be carried in the general ledger.

A controlling account is a device for eliminating detail from the general ledger, and, as the name implies, it reflects the correct sum of the supporting transactions shown in the cost ledgers. In opening the account, an entry is made to it for the total of the detailed items set up in the subsidiary records. The totals of the subsequent individual debit and credit postings to the subsidiary records are entered monthly in the controlling account. Thus, at the end of each month, the balance in the controlling account will agree with the net total of all the items in the cost ledger. The controlling accounts for operating expenses indicate the correct amount of expense incurred or expended, and the controlling accounts for the inventory items reflect the perpetual inventory balances. There is not much opportunity for the controlling accounts of the operating expenses to be in error, since the postings to these totals are usually made from vendors' bills and from depreciation schedules and the like, the sources of which are under the accountant's control and are usually very accurate. The same cannot be said of the perpetual inventory balances as reflected by the controlling accounts, unless at various times these balances are checked by taking physical inventory, comparing the extension of such inventory with the perpetual balances, and making adjustment to the controlling account. The frequency of such inventory taking depends upon the nature of the business and the kind of inventory count that has to be made. It is sometimes sufficient when accounting for finished stock inventory items, for instance, to make a physical check by use of the bin system, and when a bin stock reaches a point where it can readily be counted, the physical check is then made. In an arrangement of this kind, it is imperative that some orderly

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kind of checking procedure be maintained, so that a rotation is made of all bins within a reasonable period, which might be anywhere from six months to a year. In other instances where the perpetual inventories of raw materials are dependent upon the accuracy of the person or persons withdrawing material from stock, it is a good practice to take a physical count once every month so that the monthly perpetual inventory totals of raw materials in the general ledger reflect actual inventory on hand.

Number of Controlling Accounts Required

The number of controlling accounts in the general ledger is dependent upon the nature of the business, the need for accounting data, and whether a standard cost system or an actual cost system is used. The size of the business, the organizational setup, and the financial structure, of course, have a bearing also upon the necessary chart of accounts needed to handle all accounting transactions. In establishing the chart of accounts, it is very often advisable to assign numerical codes to the accounts for ready identification and saving of time in posting reference, even though the system in operation does not involve the use of mechanical tabulation of accounts or amounts. A suggested chart of accounts with the code numbers for a business manufacturing and selling its own products, and using a standard cost accounting system, would require the following as a minimum:

Assets
- 100 Liquid Assets
  - 101 Cash—Current
  - 102 Cash Imprest Fund
  - 103 U. S. Government State and Municipal Securities
  - 104 Accounts Receivable
  - 105 Notes Receivable
  - 106 Interest Receivable
- 200 Inventories and Semi-Liquid Assets
  - 201 Materials in Transit
  - 202 Raw Materials at Standard Cost
  - 203 Work in Process at Standard Cost
  - 204 Finished Stock at Standard Cost
  - 205 General Stores
  - 206 Coal and Fuel Oil
  - 207 Containers Returnable to Vendors
- 300 Fixed Assets
  - 301 Real Estate
  - 302 Buildings
  - 303 Machinery
  - 304 Office Furniture and Fixtures
  - 305 Delivery and Transport Equipment
  - 306 Loose Equipment and Tools
  - 307 Construction Work in Process—Buildings
  - 308 Construction Work in Process—Machinery
  - 309 Construction Work in Process—Loose Equipment and Tools
- 400 Deferred and Other Intangibles
  - 401 Patents—License—Options
  - 402 Good-Will
  - 403 Advertising Booklets, Paper, Etc.

404 Postage
405 Insurance
406 Taxes

Liabilities

500 Current Payables
501 Accounts Payable
502 Notes Payable
503 Unclaimed Wages, Salaries, and Bonus
504 Gross Payroll Paid
505 Gross Payroll Accrued
506 Interest Accrued
507 Dividends Declared
600 Accrued Taxes Payable
601 Federal Income Tax
602 Federal Capital Stock Tax
603 State Corporate Net Income Tax
604 State Capital Stock Tax
605 Federal Withholding Tax
606 Federal Old Age Benefits Tax—Employer
607 Federal Old Age Benefits Tax Withheld from Employees' Wages
608 Federal Unemployment Tax—Employer
609 State Unemployment Tax—Employer
610 State Sales Tax
611 State Use Tax
612 Taxes General
700 Valuation Allowances and Depreciation Allowances
701 Loss on U. S. Government State and Municipal Securities
702 Worthless Accounts Receivable
703 Depreciation—Buildings
704 Depreciation—Machinery
705 Depreciation—Furniture and Fixtures
706 Depreciation—Delivery and Transport Equipment
707 Depreciation—Loose Equipment and Tools
708 Valuation of Inventory from Standard Cost to Lower of Cost or Market
800 Capital
801 Common Stock—Par Value
802 Preferred Stock—Par Value
803 Capital Surplus
804 Paid-In Surplus
805 Surplus Appropriated—General

Revenue and Expense
1001 Sales Income
1002 Sales Returns and Allowances
1003 Standard Manufacturing Cost of Sales
1100 Manufacturing Variances from Standard
1102 Material Purchasing
1103 Material Utilization
1104 Direct Labor Efficiency
1105 Scrap in Process
1200 Manufacturing Expense
1201 Factory Expense Control

1202 Maintenance Expense Control
1203 Power Expense Control
1204 Absorbed Manufacturing Expense
1300 Selling Expenses
1400 General Commercial
1500 Miscellaneous Income and Expense
1501 Sale of Salvage Material
1502 Obsolete Defective and Slow Moving Inventory Losses
1503 Expenses on Goods Returned
1504 Interest Income
1505 Interest Expenses
1506 Sundry Income and Expense

Use of Codes for Identification

The above listing of accounts and account numbers should be integrated into whatever further expansion of the codes will be required for the recording of expenditures for budgetary control, the setting up of work centers, and further analysis which would be required for other purposes. Any combination of accounting needs could be provided for by an eleven digit code designed as follows:

Account	*Source of Expense*	*Work Center or Operation*	*Classification*
0000	00	00	000

A few examples of the application of the codes will suffice to further illustrate their use.

Source of Expense

This is a name used to describe a type of expense such as:

01 Salaries
02 Indirect Labor
03 Sundry Supplies
04 Maintenance Materials
etc.

Work Centers

01 General Factory
02 Steam Plant
03 Repair Shops
04 Mixing and Milling Operation
etc.

Classification

The function of the codes used in this position is to further segregate expenses which are not sufficiently detailed by the source. It is most frequently used in connection with indirect labor and maintenance materials. It is well to assign groups by hundreds as this simplifies reporting and reduces the errors due to incorrect coding.

101—Janitors 102—Transfer Truck Operators 103—Watchmen 104—Firemen	Manufacturing and Power Expense
etc. and	
201—Lubrication 202—Regrinding Milling Rolls 203—Motor Repairs	Maintenance Expense
etc.	

Although an eleven digit coding system is set up, the needs of the situation will determine the number of digits to be used. A good general rule is to use as few as possible to give adequate identification. For example, the general ledger controls will require the first four digits only as a means of identifying the proper account. The cost ledger subsidiary account for Direct Labor efficiency will require the account and operation, thus 1104–00–04—Mixing and Milling; the Factory Expense Control 1201–02–04–101 would identify Indirect Labor Janitors, in operation Mixing and Milling.

Development and Application of Standards

Before proceeding with a discussion of the accounting entries used in tying in the general ledger accounts with the results of operations as shown in detail in the subsidiary cost ledgers, it is advisable to have an understanding of the standard cost procedure used.

In this illustration, standard factory costs are developed at the beginning of each year reflecting anticipated costs for material, labor, and expense during that period, with one qualification as to expense. Since a sizable portion of factory expense is in the "operating fixed" category, the selection of the production volume has a vital influence on the usefulness of the standard unit expense rates derived. This will be discussed subsequently. Generally speaking, standard costs must serve to measure accomplishment at the point of organizational responsibility, assist in controlling costs, and furnish means to value processed and finished stock inventories on a sound and economic basis. Unit standards should be carried through to completion as labor, material, fixed expense, and variable expense.

Direct Labor Standards

The definitions of Direct Labor are quite varied, but a good rule to follow is to put all labor that can be measured against the output of a salable product, even though this might include transferring from place to place in the factory, as Direct Labor. Standards of performance should be established by industrial engineers and not by the cost accountant unless perchance he is qualified as an industrial engineer. Standards should be accepted by the foreman responsible for the work done before using in product unit costs, and preferably at an attainable level of good performance. Nothing is so discouraging to a good foreman as to be forever behind the "eight ball," primarily because he has been given standards that are too tight and cannot be met without superhuman effort and all the luck. First, be sure the foreman understands and accepts the standards to be used, and from then on you will get his cooperation and his acceptance of responsibility.

Extra-pay increments such as shift differential and overtime pay can be averaged into the direct labor standards, but this is not particularly satisfactory in measuring operating results. A better plan is to charge these extra pay items to manufacturing expense and include in the budget and in the operation or department overhead.

Material Standards

The standards for materials begin with the purchase specifications and prices, but the accountant need only concern himself with the prices. Here again, the standard purchase rates should be set up by the function chiefly concerned, namely, the Purchasing Department. It is a good idea, however, to have the standard purchase rates of vital materials agreed upon by qualified executives of the company. for in many instances the purchase commitments made at the beginning of the year do not cover the year's requirements, and subsequent purchases will be made at prices affected by general business conditions then existing. The forecasting of these conditions is aided by discussion and the opinions of other executives.

Purchases of raw materials are charged to "In Transit" account at actual cost when the vendor's bill is received and recorded as an Accounts Payable. The receipts are checked against the bill, the standard cost applied to the quantity received, and the difference charged or credited to Purchasing Profit and Loss. Thus all raw materials are carried on inventory at standard value. Withdrawals from raw material stores are at standard values also, and, as a consequence, there is no need to measure a price variance once the material enters processing.

The quantities of materials required to produce a certain article are set up in standards from specific formula wherever possible. Where there is no standard measure but that supplied by past experience, it is practical to use the data thus accumulated as standard if tempered with sound judgment and if it excludes admittedly poor performance. A standard amount of scrapped production is part of the material standards.

Although the unit costs are set up in the standard cost summary so that the final unit costs are separated as to direct labor, material, fixed expense, and variable expense, it is not necessary to operate the cost closing on this basis; in fact, it is desirable not to because of the confusion as to the meaning of the variances. To illustrate—The standard cost of a partially completed product in operation "A" is:

Labor	$1.00 each
Material	5.00 each
Fixed Expense	1.50 each
Variable Expense	1.50 each
	$9.00

This product moves to operation "B" and the employees there have been entrusted with $9.00 worth of product, which to them looks like 100% material. It is so considered in accounting for what is done to it at operation "B" and if there is any loss against standard in utilization of the $9.00 worth delivered to them, it appears as a "material variance," although a pure accounting for the cost components of the $9.00 item would distribute the variance over the four factors of labor, material, etc. The only labor variance shown in operation "B" is the result of the efficiency of the labor expended there by the employees of "B" operation.

Manufacturing Expense Standards

The manufacturing expense standards are primarily established to secure equitable product costs, and cost factors to be used in estimating. The control of manufacturing expense is obtained by the measurement of expenditures at the source with the budgeted allowances, and not after expenses have been distributed to work centers. Manufacturing expense standards should be based on a flexible budget base, at predetermined factory activity, which is not likely to agree with the forecasted activity in any year. The ability of a business to sell its products is a good guide as to the predetermined volume basis to be used for setting standard factory operational rates. Past history is one of the factors, but it must be coupled with expectancy in the future when developing the volume basis for setting up standard expense rates. Such volumes could be called "Normal Sales."

The usual steps to follow in setting up operational standard costs are:

1. Establish operational activities relative to Normal Sales.
2. Charge all direct expenses to operation, including amount of Social Security Taxes for labor incurred in operation.
3. Set up service operations such as steam plant, compressed air, hydraulic power, etc., and distribute to direct productive operations on basis of service.
4. Set up general factory which includes all expenses incurred for the plant as a whole. Distribute either to (1) operations on pro rata direct labor hour basis, or (2) to products at some point prior to finished stock.
5. Unitize the totals by dividing by some factor such as pounds, square yards, tons, machine hours, or direct labor dollars.
6. Apply such rates to products, following each manufacturing process in the plant to completion of product.

Note: In respect to distribution of general factory to products, it is surprising how many items of general expense can be allocated by analyzing the services. This is more precise and less general than following a pro rata basis of labor activity. Sometimes the analysis is made first to functions and then to operations. For example, in a rag felt mill producing roll goods and fabricated parts, there are at least two major production functions, viz. (1) Felt Forming, (2) Felt Converting. The Plant Management costs can be separated to these functions first with an advantage in factual accounting. The general expenses distributed to Felt Forming can then be applied at so much a ton of felt, or on a cost per forming machine hour. The distribution to Felt Converting can be further distributed to operations within that function on relative direct labor dollars.

Treatment of Variances from Standard

While it is possible and sometimes desirable to defer a portion of factory variances from standard, particularly if inventories are being increased, it is much simpler and usually quite satisfactory to management to consider a variance as a loss or gain item which applies to the month of occurrence. In the illustrations used, all variances are taken as profit or loss items at once.

Controlling Accounts Illustrated—Journal Entries

The use of controlling accounts in the general ledger to reflect the transactions in the subsidiary cost ledgers is illustrated by the following journal entries which are typical of the process standard cost system:

1. Debit 201—Materials in Transit
   Credit 501—Accounts Payable
   Total cost of raw materials purchased.
2. Debit 202—Raw Materials at Standard Cost
   Credit 201—Materials in Transit—Actual Cost
   Credit 1102—Material Purchased
   To compute purchasing profit on raw materials received.
3. Debit 203—W.I.P. at Standard Cost
   Debit 1103—Material Utilization
   Credit 202—Raw Materials at Standard Cost
   To record standard cost of goods produced, withdrawal from raw materials, and variance from standard.
4. Debit 204—Finished Stock at Standard Cost
   Credit 203—W.I.P. at Standard Cost
   Credit 1105—Scrap in Process
   To record standard value of goods finished, and the variance from standard of scrap.
5. Debit 1104—Direct Labor Efficiency
   Debit 1201—Factory Expense Control
   Debit 1202—Maintenance Expense Control
   Debit 1203—Power Expense Control
   Credit 505—Gross Payroll Accrued
   To distribute hourly payroll accrued for the month.
6. Debit 504—Gross Payroll Paid
   Credit 101—Cash
   Credit 605—Federal Withholding Tax
   Credit 607—Federal Old Age Tax Withheld
   To record hourly payroll paid during current month.
7. Debit 203—W.I.P. at Standard Cost
   Credit 1104—Direct Labor Efficiency
   To allow standard labor for actual production.
8. Debit 1201—Factory Expense Control
   Debit 1202—Maintenance Expense Control
   Debit 1203—Power Expense Control
   Credit 501—Accounts Payable
   To record vendors' bills for expense.
9. Debit 501—Accounts Payable
   Credit 101—Cash
   To record payment of vendors' invoices.
10. Debit 203—W.I.P. at Standard Cost
    Credit 1204—Absorbed Manufacturing Expense
    To record standard manufacturing expense absorbed by goods produced.
11. Debit 1003—Standard Manufacturing Cost of Sales
    Credit 204—Finished Stock
    To charge cost of sales for goods shipped to customers.

At the close of each month, after books are posted and the journal entries pertaining to the controlling accounts are made, the operating report and financial statements may be prepared from the account balances without further adjustments. Since the variance accounts are not closed to cost of sales each month, they must be shown as separate factors on the operating report, which would be shown in the following sequence:

1001	Sales Income		XXX
1002	Less Returns and Allowances		X
	Net Sales		XXX
1003	Standard Manufacturing Cost of Sales	XXX	
1104	Direct Labor Efficiency Variance	X	
1103	Material Utilization Variance	X	
1102	Material Purchasing Variance	X	
1105	Scrap in Process Variance	X	
	Over/Under Absorbed Expense *	X	
	Total Factory Cost of Sales	XXX	XXX
	Gross Profit		XX
1300	Less Selling Expenses		X
1400	Less Administrative		X
1500	Less Miscellaneous Income and Expense		X
	Net Profit		

* The over or under absorbed expense is the difference between the credit for 1204—Absorbed Manufacturing Expense, and the net debit total of Accounts 1201, 1202, and 1203.

Chapter 12

FORMS COMMONLY EMPLOYED IN COST ACCOUNTING

By
T. H. PATTERSON *

While the forms used by any business organization must be carefully designed to meet its particular needs, there is a basic and recognizable similarity in many commonly used forms. The examples shown herewith serve their purposes for one particular organization, but are believed to be adaptable to the needs of most manufacturing concerns in recording purchases, distributing labor, and building standard unit manufacturing costs.

Purchase Order Request—Exhibit A

This form is prepared in duplicate, the original to the Purchasing Agent and the copy retained by the originator of the request. It can be used generally, but the bulk of the requests will be prepared by the Production Scheduling Department or its equivalent in the orderly scheduling of raw material purchases for production requirements.

Purchase Order—Exhibit B

This form is used by the Purchasing Agent in ordering raw materials, supplies, and mechanical equipment. The number of copies can be expanded or decreased according to the particular procedure established. It contains the description of the article purchased and all other pertinent information, including the accounting codes or accounts to which the purchase is to be charged. To assist in identification of the copies, the heavy bars ═══ ═══ can be printed in different colors.

The Accounts Payable copy will be filed alphabetically by that section, withdrawn when the vendor's bill is received, and compared with the quantities, prices and f.o.b. terms on the invoice. If in agreement, the bill is okayed for payment, coded to account, and filed by due date. Before payment is made, the quantity billed is checked with the receiving copy #5. Notation is made on the purchase order of the date of the invoice and if the first billing completes the order, the Accounts Payable Section stamps it "Completed," and files the order alphabetically in the completed order file. If the invoice is for a partial shipment, the quantity billed and the date of the invoice will be noted on the purchase order copy before it is returned to the live order file.

The Receiving and Cost copies are completed by the Storeroom upon receipt of the material; the #4 is retained by the storekeeper, the #5 is sent to the Accounts Payable Section and used to check the quantity received against the vendor's bill, and the #6 copy is sent to the Cost Section to be used in accounting for the pur-

* Chief Accountant, Armstrong Cork Co., Lancaster, Pennsylvania.

chase. In order to insure a count by the receiving clerk, the 4-5-6 copies of this form are blanked out in the "Quantity" column when the order is typed, thereby giving the storekeeper the descriptive data but no quantity information.

REQUISITION TO STOREROOM
or PURCHASING DEPARTMENT

Date _____
Req'n. No. _____
ORDER FROM _____
ORDER No. Prefix _____ Suffix _____
Ship To _____
ADDRESS _____
Mark For _____ Dept.
Att'n. Of _____
Delivery Date Required _____

Quantity	MATERIAL	Price

Govt. Agency and Contract No. _____ Inspection at Shipping Point - Yes ☐ No ☐
END USE _____ Confirmation ☐

C M P

TERMS _____ F O B Point _____
Account No. _____ Signed _____
Project No. _____ Approved _____
For _____
Sub-Contract Order No. _____

Form 1481 5-44 9-44

Exhibit A.

The storeroom assigns consecutive receiving entry numbers to all receipts. There is room on this form for these receiving numbers, and on the printed copies 4-5-6 the words "Receiving entry #," and "Date" appear in the upper part of the form. Where a partial shipment is received, the copies 5-6 are sent through against the first shipment, and a supplementary form containing essentially the same kind of information is used to record all subsequent shipments against the order.

The usual routing of vendors' bills is to (1) Purchasing—(2) Accounts Payable —and after vouchering to (3) Cost Section.

Purchase Order
Manufacturing Company
Fairmount, Pa.

DATE

TO

IMPORTANT
SHIPPING LABEL MUST SHOW THIS INFORMATION COMPLETE

ORDER NO. 5726

REQUISITION NO. 734

SHIP TO - X MANUFACTURING CO.

MARK FOR ATT'N. OF. DEP'T.

DELIVERY REQUIRED

ENTER OUR ORDER FOR THE FOLLOWING MATERIAL:

QUANTITY	DESCRIPTION	PRICE
	COPY #1 (SHOWN) TO CUSTOMER COPY #2 (X MFG. CO. NAME OMITTED AND DEP'T.) #3 ( ) #4 (NAME SUBSTITUTED) #5 ( ) THUS: #2 ═══ PURCHASING ═══ #3 ═══ ACCOUNTS PAYABLE ═══ #4 &5 ═══ RECEIVING ═══ #6 ═══ COST DEP'T. ═══	

TERMS F.O.B. POINT

ACCT. NO. PROJ. NO.

X MANUFACTURING CO.

PURCHASING AGENT

BILL OF LADING MUST ACCOMPANY INVOICE ON ALL FREIGHT SHIPMENTS

Exhibit B.

Voucher—Exhibit C

This form is prepared in triplicate when the vendors' bills are paid. The original is sent with the check to the vendor, the first copy is attached to the invoices and filed numerically, and the second copy is filed by vendor's name. The original can be white paper stock, the first copy yellow, and the third pink, or some such combination of contrasting colors. The value of having a separate copy under the vendor's name far offsets the extra filing time and space required, since it eliminates a voucher index and provides a ready reference to the volume of business done with each vendor.

The accounting codes do not appear on the voucher, but are put on the face of

Manufacturing Company
Fairmount, Pa.

CODE
1. INVOICE DISCOUNT
2 FREIGHT
3. CREDIT

VOUCHER NO.	ACCT. PERIOD	DUE DATE MO.	DUE DATE DAY	INVOICE DATE MO	INVOICE DATE DAY	CODE	AMOUNT	DEDUCTION	NET AMOUNT

APPROVED FOR PAYMENT

EXAMINED AND FOUND CORRECT

Exhibit C. Voucher.

the vendor's bill instead. A stamp such as shown in Exhibit D is a convenient adjunct to the checking and coding of invoices. This stamp is placed on the invoice during the first operation of checking a vendor's bill.

REC. DATE	ENTRY NO.	TERMS %	DAYS MO.	QUANTITY OK.

FREIGHT F.O.B. POINT	DATE PAID	AMOUNT FRT.

ACCOUNT	SOURCE	OPER.	CLASSIFICATION	AMOUNT

Exhibit D. Rubber Stamp for Coding of Vendors' Invoices.

Materials in Transit and Receipts—Exhibit E

This form is printed on both sides and is designed for use in a vertical file. One card is assigned to each kind of raw material purchased. The "billed" information is taken from vendors' invoices by the Cost Section after the Accounts Payable Section has passed the invoices for payment and applied voucher numbers. Since all raw materials are charged to "In Transit" as vouchered, the "Billed" column con-

MATERIALS-IN-TRANSIT AND RECEIPTS NO

PLANT | INVENTORY CONTROL | COMMODITY DESCRIPTION

YEAR | UNITS

BILLED				RECEIPTS				BILLED				RECEIPTS			
DATE	VOUCHER NUMBER	UNITS	ACTUAL VALUE	DATE	ENTRY NUMBER	UNITS	ACTUAL VALUE	DATE	VOUCHER NUMBER	UNITS	ACTUAL VALUE	DATE	ENTRY NUMBER	UNITS	ACTUAL VALUE

Exhibit E.

tains the supporting details of the "In Transit" total. At the end of each month, the quantities received are matched with those billed, a summary is made of the receipts, and this is extended at the respective standard purchase rates. The actual cost of materials received is journalized from "In Transit" to Purchasing Profit-and-Loss Account, and the sum of the remaining items in the "Billed" column substantiates the "In Transit" balance at the end of each month. The form is ruled off at the end of the month, and the items remaining In Transit are brought down below the line as the starting balance at the beginning of the new month.

The Purchasing Profit-and-Loss Statement is prepared from the basic data on these cards by listing the item, quantity, actual cost and then computing the standard costs opposite each material. The quantities are then posted to a raw material ledger which is set up as follows:

Inventory at Beginning of Month — Standard Cost
Purchases during Month — Standard Cost
Total
Inventory at End of Month
Disappearance
Reported Used
Shrinkage Loss or Gain

Where shrinkage is anticipated because of the nature of the material handled, such shrinkage is set up as standard and the "usage" rate increased to reflect the standard loss. Thus an item costing $9.80 per C pounds with a standard shrinkage of 2% will have a usage rate of $10.00 per C pounds ($9.80 ÷ .98).

Returnable Container Ledger—Exhibit F

Keeping records of receipts and returning of containers is often a small but troublesome part of material accounting. The form shown is an aid in maintaining control of the scheduling of container's returns to vendors, a matter of importance in periods when containers are in short supply.

RETURNABLE CONTAINER LEDGER

SHIP TO: _____ BILL TO: _____

ACCT. NO. _____

DESCRIPTION: _____

CONTENTS: _____ DEPOSIT PAID _____ RETURN VALUE _____ TERMS: _____

RECEIPTS					RETURNS					BALANCE	
Date	Voucher No.	Pur. Order No.	Quantity	Amount	Date	Misc. S.R. No.	Pur. Order No.	Quantity	Amount	Quantity	Amount

Exhibit F.

Perpetual Inventory Form—Exhibit G

This is a commonly used form to record quantities of material ordered, received, used, and on hand at all times. A similar form can be set up for recording Finished Stock, by substituting "Production" for "Receipts," and "Shipments" for "Used."

ORDERED			RECEIVED			USED		INVENTORY		USED		INVENTORY		USED		INVENTORY	
DATE	QUAN	DATE REQ	DATE	QUAN	ENTRY NO	DATE	QUAN	DATE	QUAN	DATE	QUAN	DATE	QUAN	DATE	QUAN	DATE	QUAN

Exhibit G.

Payroll Forms

Since Cost Accounting is not concerned with the problems of payroll accounting except as they affect the distribution of accrued pay to the proper accounts, the forms shown are confined to a few that have distribution characteristics.

Daily Time and Distribution Sheet—Exhibit H

The clock numbers and names of the individual workers can be applied to this sheet before sending to the foreman in charge if the addressing equipment necessary to do this is on hand. Otherwise, it is the responsibility of the foreman to write in the name and hours worked, and designate the proper accounting codes in the spaces provided at the top of the form. The time reported is usually checked against the time shown on the clock ring card, which may be weekly or bi-weekly, depending upon the length of the pay period. The column "Pre. Hours" is for the computation of overtime or premium hours.

The form reads across to show the daily pay of each employee, and down to record the distribution. The totals across and down must check, and oftentimes effort can be saved in computing the distribution totals in dollars by combining the total hours to the same code at the same rate, before extending. This form is quite satisfactory where hourly rates are used and a considerable number of persons work at the same job, which results in a simple distribution problem. The earnings and distributions are posted to summary records if the payroll is assembled manually, or cards can be punched from the data on this form if mechanical tabulation is used.

Daily Time and Distribution Sheet—Exhibit I

This form is applicable to operations where the piecework or incentive rates predominate. Provision is made for clock no. identification only, but otherwise the procedure in using the form is similar to that used on Exhibit H.

Space is provided by the last few lines on the sheet for summarization of the accounting distribution.

Maintenance Time Ticket—Exhibit J

This form is padded and a copy may be made for the Engineering Department in following up expenditures against job appropriations between closing periods. It is best suited for reporting time of employees whose work is diversified and individual, such as maintenance of buildings, machinery, and equipment.

DAILY TIME AND DISTRIBUTION SHEET DATE

CLOCK NO.	FOREMEN 1st 2nd 3rd	ACCOUNTING CODES									PRE. HOURS	TOTAL HOURS	RATE	AMOUNT
	TOTAL HOURS													
	TOTAL DOLLARS													

Form 5568 10-45

Exhibit H.

DATE_____

CLOCK NO. _____ NAME _____

Job No.	Description	Hours	Rate	Amount	

FOREMAN_____

MAINTENANCE TIME TICKET - JOB NUMBER

Form 5569 10-45

Patt. Ex. J.

_____ PLANT - _____

DATE_____

LABOR REPORT

Types of Overtime
1. Daily or Walsh Healy 5. Holiday
2. Weekly 6. Sixth Day
3. Sunday as Such 7. Seventh Day
4.

CLOCK NUMBER	JOB CLASS.	CONTROL AND SOURCE	DEPT.	OPER.	LABOR CLASS	P or D	QUANTITY	WORKING TIME			SHIFT HOURS				TYPE OF OVER-TIME	HRS.	AMT.	TOTAL EARNINGS	
								Rate	Hrs.	Amount	Day	After-noon	Night	Amt.					

dividing the totals by the activity factor which can be direct labor dollars, machine hours, or total units to be produced at the selected standard volume.

The form provides for three standards, and, if it is the practice to set up standard expense rates once a year, it can be used for three years, thus keeping the files for standard cost at a minimum. Comparisons of changes in standards are facilitated by this arrangement which in itself is often quite valuable for analytical purposes, and in addition provides a ready check on the complete inclusion of all items when building new standards.

Form MSL 1-43

Standard Manufacturing Expense Detail

Operation - 10

	_____ Standard		_____ Standard		_____ Standard	
Source	Fixed	Variable	Fixed	Variable	Fixed	Variable
02 Salaries						
03 Indirect Labor - Prod.						
03 " " - Yard						
03 " " - M. R. M.						
03 " " - B. R. M.						
03 " " - E. & T.						
03 " Non-Rep. - M. R. M.						
03 " " - B. R. M.						
03 " " - E. & T.						
03 Improvement Expense						
09 Sundry Supplies						
10 Raw Material Expense						
13 Maint. Mat'l. - M. R. M.						
13 " " - B. R. M.						
13 " " - E. & T.						
13 " Non-Rep. - M. R. M.						
13 " " - B. R. M.						
13 " " - E. & T.						
13 Improvement Expense						
14 Fuel						
15 Freight						
16 Stationery						
Social Security						
Vacation Pay						
Retirement Insurance						
Group Insurance						
Share: - Electric Power						
Steam						
Mech. Overhead						
General Factory						
Taxes - Ins. - Depr.						
TOTAL EXPENSE						
Activity						
Rate						

Exhibit K.

The rates derived on this form are used in assembling product costs—see Exhibit L.

Final Cost Summary—Exhibit L

This form is most applicable for use in setting up complete standard costs for a catalog line of products accounted for by a process cost system.

The manufacturing processes are listed in the "Description" column and follow the actual factory flow of materials from the beginning of processing to the cost of sales.

By keeping the four elements of factory cost separate through each step of the processing, the final costs can be readily adjusted as required, particularly in respect to Sales Department needs. For example, if material costs are affected by an unexpected change in the prices of purchased material, the effect can be measured by adjusting the material cost column alone.

GRADE_____ **FINAL COST SUMMARY**

CODE_____ _____PLANT Date_____ 19____

DESCRIPTION	UNIT	QUANTITY	MATERIAL		LABOR		FIXED BURDEN		VARIABLE BURDEN		TOTAL COST	
			Rate	Amount	Rate	Amount	Rate	Amount	Rate	Amount	Rate	Amount

Exhibit L.

Chapter 13

LABOR SAVING DEVICES AND PROCEDURES; STATISTICAL SHORT CUTS; USE OF MACHINERY

By
T. H. PATTERSON *

The search which industry is making constantly to find quicker, easier and cheaper ways of doing things is not confined to engineering and manufacturing techniques, but extends to all related activities whether accounting, selling, or administrative. Any new device or procedure, therefore, that is evolved which performs a function quicker or more economically than it was done before can be classified as a labor saving device. In office and accounting work, reduction in labor is usually accomplished by (1) complete understanding of the problems involved and a thorough training of the individuals who are going to perform them, (2) elimination of needless detail, and (3) substitution of machine effort for manual effort.

In further elaboration of (1) above, this training is made easier and is more positive if it is augmented by a written procedure which prescribes the accounting technique to be followed, defines policies in accounting for borderline charges to assets or expense, and answers all other accounting questions that come up in the routine handling of accounting problems. For this purpose, therefore, an Accounting Manual which contains a chart of accounts, a description of them, the proper use of the accounts and the prescribing of general operating accounting procedure, is a timesaver and should be one of the first essentials in eliminating waste of time in the accounting office. Once the Manual is set up, it will operate with only minor changes and adjustments excepting in those instances where something new has been added to the accounting problems. In keeping the Manual up to date, certain sections may be added to and others eliminated or changed, but the revision process is not usually a laborious job, although it must be conscientiously followed so that the Manual really represents current practice and is not outmoded.

A list of standard time allowances for each major accounting step is of considerable assistance in maintaining a uniform closing schedule. Inasmuch as monthly calendar dates are not comparable unless the office force operates on a seven-day week basis, the schedule should be drawn up in terms of working days in the month, such as "10 A.M. 5th working day," etc. A copy of the master schedule is given to all supervisors who are responsible for meeting it and who plan their own supporting schedules.

The elimination of needless details can be accomplished by (1) application of the "Job Methods Training" approach which features accessibility of working ma-

* Chief Accountant, Armstrong Cork Co., Lancaster, Pennsylvania.

terial and tools, and the elimination of excess motion in performing the work; and (2) regular and periodic check up of the uses made of the work done or of the reports submitted. It is surprising how often a report is asked for to meet a real and specific need, and then continued indefinitely without question by the accountant. An accountant who has the opportunity of presenting his reports can perceive when any of them reach the point where interest is lagging or has ceased altogether. That is the time to discuss dropping the report.

The introduction of reliable non-listing calculators has done much during the past twenty years to relieve the accountant of the drudgery of making his computations by hand. Many of the timesavers, therefore, that have to do with use of short-cut methods of addition and subtraction have lost their value except in those rare instances where office calculating machinery is not available. There are many short-cut possibilities and specific applications of mathematical principles in the use of these office calculators that will reduce the amount of effort required to secure the desired results. Among those more common ones are the use of reciprocals where percentages to the same total are desired. It is easier for most people to multiply than it is for them to divide, even by mechanical means; therefore, on certain types of computation where many numbers have to be divided by the same amount, it saves time to secure a reciprocal and multiply the numbers times the reciprocal to get the desired percentages.

Another example of short cutting would be in the use of a chart showing the decimal equivalents of common fractions so that the machine operator has in front of her a conversion table to facilitate the multiplication or division by common fractions.

The tape listing adding machine, the typewriter, the duplicating machine, and the reproducing machine which operates from stencils prepared from special paper, are the most commonly used of time saving equipment in offices and are so well known that there is no need to elaborate further on their characteristics.

The intelligent designing and use of printed forms is a source of saving in many industries and the control of the forms and restrictions upon issuance of new ones is a very important matter and should be attended to by someone specifically assigned to that responsibility, either full time or part time, depending upon the size of the business. Economical sizes can be determined by reference to a chart of standard paper sizes, which can be secured from almost any printing house. Extensive use of preprinting desired information on forms is possible in factory operations; for example, where a certain commodity with perhaps dozens of descriptive characteristics is preprinted and the production identified by means of check marks opposite the proper written descriptions. The same thing can be said of the commonly used forms for billings or receipt of order forms in that, by the judicious use of carbon copies and the intelligent designing of the form, many uses can be made of a single typing of an order form. This form can be used for customer acknowledgment, order scheduling, order department use, sales office record, and a shipping copy which becomes the basis for the billing instructions to the billing clerks who prepare the invoices for sales to customers.

Filing equipment should be looked into carefully and selection made according to the requirements. A great variety of filing equipment is on the market providing for vertical, horizontal and rotary filing positions.

Tabulating Cards and Equipment

The basic features of mechanical tabulation are, first, the tabulating card through which holes are punched to record the desired data; second, the electric sorter which sorts the tabulating cards by electrical contact through the holes in the cards; and third, the tabulator which is either listing or non-listing, and which many include a computing device whereby multiplication, addition, or subtraction can be performed.

This kind of equipment can be used for numerous accounting purposes, among which are recording of production, inventory, and shipments; the accumulation of payroll and its distribution; and detailed analyses of various kinds, particularly in respect to sales.

The number of times the information punched on the tabulating card can be used is an important point to remember when considering tabulating equipment or the alternate methods which might be mechanical or manual. The more frequently use is made of the same punched information, the more reason there is for using tabulating cards and electrical sorting equipment. This type of equipment is used extensively to record sales by item, customer, salesman, territory, etc. Payroll listings and the calculation of net pay from cards showing gross pay and schedule of deductions, and the printing of the pay check can be done efficiently on this type of equipment, if there is sufficient volume to justify its installation.

General

It is impossible to lay down specific rules stating that this equipment or that equipment is best for a job because for certain size businesses one type of equipment will be most satisfactory and economical, and for a larger or smaller business some other equipment will be better. In deciding, therefore, on the kind of equipment to be used, care should be taken that the enthusiasm of the salesmen who are representing the product does not warp the judgment of the individual who will pay for it, and while there would be no question but that the job could be done as represented by the sales representative, you must answer the question as to whether it should be done that way. There are even occasions when it is cheaper and more economical to do a posting or payroll computation job manually because the equipment that otherwise would be used to perform the job has so much greater capacity than is required that there would be a tremendous amount of idle time on it and it would never pay for itself.

Statistical Short Cuts

One particular transaction in cost accounting that is adaptable to statistical short cuts is in the matter of revaluation of inventory when inventory is carried at standard cost. Oftentimes, a company has a consistent policy of inventorying at the lower of cost or market at the end of the tax year, and likewise inventories during the year on the basis of standard costs. It is a long job to recompute the standard costs on the lower cost or market and express them in cost per unit, especially at the year-end or mid-year closing when every minute counts. A useful statistical short-cut device is the calculation of the equivalent quantities on the inventory of any major raw material that might be contained actually in the materials in process or finished stock and adjusting on that basis. For example, in a product made of

grinding cork, such as Corkboard, the only ingredient in the Corkboard is the cork itself. As an example, if we would assume that the standard value of the Corkboard in finished stock and in process were based on grinding cork worth $100.00 a short ton, and it developed that at the end of the year the cost price was $95.00 and the market price $90.00, the problem of reducing the value of Corkboard from standard cost to the lower of cost or market would be relatively simple by first computing the baled cork equivalent of the quantity of Corkboard on hand. Having this total, and knowing that the standard cost was $100.00 a short ton, and the market price $90.00 a short ton, it would be known that the adjustment to inventory value for Corkboard material would be $10.00 a ton. Therefore, the extension of the equivalent tons represented by the stock of processed and finished Corkboard times $10.00 would give the inventory adjustment necessary to bring the standard cost to the market price which in this instance was lower.

This principle is, of course, more readily applied to certain manufactured articles than to others, depending upon whether there is a major or basic material component or not. There are numerous examples, however, where there is a material component that is highly important if not exclusive, and this procedure can be used to that portion of the inventory.

Another statistical short cut which often has usefulness is the quick calculation of costs at various volumes when the fixed unit cost is known. For example, an item at standard cost might be $10.00 a unit in respect to the fixed manufacturing cost, with a standard production of 1,000,000 units per year. For a quick calculation, the relation of any other desired quantity with the 1,000,000 units would give you the adjusting facts to the fixed unit of cost, viz., on production of 1,250,000 units per year, the unit cost of the fixed manufacturing expense would be $\$8.00 \left[\$10 \div \frac{1{,}250{,}000}{1{,}000{,}000}\right]$.

Chapter 14

THE FLOW OF DATA: ASSEMBLY AND REPORTING OF COST DATA

By
T. H. PATTERSON *

For the records required in the operation of a manufacturing establishment, there are two main directions to the flow of pertinent data and instructions, particularly as it concerns the accounting and administrative forces. In discussing these movements of data in their proper order, we come first to the securing of sales orders and the orderly transfer of this information to the points in the organization concerned with the order. Assuming that the order taken in this example is secured in one of the branch offices of the company, the movement of the order and the copies retained would be as follows:

1. Preparation of the order in the branch office where one copy is kept.
2. Copies #2, #3 and #4, #5, #6 of order sent to Accounting Office.
3. Approval of order by Credit Department.
4. Copy to customer acknowledging order.
5. Retention of one copy in main sales office.
6. Copy of order to Factory Production Planning.
7. Copy of order to Factory Shipping.
8. Copy of order to Factory Accounting Department.

At this point, the Scheduling or Production Planning Department of the factory will schedule the production if it is a special item, or, if a stock item, combine with others of a similar kind and include on a schedule chart for definite production and shipping dates. Upon shipment of the order, the Shipping Department will prepare the necessary bills of lading, mail one or more to the customer, send its copy, together with a copy of the bill of lading, to the Factory Accounting Office where the accounting copy will be taken from the file, attached to the bill of lading and sent to the Billing Section if the billing, as in this particular case, is done at a central point. The Shipping Office copy will then be returned to the Shipping Office to be kept on file there.

As a check against the possibility of omitting the billing of some shipments, each Factory Shipping Office prepares a summary of daily shipments listing the car number, the firm to whom the goods were consigned, and the order number, and gives the shipment an identifying number. This list is then mailed to the Billing Section. The Billing Section will bill from the information contained on the Factory Accounting copy, prepare the necessary copies of the bill for the customer, for the Accounts Receivable Section, and the Sales Analysis Section; check off the billing against the list of factory shipments, and send the Factory Accounting copy to the files.

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The other direction taken by accounting information is from the factory to the Accounting Office for the information which originates in the factory itself. This information will contain reports in respect to wages earned and the distribution of them for accounting purposes, the use of raw materials, the production of processed or finished material, and the incurrence of scrap.

Payroll Data

In most plants, the authority for pay and the official record of time worked is contained on clock ring cards, either daily, weekly, or biweekly if the pay period runs for two weeks. These clock ring cards are imprinted sometimes at the point of effort and in that respect reflect the time actually consumed on certain jobs, but in other cases are rung in at a more or less central point or several general points in the factory and the clock rings on such cards reflect the time in and out of the plant. The routing of payroll information will take the following course:

Hours on clock ring compared by factory clerks with hours of work reported by foremen and balanced.
Rate of pay determined, (1) by hourly rate on day work, (2) by supplementary piecework data showing production and time elapsed, (3) same report will show the accounting codes to be applied to the labor.
This information sent to Payroll Section where the hours of work are extended by the rate of pay and the gross earnings determined daily.
Summary made by pay periods of earnings by employees.
Computation of deductions.
Computation of net pay.
Preparation of payroll check.
Preparation in Payroll Section of payroll distribution to accounts and credit to Accrued Payroll for monthly accounting period.
Preparation of entry charging Payroll Paid and crediting Cash and miscellaneous deduction accounts for the payrolls actually paid during the accounting period.
Difference between the debits on the Payroll Paid and the credits on Payroll Accrued represent the net accrued payroll at the end of each accounting month.

Usage of Material and Resultant Production

Elsewhere in this article, the procedure for purchasing raw material has been described, and the next illustration of the flow of data will start with the material in the Factory Stores Account. The flow of data will be as follows:

Requisition to Storeroom for quantities needed signed by foremen securing the material.
Report to Accounting Office daily the use of the raw materials.
Report to the Accounting Office daily the production of processed materials at the end of that particular foreman's responsibility.
Reporting of production scrap daily to Accounting Office.
Assembly in Accounting Office of information coming in from the factory in respect to usage of raw material, production of goods, and amount of scrap.

From the above reports on production and usage of materials, the Accounting Office will prepare at whatever times are required, and at a minimum once each accounting period, the record showing the history of what has happened to the raw material, the production therefrom, and accounting for its cost and variance from

standard. This procedure is carried out throughout the factory from the points of origin of production until the production has been finished and shipped. It is frequently expedient for the plant to have a work schedule copy which goes with the production from point to point, and it is absolutely necessary in an operation processing a product to a certain point to identify it for the next operation, both as to its content and the quantity delivered. If this information is not on a route card, it can be put on the material as it leaves the department by means of tags or other identification devices.

Repair Orders—Mechanical Work

While the above is typical of production work throughout a plant, a somewhat different procedure and flow of data are necessary in the handling of mechanical work that has to do with the maintenance of equipment or the building of new equipment for use within the plant. For mechanical and engineering work, rules are usually set up as to the amount of money that can be spent on certain types of work with the foreman's approval, and beyond which further approval, perhaps of the Engineering Department or even of the plant superintendent, is required before work is begun. On a small job where the foreman would have complete responsibility for issuing the order, the routing would be as follows:

Foreman prepares the order and sends all three copies to the Engineering Office.
The Engineering Office applies estimate of costs and accounting code.
Copy returned to the foreman, copy kept for the Engineering Office and later turned over to the Shops, and third copy sent to Property Accounting.

On large maintenance jobs or where capital investment is to be made, it is good practice to have the request for work done accompanied by a letter of explanation as to its purpose, the saving in cost to be brought about, and other pertinent facts. The routing of such an order would be as follows:

Prepared by engineer working on project.
Approved by Chief of Engineering Department.
Approved by Factory Superintendent and returned to Engineering Office where copies of the repair or capital expenditure order are prepared.
Copy retained by Engineering Office.
Copy sent to Property Accounting.

Costing of Sales

The costing of sales can be done by first summarizing the quantities shipped each month and extending the items by the standard manufacturing costs, or, if the number of items which are shipped are extremely large, the cost of sales can be secured by further use of the Factory Accounting copy described in the handling of orders. If it is desired to get the cost of sales from summarization of the factory accounting copy of the order, this information can be applied at the factory before the accounting copy is sent to the Billing Section for billing. If a hand tabulated job is made, the costs can be summarized to the proper commodity groups which, in most cases, are a great deal less numerous than the items; or, if the work is done through punch card tabulation, the cost copy can be matched with the Sales Analysis copy, and a card punched showing the description of the item, the sales income, the proper commodity classification, and the standard cost of sales. This

card will then be used for tabulation of sales income by commodity, and cost of sales by commodity.

The Assembly and Reporting of Cost Data

The first thing to do in getting out a report is to be sure that the data received is factual. Much attention has been given in recent years to the form in which such data are presented, and rightly so, since the securing of the information is only a part of the job, albeit a very necessary function. Proper interpretation of operating results, the fixing of responsibilities for good and bad work, and the bringing to light of the effect of changes in manufacturing procedures are a few of the uses made of accounting reports. One of the fundamental things to remember is to prepare the report so that it is useful to the person receiving it. Following this principle, it is altogether likely that a number of reports will be made to different individuals for cost results on a particular product in various stages of its production, with the details decreasing as the level of management increases. The foreman, for example, who is responsible for a certain phase of the work, would receive a great deal of detail in respect to how his performance compares with standard. In reporting the results of that particular foreman's work to, say, the superintendent, a summary of the foreman's operation showing standard and actual and perhaps the period to date would be sufficient for the purpose. If the superintendent wanted to know anything further about the details, he could inquire.

The forms used in Exhibits 1 and 2 are illustrative of this principle, although Exhibit 1 is designed to show the results for the total plant and by commodity groups and on this particular type of report the results by foremen are not indicated. You will note that the performance against standard is shown in the first group as the direct responsibility of the plant superintendent, whereas in the other groups the fact is noted that variances from these standards affect commodities, but the responsibility is not the same as it is in the first group. The effect of volume on absorption of expense, and the loss or gain in purchasing, while they both affect total plant operating costs and the commodities served, are segregated from the other variances because of difference in responsibility. In many businesses, the securing of necessary volume for absorption of burden is considered a responsibility of the Sales Department, and likewise the securing of material at the standard purchase rates is considered a responsibility of the Purchasing Agent. At the bottom of the report, wherever it is possible to unitize a commodity, the standard cost per unit is shown, as well as the actual cost per unit. This latter figure is found by starting with the standard unit cost and unitizing the variances from standard. The actual cost then is the algebraic sum of the standards and the variances.

Exhibit 2 is a monthly record prepared primarily for the use of foremen, although copies of this are sent elsewhere as noted on the form. These variances may or may not be broken down to commodities, the exhibit illustrated being intended for use of all commodities for which that foreman is responsible. On the reverse side of the form is a space for notes concerning the causes of variances if any notes are necessary. One of the desirable things about this report for foremen is that it shows the results of preceding months from which it is possible for the foreman or anyone looking at the variance report to get an impression of the trend in the performance against standard.

In Exhibit 3, the report is designed to show the profit or loss by commodities

and by divisions. It is prepared monthly for sales managers, and periodically for general executives. The same information in respect to manufacturing variances which was found on the plant superintendent's report is transferred to this form. In addition to these data, the unit sales prices, actual and budget, and the gross sales, actual and budget, are likewise shown, as well as the gross margin before application of selling and commercial or other income and expense. As a matter of fact, it is quite possible from this exhibit to get the spread between the standard manufacturing cost and the net sales, thus indicating the profit possibility of the division or the commodity with manufacturing costs at standard. This form is not unduly cluttered up with details, yet it does give the sales manager a chance to do some analysis work, both as to current operations and the period to date results. The form is designed to show the current month in the first half of the form and the period to date in the second half.

_____ Plant

VARIANCES FROM STANDARD COST

Month of _____

	TOTAL PLANT		COMMODITY A		COMMODITY B		COMMODITY C	
	Amount	%	Amount	%	Amount	%	Amount	%
Manufacturing								
Variance from Allowance for:								
Material Utilization								
Direct Labor								
Scrap								
Expense Budgeted								
Reconditioning-Mfg. Respons.								
Total-Production Efficiency								
Cost not Included in Standards								
Overtime								
Wage Increase-Direct Labor								
Wage Increase-Indirect Labor								
Expense (Dif. Between Budget) (and Std. Allowance)								
Reconditioning-Sales Respons.								
Misc. Income or (Expense)								
Total-Other Manufacturing								
Total Manufacturing								
Expense - Volume								
Purchasing								
TOTAL VARIANCES								
Std. Cost of Units Processed								
Actual Cost of Units Processed								

Comments:

Exhibit 1.

Exhibit 4 is a simple chart form used to record the actual unit cost and sales price of certain commodities. This is a variation of the same information which was presented on Exhibit 1, at least in the charting of the total costs, and it is often found that certain individuals prefer to see results of this kind in chart form be-

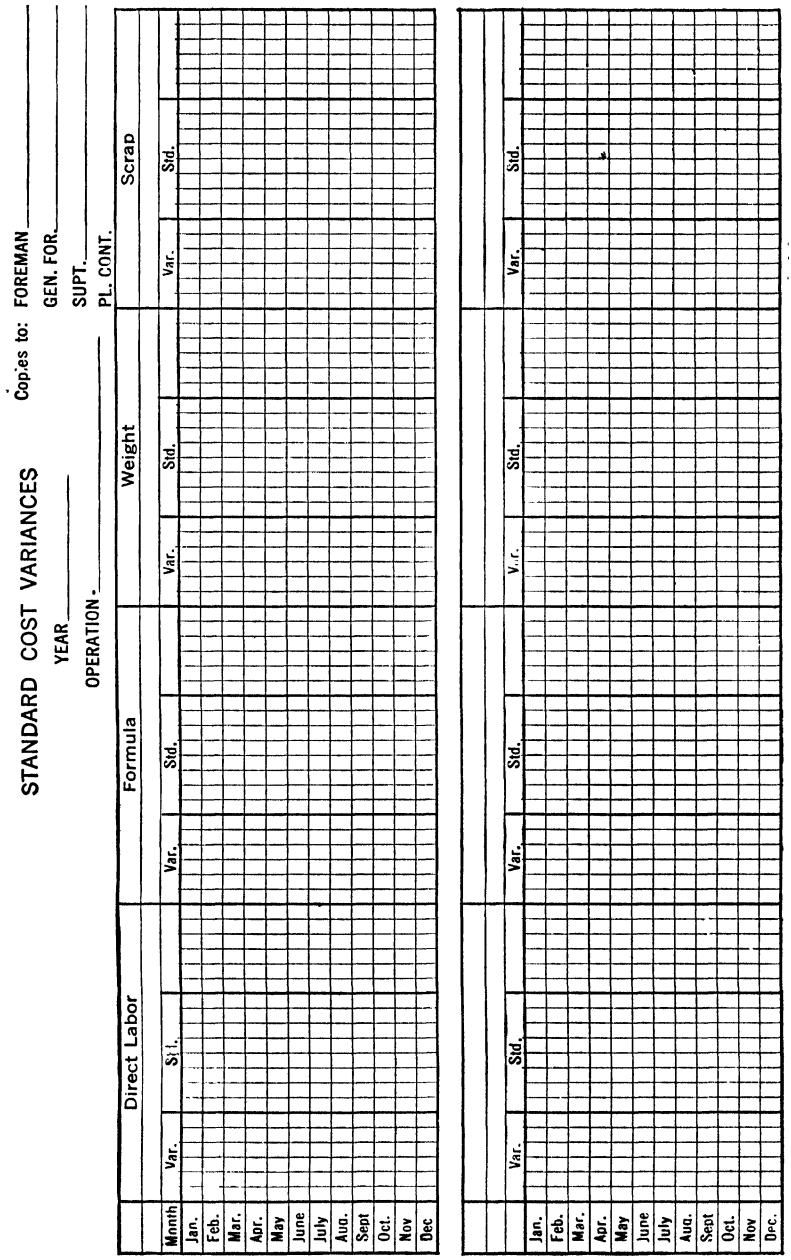

Exhibit 2.

cause it is easier for them to follow and interpret. The data on this form are not nearly as subject to analysis as those on Exhibit 1, and are not intended to be; rather the form is a record of actual performance and actual profit results without reference to any data concerning the cause of the profit or the loss condition.

_____Division

STATEMENT OF PROFIT AND LOSS BY MAJOR COMMODITY GROUPS

Month of

		Total	Commodity A	Commodity B	Commodity C
Units Sold:	Budget				
	Actual				
Unit Price:	Budget				
	Actual				
Gross Sales:.	Budget				
	Actual				
Net Sales:	Actual				
Std. Mfg. Cost of Sales					
Mfg. Variances					
Plant Volume Variance					
Purchasing Variance					
Actual Mfg. Cost					
GROSS MARGIN					
Selling Expense					
Commercial Expense					
Other Income (Expense)					
NET PROFIT LOSS before tax					

_____Months_____

Units Sold:	Budget				
	Actual				
Unit Price:	Budget				
	Actual				
Gross Sales:	Budget				
	Actual				
Net Sales:	Actual				
Std. Mfg. Cost of Sales					
Mfg. Variances					
Plant Volume Variance					
Purchasing Variance					
Actual Mfg. Cost					
GROSS MARGIN					
Selling Expense					
Commercial Expense					
Other Income (Expense)					
NET PROFIT LOSS before tax					

Exhibit 3.

Exhibit 5 is an illustration of a report which can be used for follow-up on promised cost reduction, due either to anticipated change in equipment or to a planned revision of production methods. This exhibit is used for anticipated cost changes, whether higher or lower, which have not been incorporated in the standard costs, but which are scheduled for certain dates during the coming year. The blank space in the box at the top of the form is used largely to describe in more detail the things to be done, and in it are contained all the pertinent data in respect to primary and secondary responsibility. In this is also shown the approximate effective date of the cost

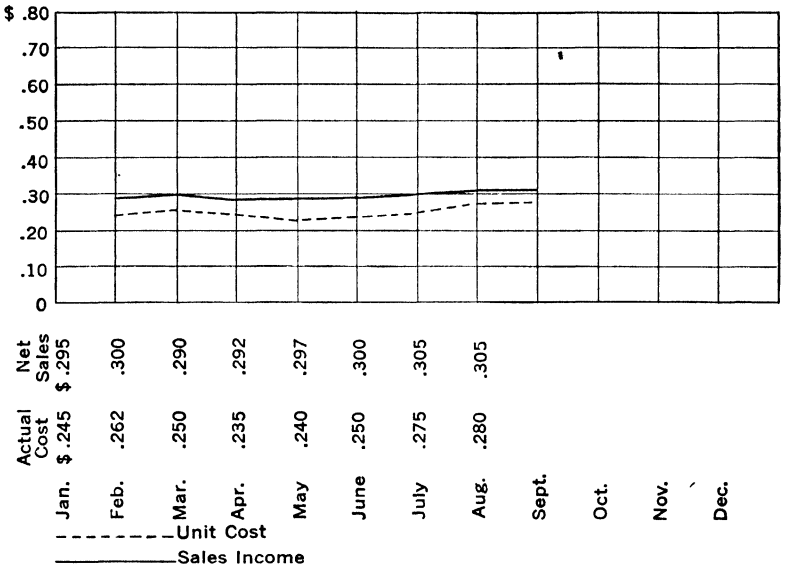

Exhibit 4. Comparison of Actual Unit Cost and Sales Price of Commodity *A*.

change. The cost change is then budgeted by months for the coming year and the actual results are tabulated against it. On the reverse side are spaces for short monthly comments. This form has been found very effective in following up promised cost changes and it can be the responsibility of the Industrial Engineers or the Cost Accounting to keep the information up to date and to arrange for corrective action. Whoever is made responsible for reporting those data must see to it that judgment is used in initiating corrective action and that he confine references to the plant superintendent, for instance, to cases that appear to be out of control or falling very far behind schedule and are apparently being neglected by the person directly responsible.

As against the preparation of specific reports for specific uses, there is the alternative use of a compromise form for any report under consideration which might be used by a number of people at various management levels. This procedure will undoubtedly save time and money in the preparation of the report information, but is usually deficient in that it does not satisfy the needs of anyone getting it since it must contain data for a number of purposes. As a result, it is often difficult to

understand or becomes cluttered up with detail which makes it tiresome to read. As a consequence, the important savings brought about by intelligent and effective use of report data are often missed. In general, if effective use is being made of a report, there is small likelihood of an accountant receiving a complaint as to its cost, even though the cost may be appreciably higher than getting out more general reports which are not as usable although more economical to prepare. Another

COST CHANGE ACHIEVEMENT REPORT

Item No. _____ Description _____ Responsibility _____

TASK PERFORMANCE

Year	Current Month		Period To Date	
	Actual	Budget	Actual	Budget
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

Gen'l Prod. Supt. _____ Engineering _____

Prod. Supt. _____ Laboratory _____

Gen'l Foreman _____ Plant Controller _____

Ind. Engineer _____

Exhibit 5.

important thing about the report is the interpretation of them by the accountant. No one in the organization knows more about what has gone into the report than the accountant and yet it frequently happens that he is reluctant to take the lead in reviewing the report with the recipient and making interpretative comments as to what it indicates to him. The personal discussion of a report with the person who is supposed to use it is most helpful to the accountant and to the person receiving the report. Personal presentation of a report gives the recipient a chance to ask questions about matters in the report which may puzzle him, and it helps develop in the accountant a management viewpoint which can do the firm for whom he is working and himself a great deal of good.

Chapter 15

COST TRANSACTIONS AND THE JOURNALS

By
C. W. SARGENT *

The collection of total costs in the formal accounting records requires:

1. Provision of means for recording each transaction immediately upon its occurrence; that is, methods of making and preserving the original evidences of transactions.
2. Provision of means for summarizing transactions of like kind; that is, various types of journal records and procedures.
3. Provision of
   a. A ledger structure, and
   b. A detailed classification, or chart, of accounts for recording and classifying the cost totals determined through the journal procedures.

These records constitute the formal cost mechanism, the procedures whereby the various kinds of cost items are recorded, summarized, and classified in the correct accounts and the proper ledgers. In addition to these procedures, there are, as already pointed out, many other expressions of costs that may precede or follow, in point of time, the preparation of the formal cost records. Examples of such statements are budgets prepared in advance of operations, and many cost analyses and reports that are prepared after the closing, and outside of the book records here referred to.

In the third point, distinction is made between the ledger structure and the classification of accounts. The former refers to the number and kinds of ledgers required in the accounting system and their relationship to each other. The classification or chart of accounts refers to the list of accounts used to analyze and summarize all of the financial aspects of the enterprise, and includes those required to record both the external, and the internal or cost transactions. The classification provides the framework of all value analysis in the business. It must be used in the original record of events, as well as in the journals and ledgers, to show what account or accounts are affected by each transaction.

The three phases of formal cost procedure noted above must be planned and interwoven to operate together; they must form an integrated system. The journal procedures must be related to the ledger structure and to the original records of transactions. The original record must provide transaction data in terms of the classification. All of these phases of the formal cost methods must be developed to fit a particular cost situation; they must be custom-built to serve specific purposes in each enterprise. It is possible to describe them in detail only in reference to a particular environment and use.

Some aspects of these records are now described. The original evidences of transactions are considered briefly; extended discussion of these forms and papers

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is given elsewhere. Summarization or journal procedures are more extensively discussed, with emphasis given to the voucher register and the factory journal. Discussion of the ledger structure and the classification of accounts is deferred to Chapter 16.

Original Evidences of Transactions

Business transactions must be recorded at the time of occurrence, so that facts about them may not be lost and so that their financial effects can be summarized. Obviously in the case of the types of transactions that are numerous—such as the collection and payment of cash, the shipment of goods, the issuance of materials and supplies, and the incurrence of labor costs—recollection cannot be depended upon to furnish the facts about these events or their money significance.

The form or report describing a business event that is prepared at the time of occurrence, or immediately thereafter, is called the original evidence of the transaction. The purchase invoice and the sales invoice are examples of business papers associated with external transactions. Cost accounting adds to the evidences required for general accounting the various forms and reports needed to record the many internal transactions of the business.

The original evidences of transactions will serve one or more purposes as circumstances require; they will provide:

1. An accurate description of the transaction.
2. An authorization of the transaction, if one is required.
3. A record of the financial effect of the transaction, when this can be expressed immediately in money.
4. A certification of responsibility for the transaction and of the accuracy of the financial facts given.

Not all of these functions are served by all original evidences. Many such records, as indicated by the lists below, do not require or permit immediate expression of their financial effects. When a money value is stated, the quantitative factor and the price factor by which it is determined will usually be indicated, and the ledger accounts affected will be shown by code number in accordance with the classification.

The variety of business events that are evidenced by some form of original record is indicated by the incomplete list given below.

I. Factory Orders Covering What Is To Be Made or Done:
   1. Orders for the manufacture of products:
      Product orders—for component parts, or whole products
      Process, and operations orders
      Replacement orders
   2. Orders relating to activities or tools which facilitate production:
      Pattern orders
      Tool orders
      Move orders
      Inspection orders
   3. Repair or maintenance orders
   4. Property change orders for
      Additions
      Betterments
      Retirements

II. Evidences Related to the Incurrence of Expenditures:
1. Purchase contracts and agreements
2. Purchase invoices and expense bills
3. Vouchers, and voucher checks

III. Evidences Related to the Procurement and Use of Materials and Supplies:
1. Purchase requisition
2. Request for quotation
3. Price record
4. Purchase order
5. Received report
6. Purchase inspection and rejection report
7. Purchase invoice
8. Purchase debit memorandum
9. Purchase credit memorandum
10. Return shipment notice
11. Bin card
12. Material reserved memorandum
13. Issued requisition
14. Bills of material issued
15. Reports of material used
16. Materials returned to stock report
17. Identification tag
18. Inventory test report
19. Physical inventory tag
20. Physical inventory sheet
21. Inventory over-and-short report

IV. Evidences Related to Labor:
1. Application form
2. Employment form
3. Employees' record
4. In-and-out time card
5. Late and absent report
6. Daily time report, direct labor
7. Daily time report, indirect labor
8. Job ticket—day work, or piece work
9. Premium and bonus ticket
10. Group bonus report
11. Rate change notice
12. Transfer record
13. Idle time report
14. Overtime report
15. Inspection report
16. Advance payment authorization

V. Evidences Related to the Progress of Work:
1. Transfer orders
2. Spoiled work report
3. Rejected work report
4. Material reconditioned report
5. Scrap report
6. Completion report

VI. Evidences Related to Sales, Shipment, and Billing:
1. Customer's order
2. Credit authorization

3. Sales order
4. Shipping order
5. Packing and delivery slip
6. Sales invoice
7. Return shipment authorization
8. Debit memorandum
9. Credit memorandum

VII. Evidences Related to Cash Receipt and Disbursements:
1. Cash receipt slip
2. Deposit slip
3. Remittance advice
4. Canceled check

The cost accountant is concerned directly or indirectly with practically all of these evidences of transactions. Those that do not require immediate entry in the accounting records—the purchase requisition, and the purchase order, for example—are usually related to later transactions that require formal entry. Sometimes several of these evidences are combined to support the record of the transaction when it reaches the stage of accounting recognition; for example, the purchase order, the received report, and the purchase invoice unite in supporting the voucher which authorizes payment. A different condition exists in relation to factory orders. Although the factory orders listed above are not given accounting recognition, they are nevertheless the basis of a related type of record, namely, the order cost sheet, that is in many cases used to accumulate the cost of individual product, repair, and construction orders.

Two major cost accounting uses of these original evidences must be emphasized and explained at this point.

1. They are used as the medium of posting to subsidiary records, either (a) directly, or (b) through summaries made to being together like transactions, for example, a number of requisitions chargeable to the same production cost sheet, or to be credited to the same subsidiary material stock sheet. This use of original records is discussed in the next section of this chapter.

2. They are used as the basis for accumulating *total* cost figures, by means of summarization through some form of journal record, for entry in the ledger control accounts. Journalization is merely a systematic summarization of the financial data provided by the original evidences of transactions. The nature of the journal function is explained in later sections of this chapter.

The final analyses of cost can have no greater accuracy and completeness than are provided by the original evidences. Data lacking in the original evidences, or inaccurately expressed there, must be lacking and inaccurate in all subsequent summaries and analyses. Hence the importance of care in making the original records cannot be exaggerated.

Original Evidences as Subsidiary Posting Media

As was pointed out in the last section original evidences are usually the media for posting the subsidiary records. Sales invoices are used to post subsidiary accounts receivable ledgers. Purchase invoices may likewise be used to post an accounts payable ledger when this record is maintained. This use of the original evidence of the sale may be a direct one; each sales invoice in this case is posted to

the individual customer's account. Sometimes the use made of the original evidence is an indirect one; several sales invoices, as an illustration, are combined into a single posting to the account record. A large distributor of gasoline, for example, with many service stations, customers, and thousands of sales slips monthly, makes it a practice to summarize the slips for each customer into one figure for the month; only this single total is posted to the accounts receivable ledger sheet. Several illustrations of the use in cost accounting of original evidences as the source of subsidiary postings are cited below.

Consider the function of the direct material requisition. It represents a single transaction covering the issuance of a stated amount of a specified kind of material used in the manufacture of a certain product. The requisition serves as the agency for recording these facts, which are to be used as follows:

1. As the media for posting the credit—both in quantity and total cost—to the perpetual stock sheet for the kind of material specified.
2. As the media for posting the debit—for the quantity perhaps, anyway for the total cost—to the order cost sheet or other means of accumulating the cost of the product for the manufacture of which the material is used.

These uses of the data provided by the requisition relate solely to the posting of the subsidiary records. The control records, both the direct material control and the work in process control, must also be credited and charged, respectively. These entries must be in totals for like kinds of requisitions, that is requisitions that are to be charged and credited to the same control accounts. The requisition must be used also as the means, through some form of journal, of accumulating the total entries to these control accounts.

In the description above, the requisition is the medium for direct posting both to the perpetual inventory sheet and to the product cost sheet. Sometimes accounting labor can be saved by eliminating direct posting from the requisition to one or both of these subsidiary records; more often direct posting to the product cost sheet is eliminated. When this is done the requisitions for a specified period applicable to a certain order are first summarized and the total is posted to the cost sheet. In these circumstances, applicable also to accounting for factory supplies, the requisitions are used as follows:

1. As the media for the direct posting of the credit to the individual perpetual stock record.
2. As the means of accumulating the total charge for direct material used in a certain month in the manufacture of a certain product; or in the case of factory supplies, the total charge for the month to a particular operating expense account.
3. As the means, through some form of journal record, of accumulating the total debit and credit to the appropriate control accounts. The same summarization that serves in (2) should be used, if possible, to supply the control totals.

Evidences of other transactions are used in a similar manner. Labor time tickets for example are used:

1. To post the payroll, a record subsidiary to the accrued payroll liability account.
2. To charge the individual product cost sheet or an appropriate subsidiary department account, either directly or through the use of a summary.
3. To accumulate totals appropriate for entry in general ledger controlling accounts such as work in process, and departmental expense control accounts.

This last use of the original evidences of transactions is described further in succeeding sections.

The Journal Function

The original evidences of transactions, after being made and used to post subsidiary records, must also be used as the basis of the journal function—that is, in summarizing and classifying the financial effects of transactions for posting to control and other ledger accounts. This summarization must be done in accordance with the requirements of the ledger structure and the account classification.

The journal function may be performed in the several ways described below.

A. By the use of special journals, one for each of the several kinds of transactions that are numerous, supplemented by a general journal in which all other transactions are entered. Examples of numerous transactions for which special journals are sometimes provided are: sales invoices, audited vouchers, material requisitions, and costing completed production. Under this method journalization and ledger posting are accomplished as follows:

1. The original evidences of transactions are written. This is usually performed by persons other than members of the accounting department.
2. The several types of numerous transactions, such as sales invoices, purchase invoices, labor time tickets, and material requisitions are entered in special journals, thereby summarizing each kind of frequent transaction separately.
3. Other transactions are entered in the general journal. These transactions occur singularly or infrequently; examples are the monthly entry for depreciation, insurance, and tax accruals. Many of these single transactions are not simple, and entry in the general journal may be based upon an elaborate study and analysis, such as a depreciation schedule. Some degree of summarization of these dissimilar transactions may be accomplished in the general journal, thereby reducing the number of ledger postings.
4. The financial data summarized in the special and the general journals are posted to the appropriate general and subsidiary ledger accounts.

B. By the use of summaries of groups of like transactions. These summaries are in reality journals of a less formal nature than the customary book journals. They may be tabulating machine recapitulations, adding machine tapes, or other hand or machine prepared statements showing items and totals, or merely totals of money values to be charged or credited to specified ledger accounts. With the increased use of mechanical devices, such as tabulating equipment, for recording, analyzing, and summarizing the great volume of transactions found in large enterprises, there is a pronounced tendency for the journal, as a formal book record, to disappear. The journal function, of course, cannot be eliminated; rather it must be developed by the application of methods that will more economically summarize great numbers of similar transactions. Examples of the use of summaries in place of the formal journal as a means of recapitulating numerous like transactions are: the sales analysis, which has almost entirely supplanted the formal sales journal; and the material used summary (or report) that has eliminated the requisition journal.

These summaries are used as follows:

1. As the basis for direct posting to the ledger accounts. In general this procedure will not be satisfactory, because many forms of summaries do not lend themselves to this use. When this is done, the formal journal record is entirely eliminated for the types

of transactions that are separately recapitulated, although the general journal will be retained for the non-summarized types of transactions.

2. As the basis for an entry in the general journal. The general journal is in this case made up of a series of entries arising from the weekly or monthly summaries of like transactions, and of entries for individual transactions that do not require the preparation of a summary. This procedure is more satisfactory than the one previously described The general journal is then the only source of postings to the general ledger; postings to some subsidiary cost or expense accounts may, however, be made directly from the summaries.

3. As the basis for the preparation of a journal voucher. Under this method, to be described more fully in a later section of this chapter, even the general journal is abolished as a formal book record. The summaries of groups of like items, and the single items that otherwise would be entered in the general journal, are each recorded upon an individual entry statement called a journal voucher.

The Journal Structure

The journal structure is composed of the aggregate of general and special journals and/or summaries and journal vouchers that are used in accounting for the affairs of a single enterprise. In addition to the matters of nature and form of the journal record discussed in the last section, the matter of location is also important. Two conditions are encountered relative to this factor. In one situation all of the journals are kept at one point, namely, the general accounting offices of the company. In the other situation, some of the journals, usually those pertaining to the general or financial accounts, are kept at the general offices; and the other journals, usually those relating to the cost accounts, are kept at one or more separate factory or branch offices which are often located at a distance from the main office.

The journal structure of a company might include the following:

A. Financial or general accounting journals or summaries:
   1. Purchase journal; or voucher journal, usually called the voucher register
   2. Cash disbursement journal; under the voucher system usually called the check register
   3. Cash receipts journal
   4. General journal
   5. Analytical sales summary; that is an analysis of sales by products, territories, salesmen, etc.
   6. Analytical sales returns and allowance summary
   7. Stock transfer and similar journal records may also be kept by the company, but frequently are kept by others

B. Cost accounting journals or summaries:
   1. Material requisition journal, or material used summary
   2. Supplies requisition journal, or supplies used summary
   3. Payroll
   4. Payroll distribution summary
   5. Burden absorbed journal, or summary
   6. Cost of completed work journal, or summary
   7. Cost of goods shipped journal or summary
   8. Factory general journal, in which all other transactions and frequently also the totals from the summaries are entered as explained in the last section

If these journals are to be divided between a general and a factory accounting office, the former would normally retain the records listed under A, and the latter

would assume responsibility for keeping the journals and summaries listed under B. Some doubt might arise as to the placing of the cost of goods shipped journal or summary. If the general office assumes responsibility for sales, shipments and finished inventory, this journal belongs in that location. On the other hand the factory may be responsible for the finished inventory, and for making shipments in accordance with instructions from the general office; in this case it will also keep the cost of goods sold journal, or prepare a periodic analytical summary of the cost of shipments.

Other matters affecting the journal structure may also require adjustment upon the division of records between these two offices. The general office will very likely require its own payroll record for administration, sales, and other supervisory salaries. The factory may require its own cash accounts. It may also, more rarely, have its own voucher register. Also, both sets of journal records must be adjusted to provide entries for the reciprocal control accounts that will ordinarily be used with this division. This matter will receive comment later.

The student of general accounting is familiar with the cash receipts, sales, sales returns, and general journals. The voucher register, the check register, and the factory journal are discussed below, both when maintained as parts of a single set of journals, and when the journals are divided between the general and the factory offices.

It should be noted that the journals of a company, and of course its ledgers and the making of the original evidences of transactions, may be separated among any number of branch plants and offices, dependent only upon the degree of decentralization that the company wishes to introduce into its accounting methods.

The Voucher System

The voucher system is a carefully planned method of recognizing, verifying, and recording the liabilities that are normally described as current payables, for distributing the charges arising from these expenditures, and for authorizing payment to be made. The voucher system is comprised of the following documents and records:

1. The voucher
2. The voucher check
3. The voucher register
4. The check register
5. The voucher index

The voucher system is an outgrowth of the purchase journal, but is superior to the latter, in that the voucher record covers not only purchases of material but all purchases of any kind whatsoever, even when these purchases are paid for immediately in cash. Under the purchase journal method, liability for expense items (other than material) is not recognized in the accounts. No entry for such items is normally made until the time of payment, when distribution is effected through the cash disbursement journal; or at the end of the year, by adjustment.

The voucher system is superior not only in the matter of inclusion, the recognition of expense purchases in the accounts, but also in the systematic procedures followed for verifying all purchase obligations, for preserving evidence of the authenticity of the liability, and for authorizing payment. The more important fea-

tures of the voucher system, according to the Accountants' Handbook,[1] are as follows:

"1. Complete elimination of cash purchases of either commodities or services, except as made through petty cash.

"2. Vouchering of all recognized accounts payable and effecting of payment only on proper authorization.

"3. Emphasis upon the individual bill or invoice as the liability unity, together with tendency to eliminate formal creditors' ledgers.

"4. Elimination of purchase journals restricted to merchandise or materials, and introduction of voucher register designed to cover incurring of all costs, including fixed assets."

Procedure Under the Voucher System

A condensed description of procedure in handling the original evidences of transactions and of making the journal record under the voucher system follows:

A. Verification of Invoices. The purchase invoices covering materials and expense items are first checked as to quantities, unit prices, extensions, receipt of material or service, authorization of the purchase, and other aspects. This will require comparison with other evidences of transactions, such as the purchase requisition, the duplicate purchase order, the receiving report, the inspection record, the freight bill, the return shipment notice, and the purchase debit or credit memorandum. Upon completion of the verification processes, the approved invoice, and in some cases the other supporting papers, are sent to the voucher section of the accounting department.

B. Preparation of the Voucher and Voucher Check. The voucher is a printed form, to which the invoices and other supporting papers may be attached, that contains the following types of information:

1. Voucher number, check number (if different from the voucher number), date prepared, month of entry.
2. Payee in whose favor the voucher is drawn.
3. The amount of the voucher, and the bank on which disbursed (this information is added at time of cash payment, rather than at time of original preparation of the voucher).
4. The specific invoices paid by the voucher—the date, number, terms, gross amount, discount, and other deductions taken, and net amount paid on each invoice. The invoices themselves are attached to the voucher.
5. The distribution of the charges—the account or accounts, both control and subsidiary, that are to be charged with the amounts authorized to be paid by the voucher.
6. Evidence as to (1) responsibility for (a) checking the evidence supporting the voucher, (b) the correctness of the distribution of the voucher, and (c) entry of the voucher in the voucher register; (2) executive approval of the voucher, and (3) authority for payment. Executive approval and authority for payment are usually combined unless a considerable delay between preparation of the voucher and payment is customary.

The voucher check contains the following kinds of information:

1. The check itself—composed of information also shown on the voucher and described above as items 1, 2, and 3. In addition, the check must bear the proper signatures which authorize payment by the bank.

[1] W. A. Paton, Editor, *Accountants' Handbook,* The Ronald Press Company, New York, 1933, p 843.

2. The remittance advice—made up of the information described under item 4 above. This part of the voucher check is usually made detachable, so that after it has served the purpose of informing the payee how the amount of the payment was determined and what it covers, the check alone may be sent through the bank.

There are many types of vouchers and voucher checks. It is preferable to design them to permit the preparation of both of these documents together. This can be done if the blanks are so drawn that data described in items 1 to 4 above will register properly, in typing, upon both forms. In this case the voucher check is the original copy, and the voucher is the carbon copy. The voucher may be prepared in triplicate, or quadruplicate, whenever more than one copy is required.

C. Entering the Vouchers in the Register. This is done immediately upon authorization of the voucher. The information shown in the register is illustrated in Figures 1 and 2. Attention must be given at this point to a numbering system for vouchers entered in the register. Several methods are described below.

1. Vouchers are numbered consecutively throughout a year, or longer. This method occasions difficulty if vouchers for two consecutive months are being registered at the same time. This condition obtains for the first few days of every month.
2. Two series of numbers are used in alternate months, each bearing a prefix number to designate whether applicable to odd or even months. The series is continued indefinitely until the numbers become so large as to be cumbersome. This method overcomes the difficulty mentioned in (1).
3. The vouchers of each month are given numbers composed of one figure to indicate the month (as 1 for January, 12 for December) and a second group of figures to represent the serial number within the month. Thus the fiftieth voucher registered in June is numbered 6–50. Sometimes this numbering system includes the year also; then the one hundred and first voucher issued in March 1939 might be 393–101.

D. Holding the Vouchers for Payment. Upon completion of registry, the vouchers and voucher checks are filed in a manner to bring them to the attention of the paying department in time to permit discounts to be taken and due dates to be met. A tickler file is often used for this purpose.

E. Disbursing the Voucher Checks. Just prior to the discount or due date, or whenever it is decided that payment is to be made, the voucher and the voucher check are removed from the tickler file, the proper signatures are attached to the voucher check, the bank at which payment is authorized and the date of disbursement are inserted upon both documents, and the voucher check is mailed or delivered to the payee. In addition to these steps:

1. The disbursement is recorded in the payment memorandum column of the voucher register, and
2. The disbursement is entered in the check register. In comparison with the cash disbursement journal under non-voucher procedure, the check register is a much simplified record. Ordinarily it contains the following information:

Date of payment
Voucher number (and check number if not the same as the voucher number)
Payee
Amount of voucher
Amount of discount taken, when this is deducted through the check register
Net amount paid
Distribution columns, one each for the various banks at which payment is authorized

A form of check register is illustrated in Figure 3.

F. Indexing the Vouchers. Immediately upon payment (sometimes after registry) entry of the voucher is made upon the voucher index. This is a classified record with a sheet for each payee. Upon these sheets there is entered the number of the voucher, its amount, and if desired the date of payment. The latter information of course cannot be entered at once if the index is prepared immediately after registry. The purpose of the index is to supply a quick reference to all vouchers issued to each payee. It is an indispensable record when the accounts payable ledger is abolished, as is usually the case under the voucher system and when the paid vouchers are filed numerically.

G. Filing the Paid Vouchers. As soon as the voucher checks have been disbursed and the vouchers indexed, they are filed for permanent keeping, either alphabetically or by number, or both alphabetically and numerically if a duplicate copy of the voucher is available for this purpose.

H. Proving the Control Account Balance at the End of the Month. When the accounts payable ledger has been abolished, the control figure should be subject to proof at the end of the month from two sources: (1) the items not marked off as paid in this column of the voucher register; and (2) the file of unpaid vouchers.

The Voucher Register

The voucher register is an important cost journal inasmuch as it records the distribution of all expenditures that are to be paid in cash. There are many forms of voucher registers; some with distribution columns confined to a single page; others with distribution columns spread over several sheets. The number of columns will depend upon the extent of the use of controlling accounts, whether the factory accounts have been removed from the general ledger, the methods of posting the subsidiary ledgers, and the preferences of the accountant who designs the record. Every register will show, in the heading, the name of the company, the month, and the sheet number; and in the body of the form, the date of each voucher, in whose favor drawn, the voucher number, the date paid, the amount of the voucher, and a number of distribution columns. A check number column is also needed if the check number is not the same as the voucher number.

Figure 1 illustrates a simple voucher register designed for use when the factory accounts are kept in the general ledger. Figure 2 illustrates the same register modified because of the removal of the factory accounts to a separate reciprocally controlled ledger. Either of these records is kept in the general office.

A matter of some importance in arranging the voucher register is the determination of the method to be used in handling cash discounts. Several possibilities exist.

1. The voucher is registered for the gross amount of the invoice. This method is illustrated in Figures 1 and 2. Discount is deducted in this case at time of payment through the check register. The latter record is shown in Figure 3.

2. The voucher is recorded at the net amount of the invoice in the vouchers payable column of the register. This type of entry is employed when reasonable certainty exists that all discounts will be taken. As to the remainder of the entry in the voucher register two possibilities exist:

   a. The amount of discount available (but not yet earned) is credited to a discount column in the register; and the gross amount of the invoice covered by the

CHECK REGISTER

AMPWELL MANUFACTURING COMPANY

Month of January, 19 Page 1

Check No.	Date	Paid to	Vo. No.	Vo. Pay. Dr.	Purchase Discount Cr.	First Nat. Bank Cr.	Second Nat. Bk. Cr.	Third Nat. Bk. Cr.
1271	10	Bedol Chem. Co.	1–2	210 40	4 21	206 19		
1272	11	Paymaster	1–3	15,290 00				15,290 00
1273	12	Adams Co.	1–1	5,871 10	58 71		5,812 39	

Fig. 3.

voucher is charged in the proper distribution column. This method of entry is illustrated in Figure 4.

Vo. No.	Vo. Payable Cr.	Discount Available Cr.	Factory Ledger Dr.	Factory Ledger Dr.
1–1	5,812 39	58 71	5,871 10	
1–2	206 19	4 21	210 40	
1–3	7,150 20		7,150 20	
1–4	2,101 10	89 60	1,810 20	

Fig. 4.

b. The discount column is eliminated and the net amount is entered also in the distribution column. In Figure 4, the factory ledger would be charged $5812.39 for voucher 1–1, according to this method. The effect is to charge the various asset and expense accounts only with the net amount expected to be paid.

If the discount is lost because of late payment, an additional voucher can be made for the further payment required. This amount can be charged to a discounts lost account, or to the account that would have been charged had the distribution columns shown the gross amount of the invoice.

Both of these methods of entering only the net amount in the vouchers payable column require the making of adjustments at the end of an accounting period for (a) the discounts lost, because of the expiration of the period on vouchers still unpaid; and (b) the discounts still available on unpaid vouchers but not yet earned because payment may not be made within the discount period.

The necessity for making a correction of the amount of a voucher after entry in the register, and the occasional need for handling partial payments may be the cause of some awkwardness under the voucher method, but the difficulties of handling

these transactions are not great in comparison with the many advantages of this system.

Vouchers in the Factory Records

When the voucher register form illustrated in Figure 2 is used, and the factory ledger is moved from the general office and is reciprocally controlled with the general ledger, some means must be adopted for notifying the factory office of the transactions shown in the voucher register that affect the factory ledger. Various devices are employed for this purpose.

1. An extra copy of the voucher may be prepared for these transactions and sent to the factory office. This office will then:
   a. Enter each voucher individually in the factory journal where it is recorded chronologically with other factory journal entries (illustrated in Figure 6), or
   b. Introduce a special journal, which may be called "Factory Voucher Analysis Record," for the purpose of recapitulating the distribution of the duplicate copies of vouchers affecting the factory ledger. This journal merely provides a place for summarizing this particular type of transaction. To illustrate the working of this method, consider vouchers 1–1, 1–2, 1–3, and 1–4 in Figure 2. These vouchers are charged to the Factory Ledger Control account in the general office voucher register. Upon entry here a duplicate copy of these vouchers is sent to the factory office. This office then enters these duplicates in the Factory Voucher Analysis Record, the credit being to General Ledger Control; the debits go to the accounts shown for these vouchers in Figure 1.
2. As an alternative procedure to sending a duplicate copy of the voucher to the factory office where each is entered individually in a factory general or special journal, the main office may prepare a Monthly Entry Advice covering all vouchers affecting the factory accounts. This advice will show the same information as is shown by the monthly totals of the Factory Analysis Record, were this form kept in the factory office. The work of arriving at these totals is now performed in the general rather than the factory office. When the method described in this paragraph is followed, and the subsidiary ledgers for direct material and supplies are kept in the factory office, means must be employed to inform the factory office currently of postings to be made to the various subsidiary material and supply accounts to record the receipt of materials and supply items.

Another method of handling factory vouchers exists when the voucher register, and perhaps also the disbursement of cash, is decentralized. In this case each factory or branch maintains its own voucher register just as it would were it an independent company.

The Factory Journal Function and Structure

The function of the factory journal or journals is to summarize the value aspects of the internal transactions that are particularly related to production, such as the issuance and use of materials and operating supplies; the distribution of labor costs; the apportionment of service department expense; the allocation of overhead expense to product cost; the closing out of the accumulated costs of product, repair, and construction orders; and the shipment of goods to customers. As was pointed out in an earlier section, the factory journal function may be performed as part of a single set of general office records, or it may be set apart and performed in one

or more separate factory offices, the accounts of which, nevertheless, are reciprocally controlled with the general office records.

In either of these circumstances the factory journal structure will be composed of one or another of the sets of records enumerated below:

1. A series of formal, special factory journals (one for each of the kinds of transactions listed in the previous paragraph that require the summarization of many original evidences), and a general factory journal in which all other transactions are entered.
2. A series of summaries for the types of numerous transactions, supplemented by a factory journal in which (a) the totals of the summaries, and the other miscellaneous transactions are entered; or in which (b) only the other miscellaneous transactions are entered, the summaries having been used as the source of direct posting to ledger accounts. The latter method is unsatisfactory unless the summaries are sufficiently formalized to approach the nature of a special journal.
3. A series of summaries for the types of numerous transactions, the totals of each of which are recorded at the end of the month on an individual journal voucher. Journal vouchers for all regular transactions are prepared in a fixed series each month. Irregular transactions are also covered by journal vouchers. Under this method the factory journal is abolished, and there is substituted therefor a number of journal vouchers somewhat analogous to the accounts payable vouchers described earlier.

As a further alternative it should be pointed out that when the factory records are not separated from the general office records, the factory transactions may be entered in the general journal. This record is, however, usually ill-adapted for summarizing the internal cost transactions along with the miscellaneous financial transactions, and hence this method of performing the factory journal function is not expedient except in the very simplest circumstances.

The Factory Journal Illustrated

The nature of the factory journal, when it is supported by a series of summaries the totals of which are entered therein, is illustrated in Figures 5 and 6.

Figure 5 is designed for use as a part of a single general office system of records. Figure 6, on the other hand, is designed for use with a reciprocally controlled factory ledger. Differences in this type of record in these circumstances are listed below:

1. Figure 6 includes entries for the individual vouchers which affect the factory ledger accounts. When there is no separation, the entry in the voucher register maintained at the general office is sufficient. When the direct material control, the factory supplies control, and other accounts are transferred to the factory ledger, vouchers affecting these accounts must be not only entered in the voucher register, but also entered in some manner upon the factory records. Hence Figure 6 provides columns for these accounts that are not required in Figure 5; hence this record also shows the entries at January 2, 5, 11, and 13.
2. Figure 6 provides two columns for debiting and crediting the General Ledger Control account. This account is reciprocal with the Factory Ledger Control account maintained in the general ledger. For every transaction that charges or credits the latter account in the general ledger, the General Ledger Control account in the factory books must be credited or charged. Therefore the balance in these accounts should always be equal and opposite.

The manner in which vouchers affecting the factory ledger are accounted for in the general office voucher register and in the factory journal is illustrated in Figures

2 and 6. Voucher 1–1, for example, is entered in the general office record as follows: (Figure 2):

	Debit	*Credit*
Factory Ledger Control	$5,871.10	
Vouchers Payable		$5,871.10

Entry in the factory journal (Figure 6) is as follows:

	Debit	*Credit*
Direct Material Control	$5,871.10	
General Ledger Control		$5,871.10

Without a separation of records between the general office and the factory this transaction is fully journalized in the voucher register (Figure 1) by the following entry:

	Debit	*Credit*
Direct Material Control	$5,871.10	
Vouchers Payable		$5,871.10

With a separation of records, the general office charges all items for which the factory ledger carries the accounts, to the factory through the single account Factory Ledger Control; and the factory books give the general office credit for these items by crediting General Ledger Control. These two reciprocal accounts exactly offset each other, so that if trial balances of the two ledgers are taken and combined, these two account balances may be eliminated. The use of these accounts, however, make each set of records self-balancing and complete in the technical sense of presenting in a trial balance an equivalance of debits and credits. Also, each office has constantly available a single account that presents the net amount of its financial claim upon or obligation to the other.

The entries in Figure 6 arising from vouchers are made from a duplicate copy of the voucher supplied by the general office; the latter retains the original voucher. Other entries are prepared from weekly or monthly summaries.

The summaries used to support many of the entries in Figure 5 and 6 are prepared weekly. Whether weekly summaries are useful or desirable must be decided in each individual case. If weekly summaries serve no purpose not served equally well by monthly summaries, the formal factory journal may be abolished, and a journal voucher plan using monthly summaries may be substituted.

The Journal Voucher and Transfer Vouchers

The journal voucher method of recording entries is one in which the journal, as a book record, is eliminated. Substituted therefor is a series of entries, each prepared on an individual form, called a journal voucher. The significance of the word voucher in this connection is that the form usually bears a certification of the correctness of the entry and an authorization by some responsible executive for placing the entry on the books, just as does the voucher payable. The entry is, in other words, formally vouched for, or vouchered, before it may be posted to the ledger. Two forms of journal vouchers are shown in Figures 7 and 8. Figure 7 shows the heading and a type of simple journal ruling. Figure 8 shows another style of ruling that may be combined with the heading shown in Figure 7.

JOURNAL VOUCHER

AMPWELL MANUFACTURING COMPANY
Factory No. 1

J. Vo. No._____
Month of_____
Year_____
Page____of____Pages

To _____

Enter the following to cover _____

Explanation _____

Prepared by _____ Checked by _____ Posted by _____

Approved for Entry _____ Date _____

Acct. No.	Name of Account	Detail	Debit	Credit

Fig. 7. Journal Voucher with Simple Journal Ruling.

Three aspects of the substitution of journal vouchers for the factory journal equire comment.

1. Journal vouchers should be prepared in the same order, month by month; that s the same type of transaction should be recorded on the same voucher number each nonth; journal voucher 5, for example, should regularly cover the journalization of the ummary of operating supplies used.
2. Supporting papers may be attached and should always be referred to if they are ıecessary to substantiate any part of the entry.
3. The journal vouchers and supporting papers should be carefully filed and preserved.

A form somewhat similar to the journal voucher is the so-called transfer voucher, ›r the inter-office entry advice. This may be prepared in much the same form as

DEBITS				CREDITS			
Account No.		Amount		Account No.		Amount	
Sub.	Control	Subsidiary	Control	Sub.	Control	Subsidiary	Control

Fig. 8. Ledger Type of Ruling for a Journal Voucher.

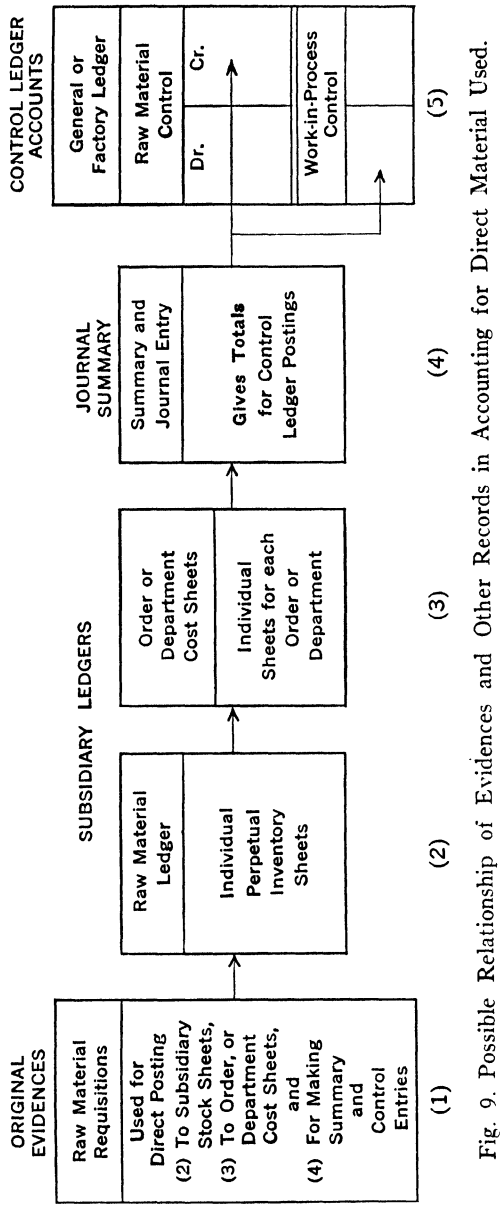

Fig. 9. Possible Relationship of Evidences and Other Records in Accounting for Direct Material Used.

the journal voucher. Its purpose is to advise the factory office, for example, to make a certain entry, say to cover depreciation expense for the period, when the property accounts are kept on the general office books. The duplicate copy of the voucher, referred to earlier, is a form of inter-office entry advice. Depending upon the methods followed, the recipient of these journal advices may use them:

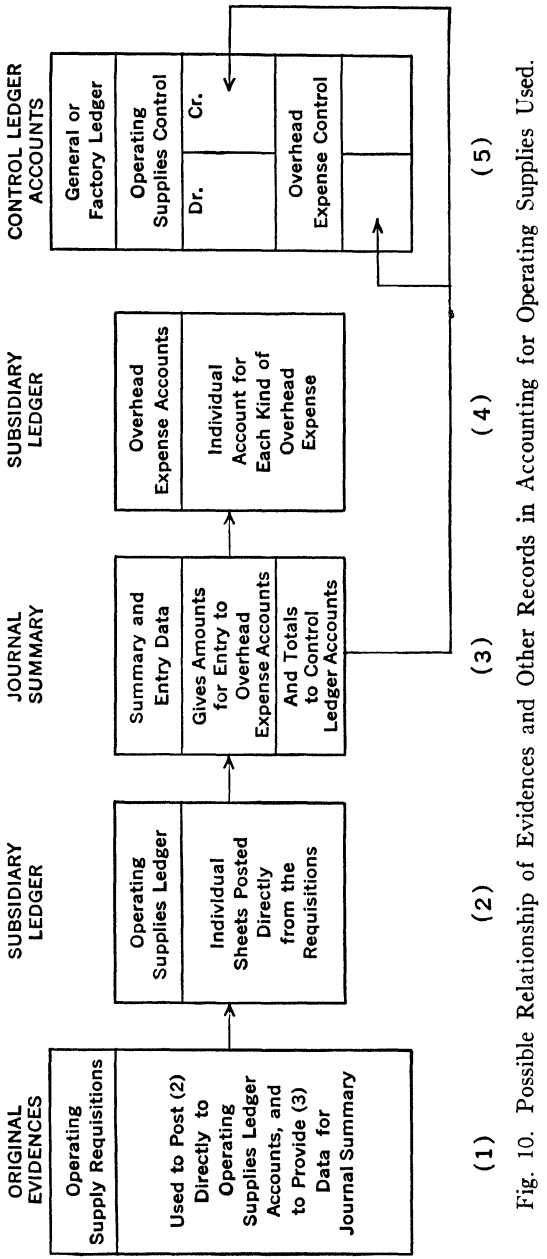

Fig. 10. Possible Relationship of Evidences and Other Records in Accounting for Operating Supplies Used.

1. As a medium of direct posting to ledger accounts; in this case they are in reality a form of journal voucher.
2. As a basis for an entry in the factory or general office journal.
3. As supporting papers for one or more journal vouchers.

The journal voucher provides a very useful and flexible method of performing the journal function, particularly for large organizations where preliminary summaries are necessarily prepared, usually by machine methods, for practically every type of transaction, and where the data for entries will be compiled in many separate offices.

Conclusion

Some of the matters discussed in this chapter may be reviewed in diagrammatic form. This is the purpose of Figures 9 and 10.

Figure 9 presents a schematic view of one form of relationship between the original evidence of transactions and the subsidiary ledger, journal, and control ledger records affected. The arrangement depicted is called a possible relationship, because it is only one of several methods applicable to accounting for direct material used. According to the method outlined, the direct material requisitions (1) are first used (2) to post quantity and cost figures to the issued columns of the individual perpetual inventory sheets in the direct material ledger. Presumably this is done daily, that is immediately upon the issuance of the materials. Next (3) these same requisitions are the media for posting a record of the quantity and cost figures to the individual order or department cost sheets which collect the costs of work in process. Having served this purpose, they are used finally (4) to provide the data for compiling a summary which gives the total value to be journalized and posted (5) as a debit to the work in process control and a credit to the raw material control accounts in the general or factory control ledger.

A somewhat different sequence of events is shown in Figure 10. This method is frequently found in accounting for the use of operating supplies; it may also be employed in the right circumstances in accounting for direct materials, and for other purposes. In this case the original evidences of transactions (1) operating supply requisitions, are used (2) to post the individual sheets, one for each kind of material, in the operating supplies subsidiary ledger. Next they are used (3) to prepare a summary of supplies used for the period, usually a month. This summary is used for direct posting or is the supporting data for a journal entry which gives (4) the amounts chargeable to the individual accounts in the operating expense ledger, and also provides totals for posting (5) to the control accounts in the general or factory control ledger.

Chapter 16

LEDGERS AND THE CLASSIFICATION OF ACCOUNTS

By
C. W. SARGENT *

Introduction

The discussion of methods used in recording, classifying, and summarizing costs is continued through a consideration of ledgers and the classification of accounts. Cost accounting uses a variety of devices and procedures, which, in contrast with financial accounting methods, are characterized by

1. A greatly increased use of subsidiary ledgers and associated control accounts, including reciprocally controlled factory ledgers.
2. A greatly expanded classification of accounts designed to record the more minute analysis of factory expenditures that is required for cost purposes.

These matters are discussed in succeeding sections of this chapter.

The Ledger Structure

The ledger structure is composed of the aggregate of general and subsidiary ledgers that are used in accounting for the affairs of a single enterprise. A simple ledger structure under cost methods might include the following ledgers, all of which are subsidiary to a single general ledger:

1. Accounts receivable ledger.
2. Notes receivable ledger.
3. Buildings ledger—individual cost and depreciation reserve records for separate units.
4. Machinery and equipment ledger—individual cost and depreciation reserve records for separate units.
5. Direct materials ledger.
6. Operating supplies ledger.
7. Work in process ledger.
8. Manufacturing overhead expense ledger.
9. Finished goods ledger.
10. Constructions orders ledger—individual cost records for each addition, betterment, retirement, and major overhauling project.
11. Securities ledger—if the outside investments are numerous.
12. Selling expense ledger.
13. Administrative expense ledger.
14. Accounts payable ledger.
15. Capital stock ledgers—one for each type of capital stock outstanding.

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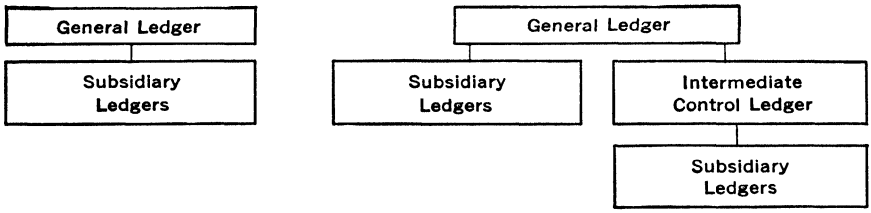
These ledgers may be arranged at several levels. In some cases, all are directly subsidiary to the general ledger. In other cases an intermediate ledger is introduced between the general ledger and certain of the subsidiary ledgers. In these circum-



stances some of the ledgers are directly subsidiary to the general ledger, and others are subsidiary to the intermediate ledger. These two ledger arrangments are represented diagrammatically above.

If the factory is located at a distance from the main office, it is often necessary to keep the subsidiary ledgers relating to production at the plant office so that the data they contain are constantly and immediately available. In this case the various ledgers listed above may be assigned as follows:

Main Office

A. *General Control Ledger*—to which the following ledgers are subsidiary:
   1. Accounts Receivable
   2. Notes Receivable
   3. Security
   4. Buildings
   5. Machinery and Equipment
   6. Selling Expense
   7. Administrative Expense
   8. Accounts Payable
   9. Capital Stock

Factory Office

B. *Factory Control Ledger*—to which the following ledgers are subsidiary:
   1. Direct Material
   2. Operating Supplies
   3. Work in Process
   4. Factory Expense
   5. Finished Goods
   6. Construction Order

The general ledger provides the over-all accounting control for the factory accounts and transactions. This control is no longer direct, however, but is effected through the agency of the intermediate factory ledger which stands between the general and the subsidiary factory ledgers. The two control ledgers are interrelated by means of reciprocal accounts as explained below. The ledger structure in this situation is presented diagrammatically in Figure 1. It scarcely needs to be pointed out that the factory ledger may be used as an intermediate control device, even when all the ledgers are kept in one office. In this case, however, the reciprocal control account device is usually lacking, and the factory ledger is operated in a manner applicable to any subsidiary ledger.

The ledger structure depicted in Figure 1 is called simple because in a large organization the control accounts and subsidiary ledgers may be multiplied several or many times: (1) instead of a single accounts receivable control and a single subsidiary ledger there may be many, the subdivisions being alphabetical, geographical, or both; (2) there may be several control accounts and subsidiary ledgers for machinery and equipment, one for each branch factory; (3) there may be several

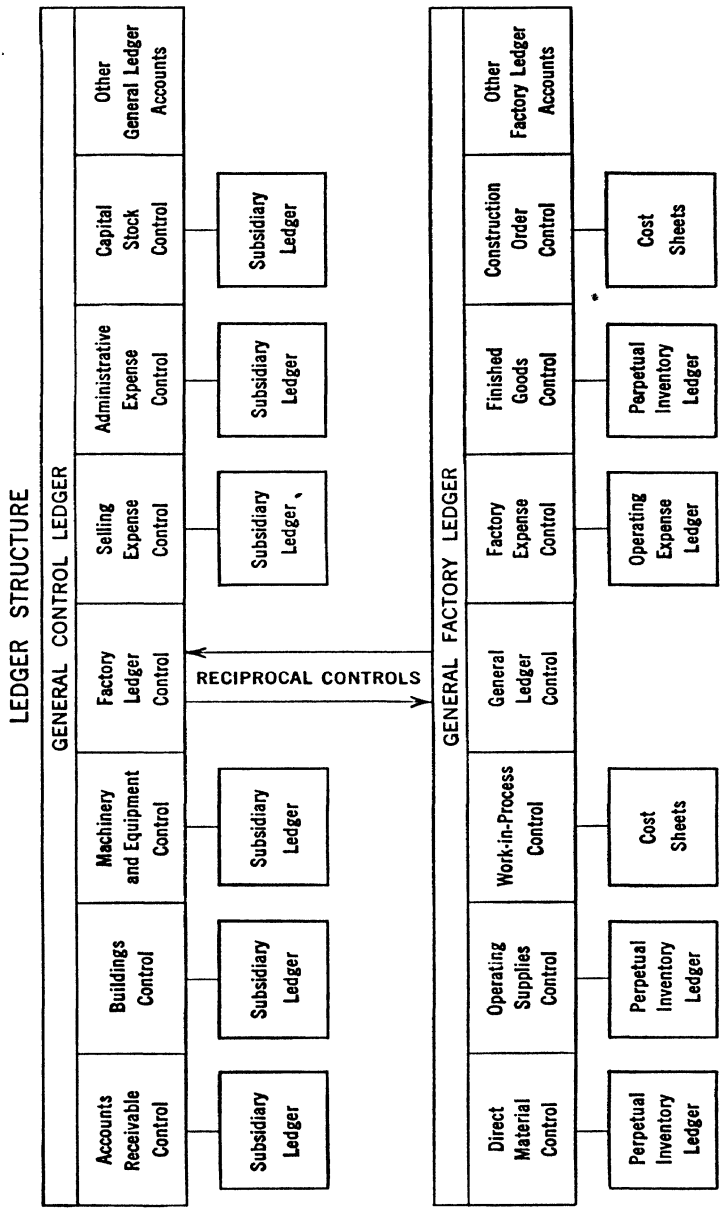


Fig. 1. Simple Ledger Structure, with Reciprocally Controlled Factory Ledger.

factory ledger control accounts and corresponding factory ledgers, each with the subsidiary ledgers shown in Figure 1. This situation, as to the factory ledgers only, is represented in Figure 2.

The contents of the factory ledger must be determined in each case. As a minimum the direct materials, operating supplies, work in process, and factory overhead expense control accounts will ordinarily be included in the factory ledger. Often, in addition, the finished inventory and the plant investment accounts are included. Normally the factory will have its own petty cash account, and often a payroll fund account operated on the petty cash basis. The factory may, more rarely, keep its own sales, accounts receivables, general cash, and vouchers payable records.

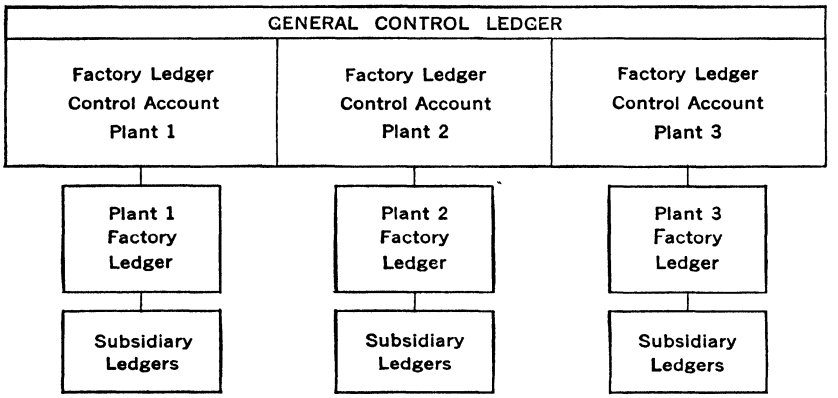


Fig. 2. Multiple Factory Ledgers.

Names other than factory ledger control and general ledger control are sometimes used for the reciprocal accounts; an example is "Works Current Account," and "General Office Current Account." Moreover, the single account may be subdivided and several reciprocal accounts used; examples are Factory Inventories, Factory Fixed Assets, used when the plant accounts are maintained on the factory ledger; and Factory Current Liabilities, used when the factory ledger carries such accounts. This subdivision seems to serve little purpose, because in any event the general office and factory office trial balances will be combined or consolidated, preliminary to making up the periodic statements.

Factory Ledger Reciprocal Control Accounts

In order to demonstrate the operation of a reciprocally controlled factory ledger, assume the following conditions relative to the division of records between the factory and the general office:

1. The factory ledger contains the control accounts shown in Figure 1. The factory office is concerned with the product cost transactions only to the moment of shipment, and with property change or construction orders.

2. The general office maintains the plant investment accounts, the cost of goods sold account, and all liability accounts, and keeps the financial journals related to sales, cash receipts, cash payments, and vouchers payable.

The trial balance of the general and the factory ledgers at January 1 are presented below.

ZINDWELL MANUFACTURING COMPANY
General and Factory Ledger Trial Balances
January 1, 19—

Name of Account	General Ledger Debit	General Ledger Credit	Factory Ledger Debit	Factory Ledger Credit
Cash on Deposit	$ 45,000.00			
Notes Receivable	10,000.00			
Accounts Receivable Control	50,000.00			
Direct Material Control			$ 35,000.00	
Operating Supplies Control			10,000.00	
Work in Process Control			15,000.00	
Finished Goods Control			40,000.00	
Land	18,000.00			
Buildings	60,000.00			
Reserve for Depreciation—Bldgs.		$ 9,000.00		
Machinery and Equipment	200,000.00			
Reserve for Depreciation—Mach. and Equip.		50,000.00		
Prepaid Insurance	1,600.00			
Vouchers Payable		20,000.00		
Accrued Property Taxes		2,700.00		
Accrued Payrolls		1,500.00		
Capital Stock Common		300,000.00		
Earned Surplus		101,400.00		
Factory Ledger Control	100,000.00			
General Ledger Control				$100,000.00
Totals	$484,600.00	$484,600.00	$100,000.00	$100,000.00

Summarized transactions for the month of January, and corresponding entries made in the general and the factory ledgers are presented in the table below in general journal form.

Transactions (Summarized totals for the month)	General Ledger Entries			Factory Ledger Entries		
	Name of Account	Debit	Credit	Name of Account	Debit	Credit
1. Cash Receipts	Cash	$45,000.00		No entry		
	Accounts Receivable Control		$ 45,000.00			
2. Vouchers Registered	Factory Ledger Control	60,000.00		Direct Material Control	$40,000.00	
	Accrued Payroll	23,000.00		Operating Supplies Control	15,000.00	
	Selling Expense Control	16,000.00		Factory Expense Control	3,000.00	
	Administrative Expense Control	9,000.00		Construction Orders Control	2,000.00	
	Vouchers Payable		108,000.00	General Ledger Control		$60,000.00
3. Cash Disbursements	Vouchers Payable	75,000.00		No entry		
	Cash		75,000 00			
4. Direct Materials Used	No entry			Work in Process Control	30,000.00	
				Direct Material Control		30,000.00
5. Factory Wages Earned	Factory Ledger Control	25,000.00		Work in Process Control	15,000.00	
	Accrued Payroll		25,000.00	Factory Expense Control	10,000.00	
				General Ledger Control		25,000.00
6. Operating Supplies Used	No entry			Factory Expense Control	9,000.00	
				Operating Supplies Control		9,000.00

Transactions	General Ledger Entries: Name of Account	Debit	Credit	Factory Ledger Entries: Name of Account	Debit	Credit
7. Depreciation Accrual	Factory Ledger Control	1,000.00		Factory Expense Control	1,000.00	
	Selling Expense Control	50.00		General Ledger Control		1,000.00
	Administrative Expense Control	100.00				
	Reserve for Deprec.—Bldg.		150.00			
	Reserve for Deprec.—M. & E.		1,000.00			
8. Insurance and Tax Accrual	Factory Ledger Control	400.00		Factory Expense Control	400.00	
	Selling Expense Control	50.00		General Ledger Control		400.00
	Administrative Expense Control	50.00				
	Prepaid Insurance		200.00			
	Accrued Property Tax		300.00			
9. Burden Applied to Work in Process	No entry			Work in Process Control	25,000.00	
				Factory Expense Applied		25,000.00
10. Cost of Production Finished	No entry			Finished Goods Control	60,000.00	
				Work in Process Control		60,000.00
11. Sales on Account	Accounts Receivable Control	100,000.00				
	Sales		100,000.00	No entry		
12. Cost of Goods Sold	Cost of Goods Sold	70,000.00		General Ledger Control	70,000.00	
	Factory Ledger Control		70,000.00	Finished Goods Control		70,000.00

After the posting of these entries the reciprocal control accounts appear as follows:

FACTORY LEDGER CONTROL

Jan. 1	Balance	100,000.00	Jan. 31	Goods Shipped	70,000.00
31	Vouchers	60,000.00		Balance	116,400.00
	Wages Earned	25,000.00			
	Depreciation	1,000.00			
	Ins. and Taxes	400.00			
		186,400.00			186,400.00
Feb. 1		116,400.00			

GENERAL LEDGER CONTROL

Jan. 31	Goods Shipped	70,000.00	Jan. 1	Balance	100,000.00
31	Balance	116,400.00	31	Vouchers	60,000.00
				Wages Earned	25,000.00
				Depreciation	1,000.00
				Ins. and Taxes	400.00
		186,400.00			186,400.00
			Feb. 1	Balance	116,400.00

Trial balances of both the general and the factory ledgers at January 31, 19— follow.

The preponderance of control accounts should be noted in this trial balance and in the preceding entries. In connection with this type of account it must be remembered that

For every debit and credit to a controlling account there must be equal debits or credits, in the aggregate, to one or more subsidiary ledger accounts.

This rule applies, in a special sense, to the reciprocal controlling accounts: For every amount entered in one of these accounts, an equivalent, but *opposite* amount must be entered in the other. For every amount debited or credited to the Factory Ledger Control, an equal amount must be credited or debited to the General Ledger Control. In this way, equal opposing or reciprocal balances are maintained.

ZINDWELL MANUFACTURING COMPANY

General and Factory Ledger Trial Balances

January 31, 19—.

Name of Account	General Ledger Debit	General Ledger Credit	Factory Ledger Debit	Factory Ledger Credit
Cash on Deposit	$ 15,000.00			
Notes Receivable	10,000.00			
Accounts Receivable Control	105,000.00			
Direct Material Control			$ 45,000.00	
Operating Supplies Control			16,000.00	
Work in Process Control			25,000.00	
Finished Goods Control			30,000.00	
Land	18,000.00			
Buildings	60,000.00			
Reserve for Depreciation—Bldgs.		$ 9,150.00		
Machinery and Equipment	200,000.00			
Reserve for Depreciation—Mach. and Equip.		51,000.00		
Prepaid Insurance	1,400.00			
Vouchers Payable		53,000.00		
Accrued Property Taxes		3,000.00		
Accrued Payrolls		3,500.00		
Capital Stock Common		300,000.00		
Earned Surplus		101,400.00		
Sales		100,000.00		
Cost of Goods Sold	70,000.00			
Factory Expense Control			23,400.00	
Factory Expense Applied				$ 25,000.00
Selling Expense Control	16,100.00			
Administrative Expense Control	9,150.00			
Construction Order Control			2,000.00	
Factory Ledger Control	116,400.00			
General Ledger Control				116,400.00
Totals	$621,050.00	$621,050.00	$141,400.00	$141,400.00

Ledger Forms and Rulings

Many kinds of ledger forms and rulings are used in connection with the various ledgers shown in Figure 1. Several are mentioned below.

A. The general and factory control ledgers are usually of the standard type of ruling illustrated in presenting the control balances in the example above. There are many variations of this form, or adaptations of it to machine bookkeeping use. The more common of these variations:

1. Add one or two balance columns (if two, one for a debit and the other for a credit balance) which are used to set out the balance of the account after each posting or at the end of the month. For machine posting so-called old and new balance columns are required.

2. Eliminate one of the two explanation and date columns found in the conven-

tional ledger form, and group the debit and credit columns and the balance columns (if any) on the right side of the sheet.

B. The subsidiary ledgers assume many forms dependent upon the nature of the record, and the bookkeeping methods followed.

1. The subsidiary accounts for factory operating expenses, and for selling and administrative expenses may be posted to individual sheets of the conventional type, one for each account. Frequently a columnar record, or distribution sheet as it is sometimes called, will be found advantageous, because in this type of ledger debits predominate; many of these accounts never require a credit entry, and if one is needed, it can be shown in red or as a circled item. Two types of ruling, and three uses of columnar sheets as subsidiary operating expense records are shown below.

Figure 3 illustrates a columnar ledger sheet that is subsidiary to a departmental control account in the factory ledger. It is suitable for use in any operating expense ledger. The total column, which makes the sheet self-balancing, should agree with the departmental controlling account. Operating expenses, numbered in accordance with the account classification, are entered in individual columns to the right of the total column. A similar record is shown in Figure 4. In this case the classification of accounts is drawn up to provide control in terms of the type of expense, with the subsidiary record showing distribution to departments.

An objection to the very useful type of subsidiary ledger record shown at Figures 3 and 4 is that this form is wasteful of paper and space; frequently only one distribution is made to the right of the total column on each line. The same objection can of course be raised to the voucher register and many other analytical record forms. A more economical type of record that meets this objection is illustrated at Figure 5. The same line here is used for as many entries as there are sets of columns. Many more entries to the page can be made in this form. A single sheet will ordinarily suffice for a month's record. This form also can be made self-balancing, as are Figures 3 and 4, by the addition of a total column.

2. The form of ledger sheet for the subsidiary inventory accounts—direct material, operating supplies, and finished goods—will ordinarily be a type of perpetual stock record. A simple form of such a record will provide columns headed as follows, reading from left to right:

Ordered Section
- Date
- Order Number
- Quantity

Received Section
- Date
- Quantity
- Unit Cost
- Total Cost

Issued Section
- Date
- Requisition Number
- Quantity
- Unit Cost
- Total Cost

ZINDWELL MANUFACTURING COMPANY
DEPARTMENTAL OPERATING EXPENSE RECORD

Department 4 Period (Month or Year)

Date	Nature of Item	Source	400 Total Dr.	401 Indirect Labor	402 Op. Sup.	405 Power	406 Repairs	408 Spoilage	410 Building Expense	412 Deprec., Ins. & Taxes	420 Portion Gen. Fact.
1/8	Payroll	J. V. 6	$1,910 20	1,910 20							
9	Repairs	Vo. 1-15	50 80				50 80				
15	Spoilage	J. V. 18	119 38					119 38			

Fig. 3. Departmental Expense Ledger.

ZINDWELL MANUFACTURING COMPANY
OBJECTIVE OPERATING EXPENSE ANALYSIS

Kind of Expense Indirect Labor Period

Date	Period Covered	Source	01 Total	101 Dept. A	201 Dept. B	301 Dept. C	401 Dept. D	501 Dept. E	601 Dept. F	701 Dept. G	801 Dept. H
1/8	1/1 to 1/7 Inc.	Dist.	10,150 80	210 10	509 81	752 63	1,901 20	4,519 51	10 20	50 90	670 15

Fig. 4. Objective Expense Analysis.

ZINDWELL MANUFACTURING COMPANY
DEPARTMENTAL OPERATING EXPENSE RECORD

Department 4 Month of January 19—

Account 401		Account 402		Account 405		Account 406		Account 408		Account 410		
Source	Amount	Source	Amount	Source	Amount	Source	Amount	Source	Amount	Source	Amount	
J. V. 6	1,910 20					Vo. 1-15	50 80	J. V. 18	119 38			

Fig. 5. Departmental Expense Analysis.

Balance Section
Date
Quantity
Unit Cost
Total Cost

This conventional record may in some cases be condensed by confining the value information—that is, the unit and total cost data—to the balance section. Whether this abridgement can reasonably be made depends upon the methods used in determining unit cost and of costing out the usage of materials. There are, of course, many other special forms of perpetual stock records.

3. Of the several kinds of subsidiary factory ledgers noted in Figure 1—perpetual inventory ledgers, the operating expense ledger, and cost sheets—the first two have been briefly discussed. The third form, which is subsidiary to the work in process control, and the construction order control, is discussed elsewhere. This form is used to accumulate product costs, when subsidiary to the work in process control; and to summarize the cost of work done on the plant itself, when subsidiary to the construction order control account. The nature of the cost sheet differs so materially under the several types of cost methods that discussion is postponed until the methods themselves are described.

4. In addition, there are many special forms used in ledgers subsidiary to the machinery and equipment control, the capital stock, and other accounts.

The Nature and Scope of the Account Classification

The chart or classification of accounts is a carefully prepared list, giving the number, or code, and the name of all the control and major subsidiary ledger accounts that are used by a company in analyzing the cost and financial aspects of its business. The account classification provides the framework for the detailed analysis of the value factor in the enterprise.

In its broadest scope the classification includes every account required in all the ledgers illustrated in Figure 1, and any other ledgers used in the business. On this basis the classification would list, by symbol and name, every account required in the general control ledger and its various subsidiary ledgers; and every account required in the factory control ledger, and its sub-ledgers. So stated, the classification would include all the individual accounts receivable; the individual perpetual inventory sheets for direct materials, operating supplies, and finished goods; the cost sheets subsidiary to the work in process and construction order control accounts; and the detailed list of stockholders. Obviously many of these subsidiary accounts, however necessary in the conduct of the business, have little significance in analyzing the financial effect of transactions that is not sufficiently represented by the control accounts to which they pertain. Therefore a classification, made for example to fit the ledger structure outlined in Figure 1, will actually list only (1) the general ledger control accounts, and the subsidiary selling and administrative expense accounts; and (2) the factory ledger control accounts, and the subsidiary factory expense accounts. This limitation is one which restricts the classifications so far as cost accounts are concerned, to accounts whch show money values only; and omits the accounts, indispensable to cost determination, which combine in some manner a quantitative and a value representation. This latter characteristic applies to the perpetual inventory and the cost sheets. Many of these accounts, however, and plant accounts as well, are often covered by supplementary classifications that tie in, through code numbers, with the account classification.

The purpose of the classification is to provide a designated place in which to record every significant aspect of operations and financial condition, thereby fur-

nishing the historical background of value facts necessary to financial and operating control. To this end, the classification should be:

1. Fitted to the organization structure, so as to facilitate the measurement of accountability and responsibility for expenditures.
2. Adapted to the costing methods used, so as to facilitate the determination of unit product costs.
3. Flexible enough to provide for expansion, inasmuch as neither all present necessities nor all future requirements can be determined at the date of adoption.
4. Carefully planned, thoroughly understood, and consistently used so as to produce reliable financial conclusions.

In general arrangement the classification will follow the sequence of items found in the periodic statements. On this basis there are two major categories of accounts with numerous subdivisions as shown in the following tabulation.

Balance Sheet Accounts	*Income Statement Accounts*
Assets	Revenue Accounts
Current	Sales
Fixed	Cost of Sales
Liabilities	Expense Accounts
Current	Manufacturing
Fixed	Distribution
Net Work	Administration
Invested Capital	Income
Accumulated Surplus	
Current Profit and Loss	

Within each of these divisions logical arrangement proceeds as indicated below from the general to the specific:

Assets Accounts

- Current
  - Cash in Bank
    - Cash in First National Bank
    - Cash in Fifth National Bank

Expense Accounts

- Production
  - Department 1
    - Indirect Labor
      - Sweeping
      - Repairs
    - Operating Supplies
    - Depreciation

The nature and scope of the account classification are best explained by an illustration. Two examples are given in the succeeding sections. In the first case both the general and the cost accounts are shown. In the second only the factory accounts are listed.

Illustrative Complete Classification

The classification given below is quoted from National Association of Cost Accountants' Bulletin of January 1, 1934, entitled "Standard Costs and Flexible Budgets in the Brewing Industry," by John W. Dixon. Mr. Dixon describes the method as follows:

". . . The system is built about a comparatively simple general ledger. Without going further than this ledger, we get accurate periodic statements and inventory valuations. The cost control element is introduced by a detailed analysis of expense posted to periodic Burden Statements. There is no cost ledger or factory ledger, a bound set of Burden Statements each period taking the place of this record. . . .

"The chart of accounts of the general ledger and the expense classification . . . . are shown in Exhibits C and D, respectively. The asset and liability acounts of the general ledger are somewhat simplified and some accounts would have to be added to cover any particular case, but all of the accounts which are necessary for the plan are included.

"The numbering system is, of course, subject to different treatment but the system shown is very flexible and should be adaptable to almost any situation. The general classifications are as follows:

General Ledger (Exhibit C)

1— 99—Assets and Liabilities
101—199—Profit and Loss Accounts

Expense Classification (Exhibit D)

Prefix (Burden Centers)

200 General Plant Burden
300 Power Plant
400 Brewery
500 Racking Room
600 Bottling House
700 Delivery
800 Selling
900 Administrative

Suffix (Burden Elements)

01—19 Raw Materials
20—29 Salaries and Wages
30—39 Supplies
40—59 Miscellaneous Expense
60—69 Fixed Charges

Thus in the Expense Classification, 436 represents Supplies for the Brewery.

"The general scheme is that all operating expenses, including raw material, direct labor, manufacturing, delivery, selling, and administrative expense are charged in the general ledger to Account 150, Unearned Burden and Manufacturing Variances. The same items are posted in detail in the Distribution Record. . . . The totals from this Distribution Record are then carried to Burden Statements for each center. . . ."

Exhibits C and D are presented below.

EXHIBIT C

CHART OF ACCOUNTS

General Ledger

Assets:

1 Cash in Banks
2 Cash on Hand
3 Accounts Receivable
10 Reserve for Bad Debts
20 Inventory, Raw Material
21 Inventory, Bulk Beer in Brewery
22 Inventory, Keg Beer in Racking Room
23 Inventory, Bulk Beer in Bottling House
24 Inventory, Case Beer in Bottling House
25 Inventory, Supplies
26 Revenue Stamp Clearance Account
27 Revenue Stamp Inventory
30 Cases
31 Bottles
32 Reserve for Case Depreciation
33 Reserve for Bottle Breakage
40 Plant and Equipment
41 Reserves for Depreciation
51 Unexpired Insurance
52 Water Deposits
53 Prepaid Taxes

Liabilities:

60 Bank Loans
65 Accounts Payable
70 Reserve for Refund, Cases and Bottles
71 Reserve for Refund, Cooperage
81 Accrued Local Taxes
82 Accrued State Excise Tax
83 Accrued Federal Income Taxes
84 Accrued Payroll
85 Accrued Interest

Net Worth:

90 Capital Stock
95 Surplus

Profit and Loss Accounts:

100 Case Sales, Private
102 Case Sales, Dealers
103 Case Sales, Distributors
111 Keg Sales, Private
112 Keg Sales, Dealers
113 Keg Sales, Distributors
120 Sales Returns and Allowances, Case
121 Sales Returns and Allowances, Keg
130 Cost of Sales, Case

140 Cost of Sales, Keg
150 Unearned Burden and Manufacturing Variances
151 Interest Charged to Cost
152 Excess Depreciation Charged to Cost
153 Fixed Charge Variances
154 Material Price Variances
155 Inventory Adjustments
160 Delivery Cost
163 Selling Expense
166 Administrative Expense
170 Interest Earned
171 Cash Discounts Received
172 Miscellaneous Income
180 Interest Paid
190 Federal Income Tax
191 Federal Capital Stock Tax
192 Federal Excess Profits Tax

An Illustrative Factory Classification

An illustrative factory classification is presented below. This classification, like the one just presented, is designed for a standard cost installation, and contemplates the use of a factory control ledger and a subsidiary operating expense ledger. The latter is composed of a series of departmental sheets, one for each department each month. The form of this subsidiary expense record is similar to that shown in Figure 3. Each departmental account in the control ledger summarizes in total the costs displayed in detail in the monthly sheet in the expense ledger.

The factory ledger accounts follow:

Account Number	*Name of Account*
001	General Ledger Control
010	Basic Wire Inventory (at Standard Cost)
011	Other Direct Materials (at Standard Cost)
012	Operating Supplies
013	Stock Wire in Process (at Standard Cost)
014	Special Wire in Process
015	Conversion Costs in Process (at Standard Cost)
016	Finished Stock Inventory (at Standard Cost)
017	Finished Special Inventory
018	Scrap Inventory
019	Fuel Oil Inventory (at Standard Cost)
030	Construction Orders in Process
050	Material Price Variance
051	Material Use Variance
052	Controllable Expense Variance
053	Volume Variance
060	Inventory Adjustments
100	Department 1—⅛" Heading
200	Department 2—3/16" Heading
300	Department 3—¼" Heading

EXHIBIT D

EXPENSE CLASSIFICATION

	General Plant 200	Power Plant 300	Brewery 400	Racking Room 500	Bottling House 600	Delivery 700	Selling 800	Administrative 900
01 to 19—Raw Materials								
Variable								
01 Choice Malt			x					
02 Caramel Malt			x					
03 Other Malt			x					
04 Rice			x					
05 Grits			x					
06 Domestic Hops			x					
07 Imported Hops			x					
08 Other Raw Materials			x					
09 Grain Sales (Credit)			x					
10 Crowns and Labels				x				
21 to 29—Salaries and Wages								
Variable								
21 Departmental Labor	x	x	x	x	x	x		
22 Repair Labor, Cases					x			
23 Repair Labor, Cooperage				x				
24 Office Salaries	x					x	x	x
25 Salesmen's Salaries							x	
Fixed								
27 Executive Salaries	x						x	x
28 Superintendence	x	x	x	x	x	x		
29 Repair Labor—Buildings, Machinery and Equipment	x	x	x	x	x			
31 to 39—Supplies								
Variable								
31 Water		x	x	x	x			
32 Purchased Power	x	x	x	x	x		x	x
33 Fuel		x						
34 Repair Materials, Cases					x			
35 Repair Materials, Cooperage				x				
36 Miscellaneous Supplies	x	x	x	x	x	x	x	x

EXHIBIT D (Continued)
EXPENSE CLASSIFICATION

	General Plant 200	Power Plant 300	Brewery 400	Racking Room 500	Bottling House 600	Delivery 700	Selling 800	Administrative 900
Fixed								
37 Repair Materials, Buildings, Machinery and Equipment	x	x	x	x	x			x
38 Purchased Repairs	x	x	x	x	x			x
39 Stationery, Office Supplies, and Postage	x						x	x
40 to 59—Miscellaneous Expense								
Variable								
40 Compensation Insurance	x	x	x	x	x	x	x	x
41 Beer Lost and Consumed				x	x			
42 Bottle Breakage					x			
43 Cullet Sales (Credit)					x			
44 Case Depreciation					x			
45 Trucks Hired						x		
46 Advertising							x	
47 Telephone and Telegraph	x					x	x	x
48 Travel	x						x	x
49 Miscellaneous Freight and Cartage In			x					
50 Miscellaneous Expense	x	x	x	x	x	x	x	x
Fixed								
55 Donations								x
56 Dues and Subscriptions								x
57 Professional Services								x
60 to 69—Fixed Charges								
Fixed								
60 Real Estate Taxes	x	x	x	x	x		x	x
61 Personal Property Tax	x	x	x	x	x		x	x
62 State Franchise Tax								x
63 Federal Permit Fee	x							
67 Insurance	x	x	x	x	x	x	x	x
68 Interest on Investments	x	x	x	x	x		x	x
69 Depreciation, Buildings, Machinery and Equipment	x	x	x	x	x		x	x

400 Department 4—5/16" Heading
500 Department 5—3/8" Heading
600 Department 6—7/16" Heading
800 Department 8—Annealing
900 Department 9—Polishing
1000 Department 10—Galvanizing
1100 Department 11—Tinplating
1200 Department 12—Nickelplating
1300 Department 13—Packing
2000 Department 20—Machine Shop
2100 Department 21—Tools
2200 Department 22—Heating Plant
2300 Department 23—Internal Trucking
2400 Department 24—Fuel Oil Storage
2500 Department 25—Power
2600 Department 26—Material Storage
2700 Department 27—Buildings and Grounds
3000 Department 30—General Factory
4000 Department 40—Shipping

In the foregoing classification, the productive departments are numbered 1 to 13 inclusive; the service departments, including shipping, are numbered 20 to 27, 30, and 40. Each of the departmental accounts in the factory ledger controls a section of the subsidiary operating expense ledger made up of monthly sheets similar to Figure 3. The accounts found in this ledger are indicated in Table 1. The individual account number is made up of combinations of the department number and the objective number. Supervision in department one, for example, is charged to account 101; in department two, to account 201. The objective accounts used in each department are indicated by x in the table.

This classification provides for the transference of direct material from the inventory account to the in-process inventory account. In contrast with this procedure, all direct labor and overhead items are charged to the departmental expense accounts. These charges include "other direct materials." These materials are actually direct, but the difficulty of accounting for them on this basis, makes it expedient to record them as elements of the department costs.

The accounts provided in the expense classification are sometimes referred to as "standing orders." The significance of this phrase is that these accounts constitute fixed designations of places to which expenses incurred in factory operations are to be charged. Unlike production orders and associated cost sheets, which are finished when manufacture is completed, these accounts are permanent, at least until the classification is revised.

Inventory Control Accounts in the Factory Classification

If the accounts are separated between a general and a factory ledger, the two main categories of accounts usually transferred to the latter are the inventory control and the factory expense accounts. Several ways of setting up these accounts in the factory classifications are briefly discussed in this and the two sections following.

Controlling accounts are normally required in the classification to cover the four main types of inventories—direct materials, operating and maintenance sup-

TABLE 1.

Objective Account Name		Productive Department Number													Service Department Number									
No.	Name	1	2	3	4	5	6	7	8	9	10	11	12	13	20	21	22	23	24	25	26	27	30	40
01	Supervision	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x							x	x
02	Excess Time	x	x	x	x	x	x	x	x	x	x	x	x	x										
03	Operating Labor	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x
04	Labor Rate Variance	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x
05	Overtime Penalty	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x
06	Sorting Labor													x										
07	Spoilage	x	x	x	x	x	x	x	x	x	x	x	x	x										
08	Operating Supplies	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x
09	Fuel Oil								x								x							
10	Other Direct Material										x	x	x	x										
12	Factory Office Clerical																						x	
13	Cost Department Clerical																						x	
14	Office Supplies																						x	
15	Compensation Insurance																						x	
16	Power Purchased																			x				
17	Light Purchased																					x		
18	Misc. Expense															x					x	x	x	
23	Depreciation	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
24	Insurance and Taxes	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
29	Maintenance Inspection	x	x	x	x	x	x	x	x	x	x				x	x	x	x						
30	Repair Allowance	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
32	Fuel Oil Storage								x								x							
34	Heat																					x		
35	Power Fixed Expense	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x								
36	Occupancy	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					x		x	x
40	Repairs Reserve	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
50	Service Dept. Expense Distributed—Credit														x	x	x	x	x	x	x	x	x	x
60	Standard Cost Allowance—Credit	x	x	x	x	x	x	x	x	x	x	x	x	x										x

plies, work in process, and finished goods. Occasionally a fifth category is introduced to cover semi-finished products, or parts and subassemblies. Single control accounts for each of these types of inventory may be provided, or each of them may be suitably subdivided if the cost situation requires it.

Separate direct material control accounts may be established for different sections of this inventory, the separation being made on the basis of type of material, location in the plant, or on the basis of both type and location. In the illustrative factory classification above Basic Wire is separated from Other Direct Materials. A manufacturer of textiles using wool, cotton, and rayon yarns may provide separate control accounts for each. Separation by location reflects the need for showing the responsibility of different storekeepers, each for the section of inventory under his charge. Separate finished inventory control accounts may also be established on the basis of type of product, location in the plant, and whether the goods are stock or special. The latter basis of separation is used in the illustrative factory classification above.

Various cost situations, and the preferences of individual cost accountants, dictate a number of ways in which the cost of work in process is controlled. A number of these methods are listed below.

1. A single work in process control account is used.
2. The work in process control is separated in terms of the cost elements so that these three accounts are maintained:
   Material in Process
   Labor in Process
   Manufacturing Expense (or Burden) in Process
3. The work in process control is separated on the basis of type of finished product, so that an in-process account is maintained for each product or product group.
4. The work in process control is separated on the basis of manufacturing departments, one control being provided for each department.
5. A combination of these methods may be used; for example, the in-process controls may be set up by departments and cost elements—that is, three work in process accounts are provided for each department or process.

In simple special order industries, such as job printing, a single work in process account ordinarily will suffice. However, the account may be split by cost elements as a means of facilitating accounting control and the localization of differences that develop between the control account and subsidiary cost sheets. In simple continuous processing industries, where the product of one department becomes the direct material of the next process, a series of in-process accounts may be used, each set up on a departmental or process basis. Other manufacturing situations are sometimes, although rarely, found in which, due to the precise scheduling of the delivery of raw materials in exact accordance with manufacturing requirements and the shipment of finished product immediately upon completion of factory operations, it is possible to eliminate direct material inventory and finished inventory accounts. In all of these situations the classification of accounts must be designed, considering all aspects of the manufacturing operations, to provide enough, but no more in-process control accounts than are needed in each case. The work in process control account or accounts will in all of these cases be supported by cost sheets designed to bring together both the quantity and value factors involved in

product cost determination. Discussion of these supporting records is deferred to Chapter 17.

The determination of the cost accumulation points for semi-finished products is a most important aspect of cost accounting. Many productive procedures involve the manufacture of intermediate products as a step in the fabrication of the final products. The woolen manufacturer makes yarns before he weaves cloth; the manufacturer of abrasive papers grinds the grits and prepares the backings before these elements are put together in the final product. Each of these intermediate steps requires suitable semi-finished control accounts. If there is any interruption of the continuous flow of materials in a processing industry, if any preliminary products, such as parts, are stored before being combined or assembled into the final product, then suitable semi-finished product accounts should be provided. In other cases, the product is of a stock nature through certain operations; beyond these, it is finished in accordance with customers' specifications. It may be advantageous in these circumstances to schedule production through the non-special sequence of operations in large batches, with physical storage upon their completion, and appropriate semi-finished inventory control amounts to accumulate the cost to this point. Whenever production is interrupted, semifinished inventory accounts must normally be introduced in order correctly to record the value situation. The inventory accounts for a woolen mill suggested in the Cost Manual of the Woolen and Worsted Industry, issued by the Wool Institute, Inc., are quoted below:

Raw Material Accounts
- Raw Wool
- Other Raw Stock
- Worsted Yarn
- Cotton Yarn
- Decorative Yarn
- Dyes and Chemicals
- Wool Oil
- Soaps and Chemicals
- Mill Supplies

Work in Process Accounts
- Stock Preparation
- Yarn Making
- Warp and Filling in Process
- Pieces in Process

Provision of Expense Accounts for Direct Material Used and Direct Labor

Differences in methods of product cost accumulation among industries are responsible for variations in the accounts provided in the factory expense classification for recording the cost of direct material used, direct labor, and overhead expenses. Three general variations due to these circumstances are found:

1. Accounts are provided in the expense classification for recording the incurrence of expense for all three cost elements. These accounts are usually set up by departments so that the amount of the cost of direct materials used, direct labor, and factory overhead in each plant subdivision is separately stated.

2. Accounts are provided in the expense classification, usually on a departmental basis, for recording the incurrence of expense for direct labor and factory overhead only. Under

this plan the cost of direct materials used is charged in total to a work in process controlling account, and in detail to subsidiary cost sheets.

3. Accounts are provided in the expense classification, usually on a departmental basis, for recording the incurrence of factory overhead expense only. Both the cost of direct material used and of direct labor are charged in total to one or more in-process controlling accounts and related cost sheets.

The factory classification may provide expense accounts, therefore, for all three cost elements as the maximum, and only for overhead at the minimum.

The first situation is found in some continuous processing industries where it is possible to determine unit costs by dividing the total costs of a department for the period by the total output. The produce made in the period is homogeneous as to all three elements of cost. One unit of output costs as much in material, labor, and burden as every other unit. Each cost element is charged to an appropriate account in the factory expense classification.

In other manufacturing circumstances, every unit of output in a given department incurs, for cost purposes, an amount of conversion cost equal to every other unit; however, the material cost differs among units of output in the department due to mixtures varying in quantity, kinds, or qualities of material. The common conversion costs may be applied to the different products on a unit, or a time basis. The material element of such product must, however, be kept separate. This may be done by setting up individual cost sheets or analyses to which this element of cost is directly charged. This direct charge eliminates the need for departmental expense accounts for material used, and hence they are not provided in the account classification. Usage of material is recorded by direct transfer from direct material inventory account to the in-process inventory account. The factory classification above is an illustration of this situation.

A similiar situation may obtain relative to direct labor. In this case also the direct labor costs are charged in total to an in-process inventory account, and in detail to appropriate cost sheets without entry to departmental direct labor expense accounts. Then the account classification need provide only an analysis of the department overhead, both direct and apportioned. This overhead will be applied to the various products manufactured on some basis which approximately measures the use made of the department facilities in the manufacture of each product.

In the last two cases cited, where material, or material and direct labor, are charged as separate elements to the in-process records, it may be desirable for control purposes to summarize the usage of material and direct labor by departments. This may be done by providing intermediate departmental clearing accounts in the classification. These accounts will not, however, have a balance at the end of the accounting period.

Under standard cost procedure the two basic purposes of cost accounting—the determination of product costs, and the control of expenditures—are more clearly differentiated in the costing mechanism than under the historical methods. The product costs are entirely predetermined, although they may be recalculated at actual. The function of the operating accounts is then limited primarily to the comparison of actual with allowed expenditures. Two basic changes may be introduced into the account classification under this procedure:

1. Material used and direct labor are both charged to department accounts in circumstances where under historical methods they would be charged directly to in-process

accounts. The purpose is to establish clearly departmental responsibility for the usage of these cost elements.

2. Variance accounts, either departmental or covering the whole factory, are provided in the classification. Their purpose is to display the difference between the amount of the expenditures allowed for the actual output and the amount of the actual expenditures.

An an illustration of variance accounts those suggested for a woolen manufacturer in the Wool Institute manual are listed below (variation, as here used, is synonymous with variance):

Purchase Variations (for the excess of actual cost of purchases over the predetermined cost)
Material Usage Variations:
- Stock preparation
- Yarn making
- Dyes and Chemicals
- Wool oil
- Warps—weaving
- Filling
- Pieces—shrinkage

Labor Variations:
- Stock preparation
- Blending and picking
- Carding
- Spinning
- Spooling
- Dressing
- Weave shed
- Burling and mending
- Wet finishing
- Dry finishing

These labor variances may be further analyzed, if desired, to express differences between standard and actual cost due to pay rates, and time taken by operations.

Overhead Accounts in the Factory Classification

Whatever the arrangement for handling direct material and direct labor, the factory account classification will always provide:

A. One or more control accounts for the factory overhead expenses incurred; and, usually, one or more other accounts, offsetting the control accounts, to represent the amount of overhead applied to or absorbed in product cost.

B. Detailed subsidiary ledger accounts to record:
1. The accumulation of each type of overhead expense incurred in each department.
2. The distribution of service department, and portions of the general overhead, expenses.
3. The allocation of overhead to product costs.

Three methods are found in stating the control accounts:

1. A single account is used.
2. Department controls are established.
3. Objective controls are used.

In the first case a single Manufacturing Expense Control is established for the whole plant. To this account all items of overhead are charged, with corresponding entry in a subsidiary ledger. Credits for burden applied to product costs may be credited to this single control. More frequently, however, credit is posted to an offsetting Manufacturing Burden Absorbed account. Entry may or may not be made to the subsidiary ledger for this credit; if not, the accounts referred to at B3 above are omitted.

In the second case, department controls are provided in the classification, and appropriate objective accounts, such as indirect labor and operating supplies, are established in the subsidiary ledger. This type of arrangement is illustrated in both of the classifications presented earlier in this chapter. The subsidiary ledger may be of the columnar type illustrated in Figure 3. Under this method the classification indicates the following groups of items:

1. The major group, operating expense (in contrast with such other major groups as assets, liabilities, and revenue).
2. The functional group, production expense (in contrast with the marketing, finance, and administrative functions).
3. The department—such as brewery, bottling, annealing, power.
4. The objective expense—the specific object or service for which the expenditure is made, such as indirect labor, or operating supplies.

This arrangement obviously proceeds from the general to the specific in this manner:

I. Major Group—Expense
  A. Functional Group—Production
    1. Department—Annealing
      a. Objective—Indirect Labor

The classification and the ledger arrangement make clear the inter-relationship of these groups. When the single control account is used in the factory ledger, control is placed at level A; when the departmental control accounts are used as the summarizing accounts, control is placed at level 1.

Controls may be provided by objective accounts. In this case the subsidiary ledger will show the departmental distribution as illustrated in Figure 4. The arrangement of the classification is then as follows:

I. Major Group—Expense
  A. Functional Group—Production
    1. Objective—Indirect Labor
      a. Departmental—Annealing

This method somewhat overemphasizes the objective distribution and fails, if a record similar to Figure 4 is the only subsidiary record maintained, to display readily the total accumulation of departmental expense. To overcome this deficiency either one of the two following expedients may be adopted:

1. The objective accounts are continued as the control medium, but the subsidiary record is kept on departmental sheets similar to Figure 3 or records serving the same purpose. The proper columns of these sheets are posted directly from the summary analysis that provides the journal entry, or from the original evidences supporting the

summary. The control account, indirect labor for example, is supported in turn by the indirect labor columns on all the departmental sheets.

2. The control ledger may provide both objective and department accounts. The first entry is made to the objective accounts—indirect labor, operating supplies expense, and the others. The objective account totals are then redistributed to the department control accounts, with postings to subsidiary department ledger accounts or analyses records. These steps are ilustrated below by showing the entries for indirect labor:

a. The indirect payroll is journalized as follows:

Debit—Indirect Labor	$10,000	
Credit—Accrued Factory Payrolls		$10,000

b. The departmental distribution is then journalized as follows:

Debit—Dept. 1—Indirect Labor	$3,000	
Dept. 2—Indirect Labor	2,000	
Dept. 3—Indirect Labor	4,000	
Dept. 4—Indirect Labor	1,000	
Credit—Indirect Labor		$10,000

The arrangement of the accounts in the classification under this method is illustrated below:

I. Major Group—Expense
  A. Functional Group—Production
    1. Objective—indirect labor, and other objective accounts. These accounts are then redistributed to
    2. Departmental control accounts, supported by subsidiary records which show for each department
      a. Indirect labor, and the
      b. Other objective distributions.

The first distribution to the objective accounts serves the statistical purpose of displaying the total amount of each objective type of expenditure. This information is of use in visualizing the factory expenses in the aggregate for each of the major types, and is often helpful in making periodic statements and tax reports. The Wool Institute manual referred to above suggests the following objective analysis of overhead for a woolen mill, with the recommendation that these be analyzed by departments:

Salaries—Supervision
Salaries and wages—Clerical
Insurance
Taxes—Local
Wages—Indirect
Royalties
Local Delivery
Stationery and Office Supplies
Telephone and Telegraph
Mill Supplies
General
Depreciation—Buildings
Depreciation—Machinery and Equipment

There are many more or less informal methods of accomplishing the objective and departmental analyses described above, introduced generally for the pur-

pose of simplifying the overhead expense records and reducing the amount of bookkeeping time. Whatever the form of these records, the relationship is essentially that of control account and subsidiary ledger.

In addition to defining the relationship of the control and subsidiary overhead expense accounts discussed above, it is also desirable that the classification of factory overhead expenses be arranged so as to distinguish:

1. The variable expenses from the fixed expenses.
2. The direct departmental expenses from the expenses apportioned to the department through the distribution of service center costs.

The need for distinguishing the variable from the fixed, and the direct from the apportioned, has already been discussed. An example of an arrangement of accounts to accomplish the separation of variable and fixed is presented in the brewery classification above.

Fundamentals of Good Classification

In addition to matters of content and arrangement discussed above, good classification requires:

1. Intelligible individual account titles, and
2. Proper symbolization.

The account is a statement of the opposing tendencies of increase and decrease, debit and credit, relative to some carefully selected, well-defined aspect, force, or tendency in the business. Its purpose is to provide financial data leading to specific conclusions about each force or tendency in the enterprise that is important enough to be separately recorded. In order that the account may serve this purpose, the account title must be brief, definite, and exact; capable of only one meaning, and employed in only one use or connection; it must be explicitly indicative of the nature of the thing, the value aspects of which are stated in the account contents. If these requirements are observed, the items included in each account will be homogeneous, congruous with the purpose of the account, and capable of yielding reliable conclusions. The individual account, designed on this basis, is the foundation of the classification.

Beside the careful determination and titling of the distinctive aspects of the business that require separate financial recognition, good classification requires the careful coding or symbolizing of each individual account. The symbol represents the account, and is used as a substitute for the account name on vouchers, time tickets, material requisitions and other original evidences of transaction, and in journals and other analytical records. The distinctive symbol of each account may be composed of (1) letters, (2) numbers, or (3) a combination of letters and numbers. Straight alphabetical symbols are of limited usefulness. Symbols composed of letters or a combination of letters and numbers that are suggestive of the nature and name of the account are of greater utility. Numeric symbols are used frequently, because figure codes are readily adapted to the use of tabulating equipment, and these machines often provide the most economical method for summarizing the great quantities of data involved in keeping the accounts of a large enterprise.

Symbolization, like classification, proceeds usually from the general to the specific. The left-hand figure represents the broadest group; the next figure or figures

to the right indicate the major sub-group; and succeeding figures refer to subdivisions of the major sub-group. Thus expenditures for supervision in the punch press department may be indicated by the code number 2101, in which 2 stands for factory operating expense, 1 for the punch press department, and 01 for supervision. Good symbols must be clear, definite and exact; capable of being easily learned and remembered; indicative, by the combination of numbers used, of the nature of the item represented, and, so far as possible, free from the probability of mistake and confusion. The method of codification followed should be simple, and flexible enough to provide for future expansion.

The system of codification often extends beyond the limits of the account classification to include subsidiary records which are not a part of that classification. Direct material and operating supply perpetual stock records may thus be included in the codification in a manner to tie up these subsidiary records with the account classification. In the rivet factory classification given above, for example, the Basic Wire Inventory Control bears the code number 010. Stock records subsidiary to this control can be coded by supplementary numbers from 1 to 99. Thus $\frac{3}{8}$" basic wire is represented by the symbol 010-19, which may also be written 01019.

Frequently some phase of factory cost may require for control purposes a more minute degree of analysis than is provided by the account classification. For example, in the milling department of a machine tool manufacturer where many diverse operations are performed, it may be desirable to analyze direct labor cost by specified individual operations. The account classification, however, provides only a single direct labor account for this department. By providing a supplementary code in the manner described above for direct material, the labor analysis may be expanded to include summarization for each kind of operation performed.

In addition to the account classification, some other aspects of plant operation, of interest to the cost accountant, which are also subject to symbolization are listed below:

1. Direct materials
2. Direct labor operations
3. Operating and maintenance supplies
4. Finished parts, subassemblies, and final products
5. Machinery and equipment
6. Tools
7. Patterns and drawings
8. Production, repair and construction orders

The Manual of Accounts

The classification of accounts, as discussed above, requires the listing in proper sequence of carefully coded and explicitly stated account titles. Consideration of the use of an account classification discloses that often many different kinds of items are charged or credited to a single account. The classification may provide, for example, one account for each department to which operating supplies are to be charged. However, the operating supplies used in a single department are normally composed of many items. In charging this variety of items to a single account the classification is requiring the grouping or combination of items, not the segregation of every single item in an individual account. Other accounts in the classification

likewise involve the combination of the cost of originally dissimilar items when used for the purpose indicated by the account title. The classification will also very likely provide an account in each department to which the cost of maintenance or repair materials used are charged. Some of the same supply items usable for operations are also used in maintenance work.

Considerations of this nature, and knowledge of the many perplexing problems that arise in using a classification—questions of whether certain items are more properly charged to one or to another account related to a given phase of operations—leads to the conclusion that often the account title alone is not sufficiently indicative of the exact items to be included therein.

It is the function of the accounting manual to provide the information for answering questions of this type. In the manual the classification is expanded to include a description of the nature of the items to be charged and credited to each account. An example of the descriptive material associated in the manual with the account code number and title is given below. The quotation is taken from the Interstate Commerce Commission Classification of Operating Revenues and Operating Expense of Steam Roads.

"388. ENGINEHOUSE EXPENSES—YARD.

"This account shall include the expense of caring for and preparing locomotives for switching service in yards where regular switching service is maintained and in terminal switching and transfer service, including a proportion of such expenses as are common to train, yard switching, and work service.

Enginehouse Men.—The pay of enginehouse employees engaged in wiping, cleaning, watching, and dispatching locomotives; keeping and preparing fires, dumping ashes, washing boilers, cleaning fire boxes, packing driving boxes and truck boxes; cleaning smokestacks, air-brake equipment, and front ends of locomotives; checking locomotive tool equipment, cleaning ash and cinder pits; operating turntables, drying sand, inspecting smokestacks and ash pans; calling enginemen; and moving locomotives around engine yards when operated by hostlers; also a proportion of the pay of enginehouse foremen and their clerks.

Miscellaneous Expenses.—The cost of tools, supplies, and sundry expenses on account of caring for and preparing locomotives at enginehouses.

Items of Miscellaneous Expenses

(See special instructions, section 22.)

Boiled oil
Compounds for cleaning and polishing
Enginehouse cupboards
Gas, Oil and electricity lighting
Heating enginehouse, including offices
Lampblack
Lanterns used by enginehouse men
Lighting enginehouse, including offices
Lubricating oil for enginehouse, ash pit, transfer table, and turntable machinery
Lye
Packing tools
Paint for front ends of locomotives
Power for operating of turntables and transfer tables
Rent of roundhouse stalls
Shovels
Signal lights on transfer tables and turntables
Waste
Water for cinder pits
Water for washing boilers
Water hose
Wheelbarrows

Note A.—Enginehouse expenses of locomotives in work service shall be included in the cost of the work to which the service pertains.

Note B.—The pay of mechanics and laborers engaged in locomotive repair work in enginehouses shall be charged to the appropriate accounts for locomotive repairs."

This explanatory material serves to define the nature of the account more exactly than is possible in the brief title itself, and to describe explicitly the items to be included therein. The purpose is to aid the accounting personnel in becoming familiar with the classification, and to enable the employees of other departments, who often have to prepare the original evidences of transactions, to know more precisely what is to be charged or credited to each account. The result of the introduction of this explanatory material should be a greater consistency in the distributions made to each account, and hence a more accurate comparability of the value total of each account, one period as related to another.

Uniform classifications of accounts, published by trade associations for the use of members, and by regulating bodies, must always include this descriptive material as a means of securing more accurate and comparable statements.

The manual of accounts will also include a full description of all the major accounting procedures followed, and of the respective duties of the various sections of the accounting and other divisions of the organization that are responsible for their performance.

Classification of the Plant Investment [1]

In addition to his interest in the classification of inventory and operating accounts regularly found in the factory ledger, the cost accountant is also concerned with the classification of plant investment, sales and cost of goods sold, and distribution expenses. The classification of plant assets and of the accounts related to sales is discussed briefly in this and the following section. Consideration of distribution expenses is deferred to a later chapter.

The proper classification of plant investment is important to the cost accountant for the following reasons:

1. He is usually charged with the responsibility of accounting for all changes—additions, betterments, renewals, replacements, and retirements in fixed plant investment, and for transfers of equipment within the plant.
2. He must account in detail for all maintenance, and repair expenditures, and assign these costs to the benefited processes or departments as a step in the correct determination of product costs.
3. He must know the amount of investment by departments and processes as a basis for periodic depreciation, insurance, and property tax charges, and also in some instances so that interest on investment can be entered as an operating cost. The basis for the determination of these expenses may be original cost, or replacement cost. In either case a detailed analysis of fixed property investment is required.
4. The cost accountant is frequently called upon to advise management as to the total cost—capital amortization and maintenance—of various kinds of equipment and the relative cost of one type as compared with another. This requirement necessitates detailed records of the cost, depreciation, and maintenance expenditures for individual units of plant assets.

In addition, detailed property records are necessary to support claims for insurance losses, to substantiate the deduction of depreciation in income tax returns, and

[1] For a detailed statement of the uses of property records, see *N.A.C.A. Bulletin*, Vol. XI, No. 4, October 15, 1929.

to facilitate the budgeting of new equipment requirements. Protection of the investment and the control of current expenditures also require a detailed determination of responsibility for the property itself and for the associated operating and maintenance costs.

Property records are kept in many ways, varying from the very meager records that many companies have, to complete duplicate unit records, filed as to one set of cards by nature of the property item, and as to the duplicate set, by location in the plant. To accomplish the purpose of classification both by nature of the property item, so that homogeneous groups can be established for depreciation purposes, and by location, so that departmental investment can be determined, plant investment records may be established at three levels:

1. A single or a limited number of control accounts indicative of the general nature of the major types of plant investment.
2. Subsidiary ledger records showing plant investment in detail according to the nature of the item.
3. Supplementary analyses summarizing the investment by location—that is, by departmental responsibility.

An illustrative classification covering the control and subsidiary records is quoted below from the Standard Accounting and Cost System for the Electrical Manufacturing Industry, Fifth Edition.

CLASSIFICATION OF MANUFACTURING PLANT

"'Manufacturing plant' is the controlling account. The selection of one of the following groups of sub-accounts is optional, depending upon requirements. For very small companies, the 'condensed accounts' may afford sufficiently detailed data, for larger ones, the 'sub-accounts' or the 'further sub-divisions' may be required. Attention is directed, however, to the desirability of so classifying fixed assets, as to permit of the application of the rates of depreciation referred to in this section.

Condensed accounts
  Sub-accounts
    Further sub-divisions

1000 Land
  1010 Land
    1011 Land—Purchase price
    1012 Land—Grading and improvements

1100 Buildings
  1110 Buildings
    1111 Buildings
  1120 Structures
    1121 Structures
  1130 Outside piping and wiring
    1131 Outside underground piping and electrical conductors
    1132 Other outside piping and electrical conductors
  1140 Inside piping and wiring
    1141 Sprinkler system
    1142 Heating and ventilating system
    1143 Other inside piping
    1144 Inside electrical wiring and conductors

1200 Machinery and tools
  1210 Machinery
    1211 Machinery
    1212 Electrical apparatus
    1213 Ovens, furnaces and vats
  1220 Special machinery
    1221 Special machinery
  1230 Tools and Instruments
    1231 Semi-durable tools
    1232 Non-durable tools
    1233 Electrical equipment
    1234 Molds, jigs, punches, dies and special tools
    1235 Metal flasks
  1240 Machinery foundations and installation
    1241 Foundations for machinery and electrical apparatus
    1242 Installation of machinery and electrical apparatus

1300 Furniture and fixtures
  1310 Factory fixtures and equipment
    1311 Factory fixtures and equipment
  1320 Furniture and appliances in factory offices
    1321 Furniture and appliances in factory offices

1400 Transportation System
  1410 Transportation system
    1411 Roads, driveways and sidewalks
    1412 Railway tracks and overhead equipment
    1413 Rolling stock
    1414 Automobiles and electric trucks
    1415 Other conveyances

1500 Patterns and drawings
  1510 Patterns
    1511 Patterns
  1520 Drawings
    1521 Drawings

1600 Plant reconstruction and alteration
  1610 Plant reconstruction and alteration
    1611 Plant reconstruction and alteration

1700 Unfinished plant
  1710 Unfinished plant
    1711 Unfinished plant"

The list of accounts quoted above is followed in the Electrical Manufacturing Industry manual by a detailed description of the kind of property item to be included in each account.

From the standpoint of cost accounting, analysis of property investment in terms of location is most important. This classification may be made in records that are supplementary to a classification in terms of the physical nature of the plant assets. This analysis must tie up with the general ledger control accounts and provides the detailed basis on which the cost accountant determines the amount of the periodic charges to each department for depreciation, insurance, property taxes, and interest on investment when figured as a cost of production.

Classification of Sales and Cost of Goods Sold

The revenue accounts, like the various divisions of operating expense, also require classification. The basis in this case is usually the types of products sold. A rivet manufacturer might classify sales as follows:

Basic Steel Rivet Sales
Brass Rivet Sales
Copper Rivet Sales
Monel Rivet Sales
Other Rivet Product Sales

This classification in terms of products can be expanded by subdividing each group in terms of diameter; or in terms of finishes applied to the articles sold, such as bright, annealed, galvanized, tinplated, nickelplated, and case hardened. Analyses may also be desirable to show sales by territories, salesmen, jobbers, and commission agents.

The question arises in this instance, and also in other cases of classification, as to the nature and extent of the subdivision that is to be recognized in the formal chart of accounts. Frequently accounts for the major product classes only are provided in the classification. Supplementary analyses outside of the formal account structure can be used to provide information about subdivisions of the main groups.

Cost of goods sold accounts will be provided for the same major product groups covered by the sales classification. This arrangement of the account classification furnishes the basis for the determination of gross profit by product groups directly from the ledger records.

The supplementary analysis of sales and cost of goods sold by territories, salesmen, and classes of customers, together with a corresponding analysis of distribution costs, provides the facts for the determination of the net profit for each of these non-product classifications. These matters are discussed in a later chapter.

Conclusion

Some aspects of the use and interrelationships of original evidences of transactions, journal summaries, ledger structure, and the account classification are recapitulated in Figure 6. Only certain major types of transactions that affect the factory records are included in this table. The assumptions as to the division of accounts between the general and the factory office are identical with those stated in the section of this chapter on reciprocal control accounts. This table is somewhat arbitrary in its specific indication of procedures, because it by no means represents the variety of methods followed in different circumstances. It does, however, indicate the interrelationships of procedures used to record, summarize, and classify costs.

Note 1—Service Department Expense Distribution

Journal Record—An individual entry may be made for each service department distributed, or a combined entry may be made.

Control Accounts Affected—If a single Factory Expense Control account is used, no entry is required; if Department Control Accounts are used, the departments to which distributions are made will be charged and the departments distributed will be credited.

Type of Transaction	Original Evidence of the Transaction	Factory Journal and Control Ledger Entries		Subsidiary Ledger Entries			
				Debit Entries		Credit Entries	
		Journal Record and Source of Posting Control Accounts	Control Accounts Affected	Source of Posting	Type of Record	Source of Posting	Type of Record
1. Direct Material Purchases	Purchase invoices Received reports Vouchers	Factory Special or General Journal, or Journal Voucher Supported by a summary	Dr. Direct Material Cr. General Ledger	Received report	Perpetual stock sheets (received section)	None	None
2. Operating Supply Purchases	Same as 1	Same as 1	Dr. Operating Supplies Cr. General Ledger	Received report	Perpetual stock sheets	None	None
3. Direct Material Purchase Returns	Return shipment Order Debit memo	Same as 1	Dr. General Ledger Cr. Direct Materials	None	None	Return shipment order	Perpetual stock
4. Direct Material Used	Requisition, bill of material, or daily report	Requisition Journal, or General Journal or Journal Voucher entry supported by a summary	Dr. Material in Process Cr. Direct Material	Individual requisition or a summary	Cost sheets or department accounts	Requisition	Perpetual stock sheets (issued section)
5. Direct Material Returned to Stock	Material credit form	Same as 4	Dr. Direct Material Cr. Material in Process	Material credit form	Perpetual stock sheets	Material credit form, or summary	Cost sheets or dept. material accounts
6. Operating Supplies	Requisition, or Report of Supplies Used	Requisition Journal, or General Journal or Journal Voucher entry supported by a summary	Dr. Factory Expense, or Dept. Accounts Cr. Operating Supplies	Journal entry or supporting summary	Expense ledger accounts	Requisition	Perpetual stock sheets (issued section)
7. Direct Wages Earned	Clock cards and time tickets	Factory Journal, or Journal Voucher entry supported by distribution summary	Dr. Labor in Process Cr. Accrued Payroll	Time tickets or distribution summary	Cost sheets or dept. accounts	Time tickets or clock cards	Payroll

8. Indirect Wages Earned	Same as 7		Dr. Factory Expense or Dept. Accounts Cr. Accrued Payroll	Journal entry or distribution	Dept. expense accounts	Same as 7	Same as 7
9. Depreciation Accrued	Depreciation schedule	Factory Journal, or Journal Voucher, supported by the schedule	Dr. Same as 8 Cr. General Ledger	Journal entry or Summary	Dept. expense accounts	None	None
10. Insurance and Property Tax Accruals	Analyses or schedules	Same as 9	Same as 9	Same as 9	Same as 9	None	None
11. Service Department Expense Distribution	Burden distribution sheet or other summary	Factory Journal or Journal Voucher supported by a summary (See Note 1)	See Note 1	Entry or summary	See Note 1	Entry or summary	See Note 1
12. Overhead Absorbed in Product Cost	See Note 2	Factory Journal or Journal Voucher supported by a summary	Dr. Burden in Process Cr. Factory Expense Absorbed (one or several Dept. accounts)	See Note 2	Cost sheets	Entry or summary	Subsidiary Absorbed Accounts (if any)
13. Completion of Manufacture	Completion reports or output records	Factory Journal or Journal Voucher supported by a summary	Dr. Finished Goods Cr. Material in Process Cr. Labor in Process Cr. Burden in Process	Order or dept. cost sheets	Finished stock record or completed order cost sheets	None	(Completed cost sheets removed from ledger)
14. Goods Shipped	Shipping order sales invoice	Sales Journal, or Factory Journal or Journal Voucher entry supported by a summary	Dr. General Ledger Cr. Finished Goods	None	None	Shipping order	Finished stock record (issued section)

Fig. 6. SUMMARY OF ACCOUNTING PROCEDURES FOR MAJOR TYPES OF FACTORY COST TRANSACTIONS

Subsidiary Debit Entries—If the classification provides accounts for distributed charges, these accounts will be charged; otherwise the record of these charges is to be found only in the Burden Distribution Sheet, or other summary serving this purpose.

Subsidiary Credit Entries—Frequently the classification and the subsidiary ledger do not provide credit accounts for the distribution of service department expense; the only credit record is contained in the Burden Distribution Sheet. In other cases, as in the rivet department classification presented in this chapter, such subsidiary credit accounts are provided.

Note 2—Overhead Absorbed in Product Cost

Original Evidence—Original evidence of burden absorbed may be found on the direct labor time slip. In other cases there may be no true original evidence, but the first entry is made on the cost sheet, the subsidiary ledger record. These entries are then summarized to provide the control account totals. In other cases, a formal Burden Applied Journal may be maintained, or a less formal summary is prepared at the end of the period to furnish the totals for entry to the control and subsidiary accounts.

Subsidiary Debit Postings—Any of the records mentioned in the preceding paragraph may be used as the source of debit postings to cost sheets.

Chapter 17

MAJOR METHODS OF PRODUCT COST SUMMARIZATION

By
C. W. SARGENT *

Introduction

The purpose of this discussion is to describe the major types of methods used for summarizing the total and unit costs of products manufactured. This determination necessitates the use of both quantitative and value analysis, and the bringing together of these factors relative to each product made so that its particular costs can be known.

Statements of product costs may be divided into two broad types indicated by the terms statistical and accounting. Statistical costs refer to statements that do not tie in with the financial records of the company; they are compiled intermittently and not by measuring continuously the flow of values associated with the productive operations. They should be relied upon as the sole expressions of cost only in very rare circumstances. Their chief use should be as auxiliary compilations supplementing the regular statements. Accounting costs are based upon formal cost procedures that tie in with the financial accounts of the company. They result from the continuous process of recording the internal transactions of the business.

The principal methods of determining product costs, namely the

1. Order
2. Process
3. Operation, and
4. Standard

methods are described in succeeding sections. The first three of these are historical or retrospective methods. The last method listed uses predetermined product costs.

Two other methods of product cost summarization—namely, the product analysis and the estimating methods—are not described. These procedures rely upon periodic physical inventories for the determination of costs, and hence they cannot be classified as complete cost procedures. They represent, nevertheless, an advance in the direction of product cost determination in comparison with financial accounting procedure.

ORDER COST METHOD

Characteristics

Under the order method the basis of product cost summarization is the individual production order. The production order is an agency for initiating and controlling the work performed in the plant. The order may specify:

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1. The manufacture of a stated quantity of a complete product, or
2. The manufacture of a stated quantity of a specified part, or
3. The assembly of parts already manufactured into a stated quantity of a subassembly or a final product.

Each production department will receive a copy of the production order, or of subsidiary instructions specifying the nature of the work it is to perform on the order.

Under the order method the output is predetermined—that is, the quantity of production to be made on each order is decided before operations start. This figure requires verification to determine whether the exact quantity specified, or more or less, is actually manufactured. The major objectives of the costing effort, so far as product cost determination is concerned, is to record and summarize the costs of the direct material and direct labor used in the manufacture of the order, and to apply to each order a reasonable portion of the overhead expenses of each department that contributes to its production. Although the output to be made is known in advance, the amounts of the cost of material, labor, and burden can only be ascertained as production takes place; they must be measured as the work progresses.

This method of cost accounting is used both for products made for stock, stock orders; and for products made in accordance with the specifications of particular customers, special orders. It can be used only where the particular items being manufactured on each order can be individually identified—that is, the products are distinct articles rather than bulk products. It is particularly applicable to intermittent processing or assembly industries making a wide variety of nonstandardized products, in which the various lots manufactured differ in quantity, size, quality, operations required, or some other product characteristic that is responsible for significant differences in cost. The basic assumption underlying the use of this method is that the products made on the different production orders are heterogeneous as to cost; that a homogeneous product can be defined only in terms of the single order.

The Order Cost Sheet

An order cost sheet is issued for each production order. One form of such a sheet is shown in Figure 1.

The order cost sheet is subsidiary to the work in process controlling account. A single in-process control account may be used; or control may be effected by cost element, in which case material in process, labor in process, and burden in process controls are used, each control account relating only to its particular section of the order cost sheet. The ledger subsidiary to the work in process control accounts is made up of the cost sheets for all unfinished production orders. Whenever the work in process controls are in balance with the subsidiary cost ledger, as should be the case at the end of each month:

1. The total of the materials section of all cost sheets should equal the balance in the material in process control;
2. The total of the labor section should equal the balance in the labor in process control; and
3. The total of the burden applied section should equal the balance in the burden in process control.

ORDER COST SHEET

Pro. Order No._____
Sales Order No._____
Article _____ Product Code _____ Date Wanted_____
Date Started_____
Date Finished_____
No. of Units to be Made_____ Units Made_____

MATERIALS			LABOR AND BURDEN					
Date	Req.	Cost	DEPARTMENT A					
			Date	Employ. No.	Labor Cost	Labor Hours	Burden Rate	Burden Applied
			Total					
			DEPARTMENT B					
Total			Total					

DEPARTMENT C

LABOR				BURDEN			
Date	Emp. No.	Operation No.	Labor Cost	Mach. No.	Mach. Hours	Mach. Rate	Burden Applied
Total							

SUMMARY OF COST

	LABOR		BURDEN		COMBINED	
	Total	Unit	Total	Unit	Total	Unit
Dept. A Dept. B Dept. C						
Total L. & B.						
Material Total Manufacturing Cost						

Fig. 1.

As soon as a production order is started a cost sheet bearing the same number is headed and inserted in the subsidiary ledger. When production is reported finished and all material requisitions and time tickets applicable to the order have been received by the cost department and entered in the cost sheet, and when burden applicable to the order has been calculated, then the cost of the order can be recapitulated in terms of total and unit costs at the bottom of the form. Then also, or at the end of the current month, the costs of all orders finished are summarized, proper credit is given to the work in process control accounts, and the cost sheets representing orders completed are removed from the subsidiary ledger.

There are many forms of order cost sheets adapted to fit the productive organization and the particular methods of analyzing and summarizing costs followed by the companies using them. In comparison with Figure 1, these forms may differ as follows:

1. As to materials; by providing a record of
   a. The use of materials by departments
   b. The kind, quantity, and unit price of materials.
2. As to labor, by providing
   a. Space for a larger number of departments.
   b. A record by operation numbers in all departments.
   c. A record of quantities for each operation.
3. As to burden, by providing
   a. Space for a larger number of departments.
   b. For more than the two types of bases (labor hours, and machine hours) upon which the amount of burden applicable to the order is calculated.
4. As to other matters, by providing
   a. Space for the calculation or notation of the estimated cost of the order, prepared before manufacture is started, either for comparison with actual cost, or as a basis used in setting the selling price.
   b. Space for the addition of special manufacturing costs, such as that for special tools or development.
   c. Space for the addition of costs beyond manufacture, such as packing, transportation, selling, and a portion of general administrative costs; and for the notation of the selling price, and the gross or net profit realized on the order.

Sources of Entry of Material Cost

The cost of material used on each order may be posted to the cost sheet in the following ways.

1. Directly from the individual requisition.

In this case it may be desirable to show, in addition to the date, requisition number and amount, the quantity, kind, and unit cost of each item. In this way all the information contained in the individual requisition is transferred to the cost sheet.

2. From a bill of material.

Whenever the product results from the assembly of a number of parts, all the parts necessary to the completion of the order may be issued on a single bill of material, the total of which is entered in the cost sheet without specifying the quantity and cost of each part.

3. From a daily, weekly, or monthly summary or report of materials used.

Whenever the items of material required for each order are numerous and are

issued on individual requisitions rather than on a single bill of material, considerable accounting labor can be saved by recapitulating the requisitions for a specified period, and entering on the cost sheet only the totals from this summary. There will then be as many entries on the cost sheet as there are recapitulation periods during which the order is in process. This method may be followed when the requisitions per order are relatively few, provided a detailed record on the cost sheet of the kind, quantity and unit price (as made in method 1) is not of positive value in understanding and interpreting the completed order cost.

The type of summary here referred to is one covering all direct materials used in the factory or a given department during a recapitulation period.

4. From an order summary of materials compiled at the completion of the order or at the end of the accounting period.

This type of summary covers only a single order. The procedure followed is this: All of the requisitions for material covering a given order are filed in an envelope or in a vertical file. When the order is finished they are added and a single entry is made in the cost sheet for the total. If the manufacture of the order has not been completed at the end of the month, an entry is made in the process of balancing with the control, for the cost of material used to date.

Whatever the method of entry upon the cost sheet, all the direct material requisitions for the month must be summarized and entered at the end of the month through a factory journal or journal voucher as a charge to material in process control and a credit to direct material control. The summary referred to in method 3 may be used as the basis for this entry. This summary may also be used to recapitulate the direct material used by departments. The department totals may or may not be entered to departmental direct material clearing accounts. If these accounts are used two entries are required as shown below:

Dept. A—Direct Material Used	$5,000	
Dept. B—Direct Material Used	3,000	
Dept. C—Direct Material Used	2,000	
Direct Material Control		$10,000
Material in Process Control	$10,000	
Dept. A—Direct Material Used		$ 5,000
Dept. B—Direct Material Used		3,000
Dept. C—Direct Material Used		2,000

The clearing accounts may serve a useful purpose in displaying the cost of material used by departments. The final charge, however, is to the material in process account.

Sources of Entry for Direct Labor Cost

The direct labor cost of each order may be posted to the cost sheet in the following ways:

1. From the individual order time ticket.
2. From a daily, weekly, or monthly summary of direct labor, generally called the labor distribution.
3. From an order summary of direct labor, made at the completion of the order or at the end of the accounting period.

These sources of posting parallel methods 1, 3, and 4 described above for direct material. The original evidence for direct labor is the individual time ticket, showing for each workmen the time spent on each job, if payment is at hourly rates; or the number of pieces, the piece rate, and the total labor cost if payment is made on this basis.

A total entry must be made weekly or monthly to the Labor in Process Control. Departmental clearing accounts for direct labor will be used in the manner described above for direct material if these accounts are provided by the classification.

Accounting for Overhead

Accounting for overhead involves these three steps.

1. Accumulating the overhead costs by departments in accordance with the classification of accounts.
2. Distributing the service department overhead to the producing departments.
3. Applying the productive department overhead to the individual orders—entering it on the cost sheets in amounts applicable to each order, and entering the total so applied to the Burden in Process Control.

The present description is concerned only with the third step, and with this step only in its broad outlines.

Burden is charged to order cost sheets (alternative expressions are applied and absorbed) at (1) predetermined rates, or (2) actual rates. Under either of these methods, certain selected bases are multiplied by department burden rates, set in advance of the period or determined at its close, so as to state the amount of burden applicable to each order. The bases commonly used are:

a. Direct labor cost
b. Direct labor hours
c. Department hours
d. Machine hours
e. Material cost
f. A multiple base, such as direct labor time and machine time

Assume that a departmental direct labor hour method is selected as the basis for applying burden to cost sheets, and that the predetermined type of rate is to be used. The application of burden then involves the following steps as to each productive department:

A. Before the beginning of the accounting period—predetermining the burden cost per direct labor hour, that is calculating the rate. This calculation requires:
   1. Estimating the number of direct labor hours to be expended in the department during the coming accounting period.
   2. Estimating the amount of overhead expense to be incurred by the department in operating for this number of direct labor hours.
   3. Determining the rate by dividing (2) by (1).

B. During the accounting period—
   1. Measuring and recording the number of direct labor hours used on each production order. This is done through the order time tickets, and may be entered directly on the cost sheet by any of the methods listed above for accounting for the direct labor cost of the order.
   2. Extending the direct labor hours on each order at the predetermined rate, and entering the amount of the burden applied to the order on the cost sheet.

3. Summarizing the total burden applied for the period, and entering the total as a debit to Burden in Process. The Burden Applied account of each department is credited in an amount which is the product of the total labor hours on orders multiplied by the departmental predetermined rate.

Step B2, extending the direct labor hours on each order and entering the resulting amount on the order cost sheet, may be performed in several ways.

1. The extension may be made on the order time ticket. Under this method this ticket performs the dual function of stating the labor time and cost for each increment of direct labor, and the burden applied to that labor time or cost. It also performs the third function of showing the earnings of the workman for payroll purposes. Entry is made on the cost sheet directly from the time ticket.

2. The entry of burden may be made directly on the cost sheet, either for (a) each increment of labor entered therein; or (b) for the total labor required in each department to complete the job; or (c) for the amount expended to the end of the accounting period. The latter calculation is made as to the jobs unfinished at the end of the period. The total is the only basis available when summary entries of labor time and cost are made on the cost sheet.

The summary debit to the Burden in Process account may be prepared by (1) recapitulating the burden shown on each order time ticket when the data are available at this source; (2) by means of an independent calculation based upon the total labor hours charged to cost sheets by each department; or (3) by recapitulating the extensions made on each cost sheet. The latter method is unsatisfactory inasmuch as it does not provide an independent, or "control" check, upon the individual cost sheet entries.

When machine time is used as the basis for applying burden, as required in Department C of Figure 1, an independent record of machine hours must be kept, or the order time ticket must be made to perform the function of showing which machine was used in the manufacture of the order in each department, and for what period of time.

When actual, in contrast with predetermined, rates are used, essentially the same procedure is followed except that the rate is determined after the close of the period. At this date the actual amount of the base, labor hours for example, and the actual departmental overhead of the period are known. The disadvantage of this type of rate is that the costing of completed orders is considerably delayed. The cost of orders finished on the first day of the month, for example, cannot be calculated, as to the overhead element, until the fifth to the tenth of the succeeding month. In the meantime the articles produced have been shipped in whole or in part, and the costing of goods sold is likewise delayed. The advantage of the method is that it does provide more nearly the exact actual cost, and it obviates the necessity of disposing in some way of the amount of over or under absorbed burden.

Summarizing the Cost of Finished Orders

Upon completion of manufacture the cost of production orders for stock products must be transferred to the Finished Stock Control. A summary presenting the information given in the form below is prepared for this purpose.

When predetermined burden rates are used, the order cost sheet can be closed immediately upon completion of manufacture, and its totals entered on the above summary. The cost sheet itself is removed from the cost ledger and is used to post

SUMMARY OF STOCK ORDERS

FINISHED

Month of July, 19___.

Date	Order No.	Product Symbol	Dr. Finished Stock	Cr. Material In Process	Cr. Labor In Process	Cr. Burden In Process
2	19520	4—902	520.50	150.40	219.60	520.50
3	19750	3—120	1480.20	670.00	510.30	299.90

Fig. 2.

SUMMARY OF SPECIAL ORDERS

COMPLETED AND SHIPPED

Month of July, 19___.

Date	Product Order No.	Sales Order No.	Dr. Cost of Goods Shipped	Cr. Material In Process	Cr. Labor In Process	Cr. Burden In Process

Fig. 3.

the order number, quantity, total cost, and unit cost data to the finished perpetual stock sheet indicated by the product symbol. The totals shown by the summary are posted to the respective control accounts at the end of the month.

Special orders manufactured are usually shipped immediately, and hence their cost may be transferred directly to cost of goods shipped as soon as shipment is made. A summary similar to Figure 3 is prepared for this purpose. Upon completion of manufacture and shipment the cost sheet is removed from the in-process cost ledger, and is filed for future use should another order for the same item be received.

The cost of stock orders shipped will be summarized from a copy of the shipping order or the invoice. The entry will be a charge to Cost of Stock Orders Sold, and a credit to Finished Inventory Control. The individual perpetual finished stock sheets are posted from the shipping order.

Diagram of Order Cost Procedure

Figure 4 presents a diagrammatic summary of order cost procedure. Major control accounts, and subsidiary ledgers, are shown. Control account entries are indicated in solid lines, and entries to subsidiary records are indicated by broken lines. Study of the diagram may clarify the descriptive material presented above.

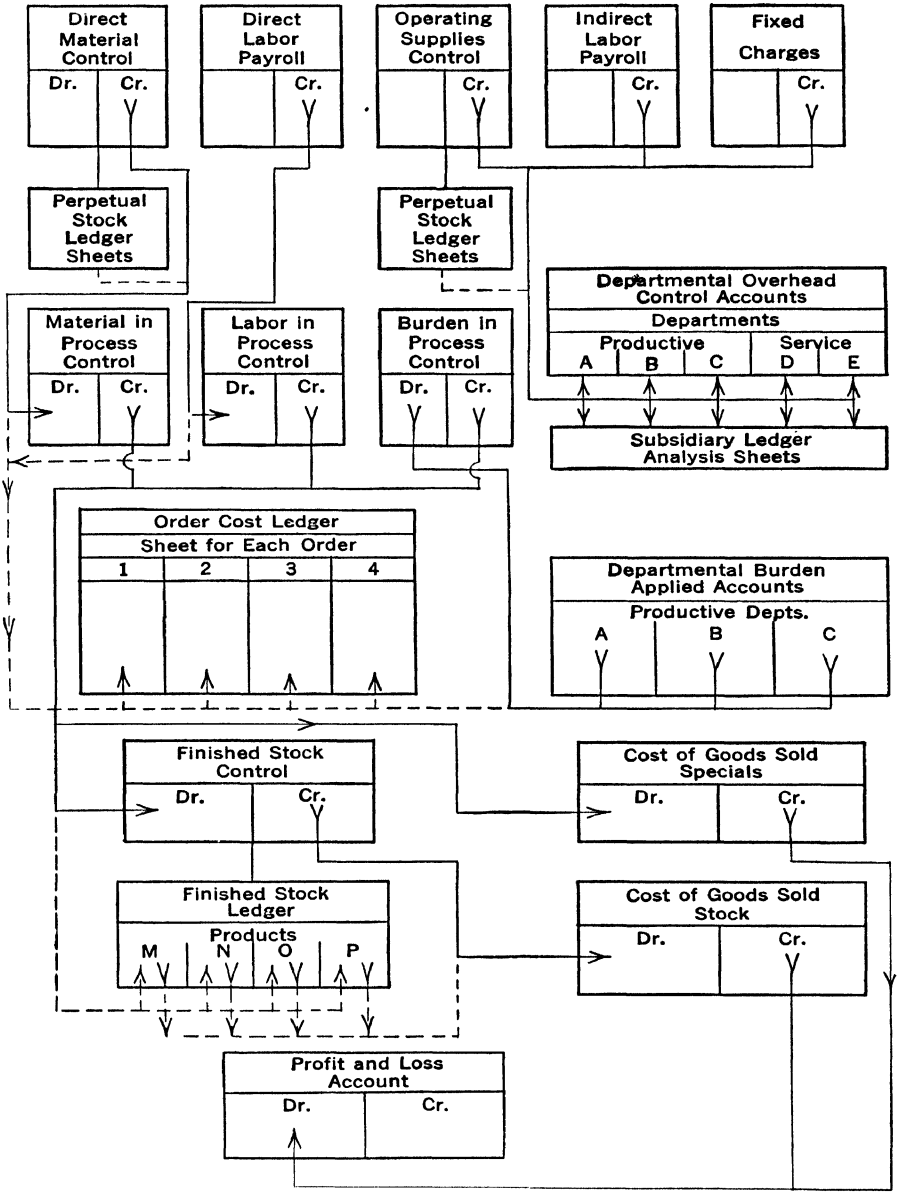


Fig. 4. Diagram of Order Cost Procedure.

Advantages and Disadvantages of the Order Cost Method

The order cost method produces the specific cost of each order. Whenever the business is engaged in the manufacture of non-standardized products, this method may offer the only way in which actual product costs can be determined. There are, however, four serious disadvantages in its use:

1. It is expensive to operate.
2. It fails to supply adequate control data.
3. The costs of identical items made from time to time are apt to fluctuate widely.
4. The method is particularly subject to the making of clerical errors, both in preparing the original evidences of transactions in the factory, and in summarizing the mass of details in the cost office.

The order method is a distinct advance over general accounting procedure. In contrast with standard cost procedure, however, its weakness lies in its failure to provide control data through comparisons of actual with standard performance and costs. Comparisons under the order method are usually limited to checking the actual costs of the order with the advance estimates, if any were made, and with the cost of similar orders produced in the past. These costs are often found to differ widely, and analysis of the causes of differences is impossible or unreliable.

Application Other than to Product Cost Determination

In spite of these disadvantages practically all companies have use for order cost procedure, even when product costs are determined by some other method. The principal other uses are in connection with plant construction work and repair work. All property changes—additions, betterments, and retirements—should be carefully accounted for, and whenever the work is done entirely or partially by employees of the company, some form of order cost procedure is essential. The method described above is generally applicable, except that many of the charges for material may come directly from vouchers covering special purchases, and special non-productive department overhead rates may be used to apply burden originating in the engineering and maintenance departments.

In other cases where maintenance or repair work exceeding a specified figure must be especially authorized, order cost procedure is also applicable.

Process Cost Method

A General Description

The basis of cost accounting under this method is the individual process. Inasmuch as processing is performed in a department or division of the factory, this method is sometimes called departmental or divisional cost accounting. The difference between the department and the division is that in the department only a single process is performed, whereas in the division either (1) a group of related processes are conducted, or (2) a group of related products that require similar operations or processing are manufactured. Within a division manufacturing a group of related products, the individual processes may be separated in departments.

There are many variations of the process cost method. In its simplest form, however, the procedure is as follows:

1. All elements of cost are charged to the process, that is to the department, for a *fixed period of time,* the accounting period. The department accounts therefore accumulate the cost of direct material used, direct labor cost, direct department overhead, and apportioned overhead.
2. The output of the department for the same period is recorded.
3. The average unit cost of the department output is calculated by dividing (1) by (2).

If a number of products are processed in the same department, two general modifications of this simple form of procedure are required in order to arrive at reliable individual costs. These modifications are:

1. The material element may be kept separate from the conversion costs, in order that the amount of the cost of this element can be separately determined for each product. In this case the conversion cost within a given process is identical per unit for all products, but the material costs differ.
2. The output factor may be modified to recognize the fact that the processing effort, and hence the processing cost, is not identical on a per unit basis, for all products processed within the department.

Both of these modifications of the simplest form of process cost procedure described above are elaborated in later sections.

Outstanding Characteristics

The outstanding characteristics of this method, inherent in the procedure outlined above, are:

1. *The fixed period of time,* called the process period. This period usually corresponds with the accounting period—that is, one month. In some productive circumstances to which the process method is applied, particularly if a variety of products pass through the same process during a month, some shorter period, say the process hour, may have to be used in order to allocate the conversion costs incurred in a given department to this variety of products.

This characteristic may be contrasted with the order method, under which the period of time is not fixed. The fixed factor under the order method is the quantity of the specified product manufactured.

2. *The use of the department accounts* to collect either all elements of cost, or at least the conversion costs, applicable to the process. A corollary of the accumulation of costs by departments is that the importance of the distinction between costs that are direct and indirect as to the product tends to disappear; at least it is less important than under the order procedure. In many process procedures, no distinction need be made between direct and indirect labor in order to cost the product.

3. *The recording of output by departments.* Output must be separately recorded for the individual processes or departments for which costs are collected.

4. *The averaging of the unit costs by processes* or departments. This averaging takes place through the procedure of dividing the costs of a department for the period by the unit output of the period. This averaging is of two types:

a. The averaging that results when the units of output within a department are identical. If only a single product is worked upon in a given process, it is nevertheless a fact that, because of differences in the quality of materials or in the efficiency of workmen, some units will actually require more processing time than others.

Under order procedure these differences are reflected in the costs charged to each order. These differences, however important from a cost control standpoint, are from the product cost standpoint purely accidental and unimportant. By the process method these differences are averaged, so that a single process unit cost per period is calculated.

b. The averaging that results when the units of output within a department are not identical. This type of averaging takes place if more than one type of product is processed in a department during the period under conditions which indicate that one product requires more processing time per unit than another. The error resulting from using a single unit process cost may in some cases be insignificant; in other cases it may be considerable. In the latter circumstances the statement of the unit process cost is unreliable for control purposes, and the individual product costs are also inaccurate. In this case the process method must be abandoned, or it must be modified in either of two ways: (a) a weight factor may be introduced to represent the relative processing difficulty, in point of time required per product unit; or (b) the product unit may be abandoned as a representation of process output, and a time unit, the process hour, substituted. The latter alternative introduces a further step in the costing procedure, because it is necessary to know not only the physical units of each product processed, but also the process hours spent on each product.

5. *The necessity of inventorying the work in process* and estimating the degree of completion and the costs to be associated therewith. Three situations are found relative to this necessity.

a. If the processing period is short, there may be no work in process. This condition may exist naturally, or it may be due to the deliberate efforts of management to see that all work is finished when the period ends. There being no work in process in this case, no estimates of its status are required.

b. There may be normally a constant amount of work in process at the beginning and end of each period. This statement will rarely be true exactly, but if the amount is practically constant, and if this amount is small relative to the total output of the period, then the work in process may be neglected in the unit cost calculations.

c. The amount of work in process may vary considerably from period to period, so as to affect substantially the unit cost calculations. In this case the amount of work in process must be determined; the degree of completion *within the process* must be estimated; and the amount of costs applicable thereto must be calculated.

This necessity of calculating the amount of cost assignable to work in process arises from the fact that the procedure of charging costs to the process accounts does not of itself distinguish between the amounts of cost applicable to units finished and units still unfinished. Process costs are in this sense joint costs to be apportioned both to completed work and to work still in process. This circumstance may be contrasted with order cost procedure. Under the latter method the order cost sheet constantly presents a record of the cost accumulated by all unfinished orders. Under the process method, the cost of unfinished work in each department must be calculated, unless as pointed out above it does not exist or may be neglected without serious error. The amount of cost assigned to work in process is important obviously because it affects also the valuation of finished units. Problems associated with this calculation are mentioned at a later point.

6. *The necessity, in some cases, of the progressive transfer of costs* from department to department. Not infrequently in applications of the process method the product of one department is the raw material of the next process. As the goods progress from process to process, the accounts should reflect the amount of the accumulating costs. This is accomplished by transfers of the cost of work finished in one department to the accounts of the succeeding process, until at the final stage of manufacture, the total cost of the completed product is transferred to the finished inventory.

Application of the Process Method

The application of the process method may be discussed from several standpoints. From the standpoint of the nature of the article produced, the cost of the following types of products may be determined in accordance with the process method:

1. Bulk goods, such as refined sugar, gasoline, fuel oil, cement, flour, paper pulp, pig iron.
2. Like articles:
   a. Single items, such as nails, rivets, bolts, screws, and many others.
   b. Compound units, made from the assembly of a few or many parts, such as electric light meters, household electrical appliances, typewriters, automobiles, machine tools.
3. Service industries, supplying electric power, natural and artificial gas, water, heat.

The common factor that must be present in order to apply the process method to the costing of products as different as paper pulp and washing machines is that they be manufactured under conditions of continuous processing or under mass production methods. Bulk goods are naturally manufactured in processes through which they flow in a continuous stream. Many single like articles are also made under similar conditions. Whether compound units or assembled products are manufactured under these conditions is dependent upon the layout of the factory and the method of utilizing the production facilities. Like articles can be made either under functional layout and intermittent processing, or under conditions of product layout and continuous processing. The assembly line that operates on a single model at a time is no less continuous than a department of a bulk goods plant, such as the materials preparation and beater departments in a paper mill, that also processes only a single product at a given time. In both cases, a change may be made from time to time to different models or mixtures, without in any way changing the fact of continuous processing except that the process period will no longer coincide with the accounting period.

In addition to its application to the determination of product costs, the process method is used by almost every company in the determination of service department costs. This use makes the process method of almost universal application.

Variations of the Process Method

The order and the process methods differ strikingly in one aspect. The order method is a more stable procedure in that it can be applied to a wide variety of productive circumstances without basic changes in the procedure itself; hence it is easily described and understood. On the other hand, the process method is more variable in that adaptation to different productive circumstances modifies the pro-

cedure described above, so that instead of being in a sense singular and fixed, there are many varieties and forms of this procedure. Hence a single description fails to fit the many modifications of basic process procedure that are found among different industries and companies. Some of the different circumstances responsible for these variations are: (1) the number of products manufactured; (2) the plant layout, and the bases of departmentalization and divisionalization employed; (3) the nature of the product flow—whether all processes are used by all products or whether the processing is selective—that is, some products require certain processes and omit others; and (4) the extent of the common costs among products, particularly whether (a) the material cost element for each product must be separately accounted for, and (b) whether the conversion cost for processes that are common to several products must be apportioned among them on some basis other than the number of units of each product made.

Using these factors as a basis the following classification, indicative of the variety of process cost procedure, is presented.

I. Non-departmental procedure; that is, costs for the entire plant are accumulated without separation by departments.

- A. A single product is manufactured. All costs for the period apply to this single product.
- B. More than one product is made:
  - 1. The cost elements of all products are recorded together.
    - a. Apportionment to the several products is made on the basis of units of each, that is all products are assumed to have any equal unit cost, or
    - b. Apportionment to the several products is made on the basis of:
      - i. Weighted units of each product.
      - ii. Processing time.
      - iii. Weighted units for the material cost element, and processing time for the conversion cost.
  - 2. A separation of the cost elements is made.
    - a. The individual material cost of each product is separately recorded.
    - b. The conversion cost is apportioned on the basis of
      - i. Units.
      - ii. Weighted units.
      - iii. Processing time.
    - c. The cost of each product is the sum of its material cost plus the conversion cost apportioned to it.

II. Departmental procedure, that is costs are collected in department accounts for the individual processes.

- A. A single product is manufactured and flows progressively through all the processes. Transfers of costs representing the flow of work are made in the accounts from department to department. These productive circumstances may be called *single sequential processing*.
- B. Several products are made.
  - 1. Each product is made in a separate department. The plant is departmentalized on a product basis, and each product is made in a distinct section. Within each department the processing may be simple or complex, but in either event only one product is involved. All elements of cost are recorded in the department accounts. This condition may be called *independent, or parallel processing*. In effect each department is an independent plant making a single product.

2. All products flow through a sequence of common departments; all departments work on all products. These circumstances may be called *multiple sequential processing.*
   a. The cost elements applicable to each process are combined for all products in the department accounts. Apportionment is made *for each process* as shown in I B 1 above.
   b. A separation of the cost elements is made.
      i. The individual material cost of each product is separately recorded.
      ii. The conversion cost *for each process* is apportioned to the various products on the basis of units, weighted units, or processing time.
      iii. The individual cost of each product is the sum of its material cost plus its share of all of the process costs.
3. Products flow through a selective sequence of processes—that is, certain processes may be common to all products, and other processes apply only to some of the products. These circumstances may be called *selective processing.* Usually the material element for each product is separately recorded rather than being charged to the department accounts.
   a. The conversion cost of each process is apportioned to the benefited products on one of the bases listed in I B 2 b.
   b. The total cost of each product is composed of its material cost plus its portion of the cost of all processes through which it has been passed.

III. Divisional procedure—that is, the plant is organized in divisions along product lines; within a division only one, or a group of related products are manufactured. Each division is organized into departments within each of which a particular kind of processing takes place.

A. If within each division a single product is manufactured, the processing procedure is analogous to the single sequential circumstances described above, and the organization as a whole may be described as organized for *parallel-sequential processing.*
B. If within each division groups of similar although non-identical products are made, the approximate average individual cost of each of which the management wishes to know, then the productive circumstances within each division are analogous to either:
   1. The multiple sequential processing, or
   2. The selective processing described above, and the organization as a whole may be described as arranged for parallel-multiple sequential, or parallel-selective processing, or both.

In addition to the circumstances described above the process method is used also in determining the cost of products of a main- and by-product nature, and of joint-cost products.

It is apparent that the difficulties of applying the process method increase with the number of products manufactured, and the necessity of separating the material costs from the conversion cost elements.

Parallel, sequential, and selective process accounting are described further in the following sections.

Parallel Process Accounting

A diagram of parallel process accounting is presented in Figure 5. At the top of this diagram blocks are shown which represent the main sources of the charges

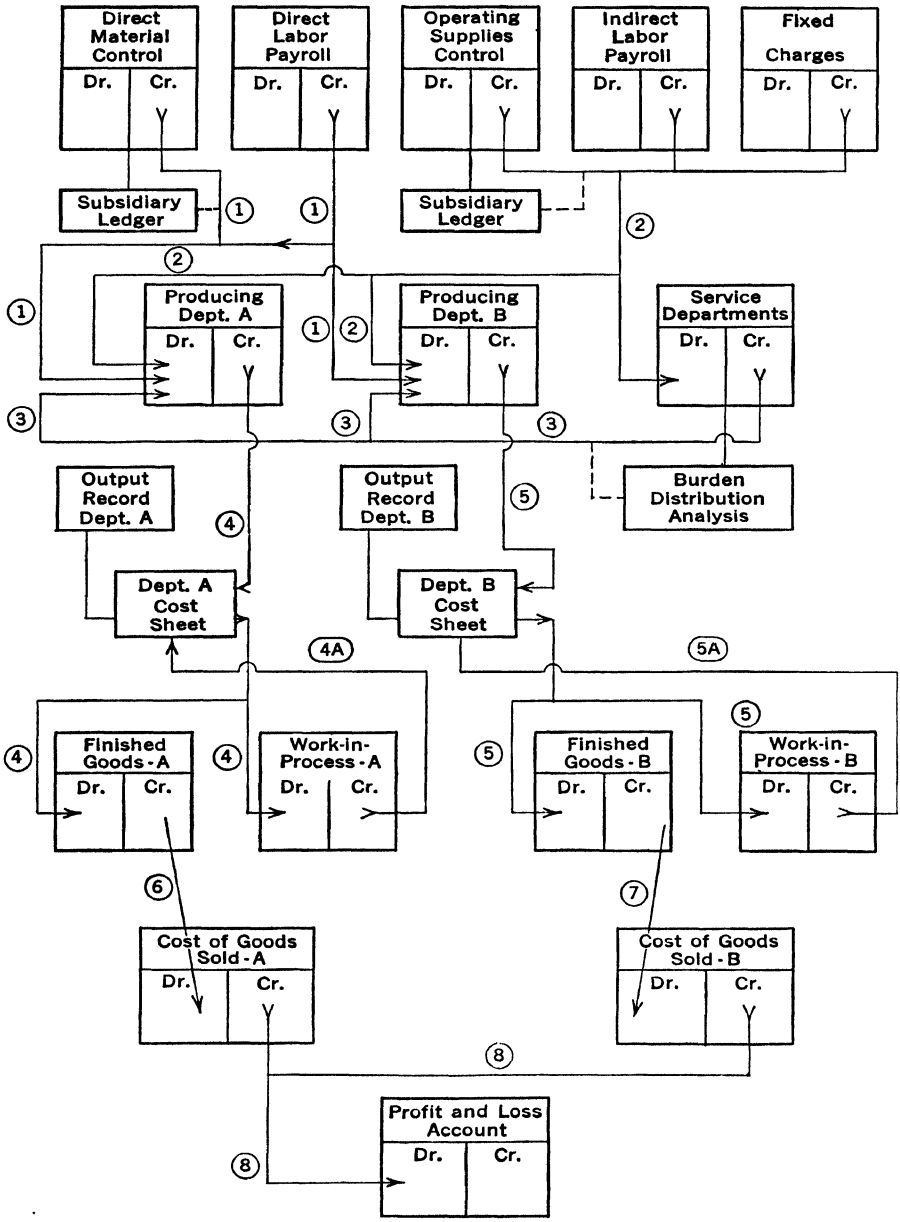

Direct Material Control
Dr.
Cr.
Direct Labor Payroll
Dr.
Cr.
Operating Supplies Control
Dr.
Cr.
Indirect Labor Payroll
Dr.
Cr.
Fixed Charges
Dr.
Cr.
Subsidiary Ledger
Subsidiary Ledger
Producing Dept. A
Dr.
Cr.
Producing Dept. B
Dr.
Cr.
Service Departments
Dr.
Cr.
Output Record Dept. A
Output Record Dept. B
Burden Distribution Analysis
Dept. A Cost Sheet
Dept. B Cost Sheet
4A
5A
Finished Goods - A
Dr.
Cr.
Work-in-Process - A
Dr.
Cr.
Finished Goods - B
Dr.
Cr.
Work-in-Process - B
Dr.
Cr.
Cost of Goods Sold - A
Dr.
Cr.
Cost of Goods Sold - B
Dr.
Cr.
Profit and Loss Account
Dr.
Cr.

Fig. 5.

made to the departmental process accounts—namely, direct material, direct labor, operating supplies, indirect labor, and fixed charges. Below are shown accounts which accumulate the operating charges in producing departments A and B, and the service departments. The costs here accumulated each month are combined through the departmental cost sheet with the record of output and give the information upon which the producing department charges are transferred to finished goods and work in process. The major entries may be followed in the diagram through the following numbers:

1. Direct charges to the producing departments for material and labor.
2. Direct charges to the producing and service departments for operating supplies, indirect labor, and fixed charges.
3. Charges to the producing departments and credits to the service departments for the apportionment of service expenses.
4. Charges to finished goods A and work in process A, and a credit to producing department A for the cost of work fully completed and partially finished during the period. Line 4 A indicates the fact that if there was work in process at the beginning of the period, its quantity and cost must be considered together with the current charges in making entry 4.
5. Entry 5, for producing department B, is similar to entry 4.
6 and 7. These entries transfer the cost of shipments from finished inventory to cost of goods sold accounts.
8. Entry 8 closes out cost of goods sold accounts to profit and loss.

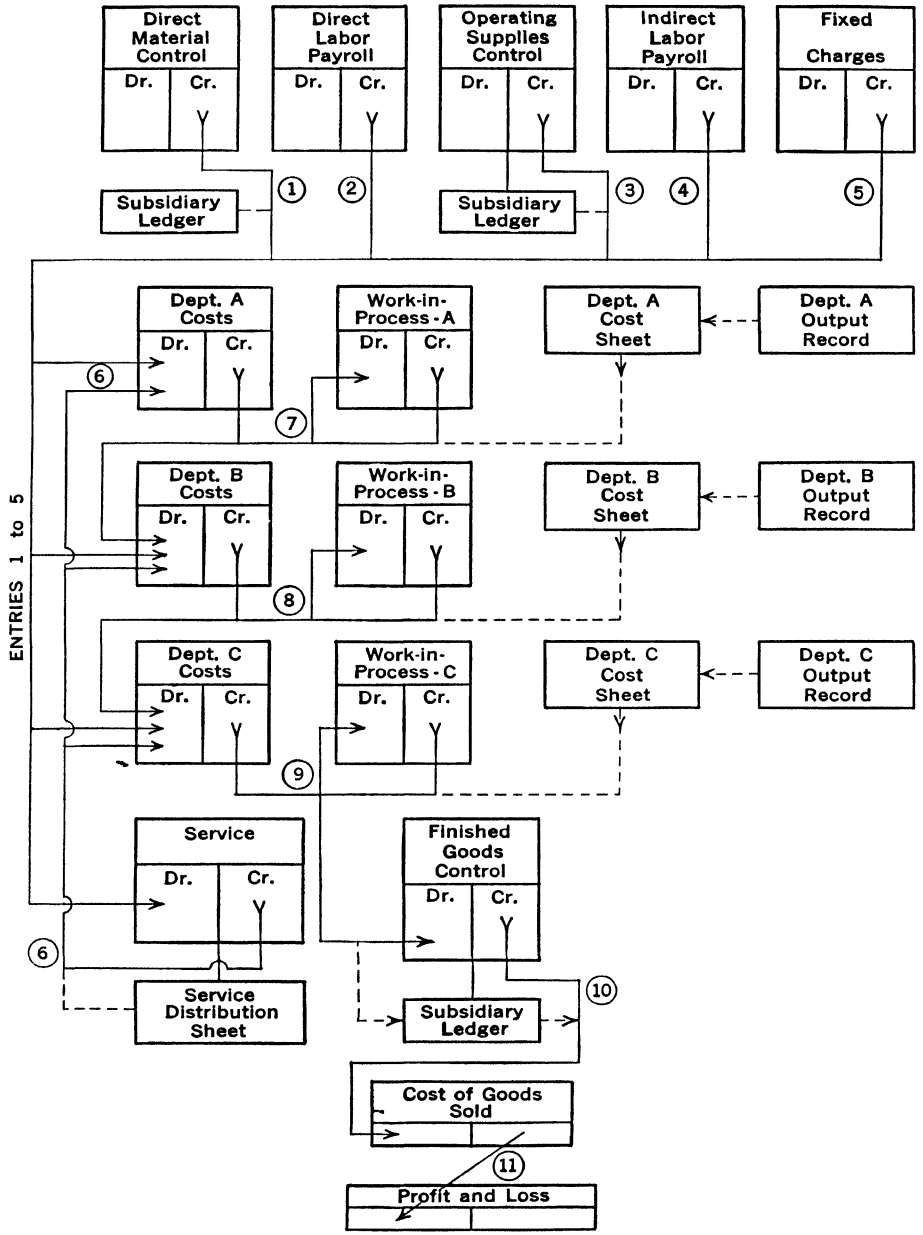
Many variations of the simple parallel process method diagrammed above are found.

Sequential Process Accounting for a Single Product

A diagram of progressive or sequential process cost accounting is presented in Figure 6. In this case production starts in department A and progresses through department C from which it emerges in finished condition. The costs in each department are the sum of the costs transferred from previous departments and the department charges. A simple hypothetical illustration of this type of process procedure is given below in the form of entries. Entry numbers correspond with the figures shown in the diagram. Service departments are combined in the diagram and in the entries for the sake of simplicity in presenting the main outlines of the sequential process method.

The trial balance of the factory ledger at the beginning of January 19— follows:

	Debit	*Credit*
Direct Material Control	$10,000.00	
Operating Supplies Control	5,000.00	
Work in Process—Dept. A (1000 Units)	1,580.00	
Work in Process—Dept. B	—	
Work in Process—Dept. C (1800 Units)	5,940.00	
Finished Goods (3000 Units)	10,800.00	
General Ledger Control		$33,320.00


Direct Material Control
Dr.
Cr.
Direct Labor Payroll
Dr.
Cr.
Operating Supplies Control
Dr.
Cr.
Indirect Labor Payroll
Dr.
Cr.
Fixed Charges
Dr.
Cr.
Subsidiary Ledger
Subsidiary Ledger
1
2
3
4
5
ENTRIES 1 to 5
Dept. A Costs
Dr.
Cr.
Work-in-Process - A
Dr.
Cr.
Dept. A Cost Sheet
Dept. A Output Record
6
7
Dept. B Costs
Dr.
Cr.
Work-in-Process - B
Dr.
Cr.
Dept. B Cost Sheet
Dept. B Output Record
8
Dept. C Costs
Dr.
Cr.
Work-in-Process - C
Dr.
Cr.
Dept. C Cost Sheet
Dept. C Output Record
9
Service
Dr.
Cr.
Finished Goods Control
Dr.
Cr.
6
Service Distribution Sheet
Subsidiary Ledger
10
Cost of Goods Sold
11
Profit and Loss

The control account summary entries are listed below.

	Debit	*Credit*
1. For Direct Material Used:		
Department A	$5,000.00	
Department B	3,000.00	
Department C	1,000.00	
Direct Material Control		$ 9,000.00
2. For Direct Labor:		
Department A	$6,000.00	
Department B	7,000.00	
Department C	4,000.00	
Accrued Payroll		$17,000.00
3. For Operating Supplies Used:		
Department A	$1,000.00	
Department B	800.00	
Department C	1,200.00	
Service Departments	1,500.00	
Operating Supplies Control		$ 4,500.00
4. For Indirect Labor Payroll:		
Department A	$ 700.00	
Department B	900.00	
Department C	600.00	
Service Departments	1,800.00	
Accrued Payroll		$ 4,000.00
5. For Fixed Charges:		
Department A	$ 800.00	
Department B	400.00	
Department C	700.00	
Service Departments	900.00	
General Ledger Control		$ 2,800.00
6. For Service Expense Apportionment:		
Department A	$1,200.00	
Department B	1,900.00	
Department C	1,100.00	
Service Departments		$ 4,200.00

At this point all the expenditures of the month have been accumulated in the producing department accounts. In the meantime production records for the period and an inventory check at the end of the period show the following output and inventory data. Units are in each case stated in terms of the final finished product physical unit.

OUTPUT AND INVENTORY DATA

Month of January 19—

	Dept. A	*Dept. B*	*Dept. C*
In Process January 1			
Units in Process Finished but not Transferred	1,000		
Units in Process Two Thirds Finished			1,800

New Units Started in January	10,000		
Units Transferred in January			
From Dept. A to Dept. B	(11,000)	11,000	
From Dept. B to Dept. C		(10,000)	10,000
From Dept. C to Finished Inventory			(9,400)
In Process January 31			
Dept. A			
Dept. B—Completed		1,000	
Dept. C—One-Third Finished			2,400

The expenditures and output for each department are now brought together on a department cost sheet. For the purpose of stating the per unit cost for each process it is necessary to calculate the number of equivalent units in any department where there was unfinished work at the beginning or end of the period. This is done by reducing the number of physical units worked on in the department to the number of fully completed units that the work performed represents. In the present case Department C is the only process in which there is unfinished work in process at either the beginning or end of the period. The calculation of the work performed in this department in terms of finished or "equivalent" units follows:

a. 1800 physical units that were two thirds finished in December, had the remaining one third of the work necessary to complete them performed in January. This performance in Department C of one third of its work on 1800 units is equivalent to the performance of all the work on 600 units.
b. 2400 units that were transferred to Department C in January were only one third finished at January 31. One third of 2400 units equals 800 complete units, from the standpoint of Department C accomplishment.
c. The remaining 7600 units transferred to Department C in January were fully completed and transferred to finished goods.

Physical Units		*Equivalent Units*
1,800	Units in process January 1 were completed	600
10,000	Were transferred to the department: Of these 7600 were completed and transferred to finished goods;	7,600
	and 2400 were only one third finished on January 31.	800
11,800	Total physical units worked on.	
9,400	Completed units transferred to finished inventory.	
2,400	Physical units on hand one third finished.	
	Total performance of the department in terms of finished units	9,000

The department cost sheets are now prepared. Their function is to bring together the expenditure and output factors thereby showing (1) the total cost of operating the department; (2) the unit cost of the work performed, using for this purpose the number of equivalent units where this figure differs from the number of physical units; (3) the unit and total cost of work transferred, and (4) the valuation of the final work in process inventory.

DEPARTMENT A COST SHEET

Month of January 19—

	Total Cost	*No. of Units*	*Unit Cost*
In Process January 1			
Completed in December	$ 1,580.00	1,000	$1.58
January Expenditures			
Direct Material	$ 5,000.00	10,000	$0.50
Direct Labor	6,000.00	10,000	.60
Operating Supplies	1,000.00	10,000	.10
Indirect Labor	700.00	10,000	.07
Fixed Charges	800.00	10,000	.08
Apportioned Charges	1,200.00	10,000	.12
Total	$14,700.00	10,000	$1.47
Total in Process	$16,280.00	11,000	$1.48
In Process January 31			
Transferred to Dept. B	$16,280.00	11,000	$1.48

7. Entry to Effect Transfer of Department A Output:

	Debit	*Credit*
Department B	$16,280.00	
Department A		$14,700.00
Work in Process, Department A		1,580.00

DEPARTMENT B COST SHEET

Month of January 19—

	Total Cost	*No. of Units*	*Unit Cost*
Transferred from Dept. A	$16,280.00	11,000	$1.48
January Expenditures			
Direct Material	$ 3,000.00	11,000	$0.27273
Direct Labor	7,000.00	11,000	0.63636
Operating Supplies	800.00	11,000	0.07273
Indirect Labor	900.00	11,000	0.08182
Fixed Charges	400.00	11,000	0.03636
Apportioned Charges	1,900.00	11,000	0.17273
Total	$14.000.00	11,000	$1.27273
Total Costs in Process	$30,280.00	11,000	$2.75273
Deduct—In Process Finished on January 31	2.752.70	1,000	2.75273
Transferred to Dept. C	$27,527.30	10,000	$2.75273

8. Entry to Effect Transfer of Department B Output to Department C and to Work in Process:

	Debit	*Credit*
Department C	$27,527.30	
Work in Process—B	2,752.70	
Department B		$30,280.00

DEPARTMENT C COST SHEET

Month of January 19—

	Equiv. Units
Performance in Equivalent Units	
1800 Units in Process January 1—Work to Finish = One Third	600
7600 Units Received and Finished	7,600
2400 Units Received, One Third Finished	800
Performance for January	9,000

	Total Cost	*No. of Units*	*Unit Cost*
January Expenditures			
Direct Material	$ 1,000.00	9,000	$0.11111
Direct Labor	4,000.00	9,000	0.44444
Operating Supplies	1,200.00	9,000	0.13333
Indirect Labor	600.00	9,000	0.06667
Fixed Charges	700.00	9,000	0.07778
Apportioned Charges	1,100.00	9,000	0.12222
Total	$ 8,600.00	9,000	$0.95555
Add—Work in Process January 1	5,940.00	1,800	—
Transfers from Dept. B	27,527.30	10,000	$2.75273
Total in Process in January	$42,067.30	11,800	—
Less in Process Inventory January 31, values as below	7,370.99	2,400	$3.07124
Transferred to Finished Stock	$34,696.31	9,400	$3.69110

Valuation of Work in Process Inventory at January 31	
2400 Units at Dept. B Cost ($2.75273)	$6,606.55
2400 Units at One Third of Dept. C Cost	764.44
	$7,370.99

9. Entry to Effect Transfer of Department C Output to Finished Goods and Work in Process

	Debit	*Credit*
Finished Goods	$34,696.31	
Work in Process—Dept. C	7,370.99	
Department C		$36,127 30
Work in Process—Dept. C		5,940.00

A question might be raised at this point as to the proper unit cost to be assigned to the goods finished in Department C. These goods are composed of two increments, a separate value for each of which can be calculated as shown below:

	Total Cost	*Unit Cost*
1. 1800 Units Started in December		
December Cost	$ 5,940.00	$3.30000
January Cost (One Third of $0.95555)	573.33	.31851
Total	$ 6,513.33	$3.61851
2. 7600 Units Started and Finished in January		
Costs through Dept. B	$20,920.75	$2.75273
Dept. C Cost	7,262.23	.95555
Total	$28,182.98	$3.70828

This calculation shows that the units started in December and finished in January cost $3.61851, while the units started and finished in January cost $3.70828. The weighted average of the two increments is shown in the department cost sheet as $3.6911. If the costs fluctuate widely from month to month, the use of the separate increment costs will have the effect of keeping the finished stock valuation more nearly on a current basis, provided it is assumed in costing shipments that lots started first are shipped first.

10. Entry for January Shipments:

3000 units from December production at	$3.60	per unit
5000 units from January production at	3.6911	per unit

	Debit	*Credit*
Cost of Goods Sold	$29,255.50	
Finished Goods		$29,255.50

It should be noted in this tabulation that it is assumed that material is added proportionately in each department as the work progresses; hence it can be said that, if one third of the work of a process has been performed, one third of the material added in that department has been used. Several variations of the utilization of material are found. Frequently material is added at the beginning of processing.

A summary of *current month cost* for a completed physical unit is presented below:

SUMMARY OF LATEST UNIT COST

Month of January 19—

Nature of Item	*Dept. A*	*Dept. B*	*Dept. C*	*Total*
Direct Material	$0.50	$0.27273	$0.11111	$0.88384
Direct Labor	0.60	0.63636	0.44444	1.68080
Operating Supplies	0.10	0.07273	0.13333	0.30606
Indirect Labor	0.07	0.08182	0.06667	0.21849
Fixed Charges	0.08	0.03636	0.07778	0.19414
Apportioned Charges	0.12	0.17273	0.12222	0.41495
Total Cost	$1.47	$1.27273	$0.95555	$3.69828

It will be noted that this total unit cost does not agree with the final unit product cost shown by the Department C cost sheet. The latter figure is 3.6911. The cause of the difference is the carry-over of inventories in the three processes at unit costs differing from those applicable to the present month. A statement similar to the above that does agree with the cost sheet in the final department may be made up if the composition, in terms of direct material and the other items, of the department inventories carried over from the previous month is known. These figures should be readily available from the department cost sheets of the previous month.

The summary of latest unit costs is used for control purposes in comparison with

1. Similar figures of the previous month.
2. Cost standards, if these have been established.

Sequential Process Accounting—Multiple Products

Sequential process accounting for several products presents a more difficult situation. Usually the material cost of each product must be separately determined, and the processing cost in each department must be allocated to each product by the use of weights or by means of a record of process time spent on each. To illustrate the application of this method in those circumstances assume the following facts:

1. The factory is organized in three producing departments.
2. There are no in process inventories either at the beginning or end of the period.
3. Direct material is introduced at the beginning of operations in Department A.
4. Three products are manufactured.

The cost ledger and production records for the month of January present the following summarized information:

Cost of Direct Material Used for

Product X	$10,000.00
Product Y	6,000.00
Product Z	8,000.00
Total	$24,000.00

Processing Costs for the Month, after the apportionment of Service Department Expenses:

Department A	$14,600.00
Department B	18,400.00
Department C	9,800.00
Total	$42,800.00

Output of Completed Products:

Product X	10,000 units
Product Y	12,000 units
Product Z	20,000 units

The following weight factors have been determined in the past from test runs and other data. The weight factors represent the relative output per unit of time of the three products in each department:

Product	*Dept. A*	*Dept. B*	*Dept. C*
X	1	2	3
Y	3	1	4
Z	5	3	1

On the basis of the production of physical units in the month, and the weight factors, the following compilation of departmental weighted output is made for the month of January.

Product	*Dept. A*	*Dept. B*	*Dept. C*
X	10,000	20,000	30,000
Y	36,000	12,000	48,000
Z	100,000	60,000	20,000
Total Weighted Output	146,000	92,000	98,000

The processing costs allocated to each product on the basis of this weighted output are summarized below:

Product	*Dept. A*	*Dept. B*	*Dept. C*
X	$ 1,000.00	$ 4,000.00	$3,000.00
Y	3,600.00	2,400.00	4,800.00
Z	10,000.00	12,000.00	2,000.00
Total	$14,600.00	$18,400.00	$9,800.00

Total and unit product costs for the period are summarized in the following table.

Nature of Item	*Product X*		*Product Y*		*Product Z*	
	Total	*Unit*	*Total*	*Unit*	*Total*	*Unit*
Material	$10,000	$1.00	$ 6,000	$0.50	$ 8,000	$0.40
Dept. A	1,000	0.10	3,600	0.30	10,000	0.50
Dept. B	4,000	0.40	2,400	0.20	12,000	0.60
Dept. C	3,000	0.30	4,800	0.40	2,000	0.10
Total	$18,000	$1.80	$16,800	$1.40	$32,000	$1.60

Many variations of the simple process cost procedure outlined above are found. In many cases of sequential processing of multiple products satisfactory weight factors are not readily determinable. Process costs common to several products may then be allocated on the bases of processing time. This basis of allocation requires the keeping of another record showing the time spent on each product in each process.

Selective Process Accounting

Selective processing involves the manufacture of several products, all of which pass through certain processes but omit others. There is not the complete separation of processes by products characteristic of parallel process accounting. Each process may be applied to several products, but all products do not go through all processes. To illustrate this situation assume that the Warren Company manufactures four products, M, N, O, and P, using several productive departments. Each department contributes to the production of each product as follows:

Department A initiates the production and works exclusively on product M.
Department B initiates the production and works exclusively on product N.
Department C initiates the production and works exclusively on product O.
Department D initiates the production and works exclusively on product P.
Department E continues the production of products M, N, and O.
Department F completes the production of products M and O, and continues the manufacture of P.
Department G completes the production of products N and P.

This situation may be expressed from the standpoint of the products as follows:

Product M is made in departments A, E, and F.
Product N is produced in departments B, E, and G.
Product O is made in departments C, E, and F.
Product P is made in departments D, F, and G.

To illustrate the determination of product costs under these conditions assume that:

1. All direct materials are introduced in the originating departments.
2. There are no initial or final work in process inventories.
3. A single finished product unit, pounds, may be used in all departments to represent the output of all products.
4. In Department E there is no difference, per unit, in the cost of processing M, N, and O.

5. In Department F, there is no difference in the processing cost per unit among products M, O, and P.

6. In Department G, product N costs twice as much per unit to process as product P.

The producing department accounts for the month of January, after the apportionment of service department expenses, show total costs as follows:

Department A	$ 8,000.00
Department B	12,000.00
Department C	10,000.00
Department D	6,000.00
Department E	3,500.00
Department F	8,000.00
Department G	2,800.00
	$50,300.00

The completed output of each product, in pounds, was:

Product M	10,000
Product N	20,000
Product O	40,000
Product P	30,000

The department output therefore was:

Department A—Product M		10,000
Department B—Product N		20,000
Department C—Product O		40,000
Department D—Product P		30,000
Department E—Product M	10,000	
Product N	20,000	
Product O	40,000	70,000
Department F—Product M	10,000	
Product O	40,000	
Product P	30,000	80,000
Department G—Product N—20,000 × 2	40,000	
Product P—30,000 × 1	30,000	70,000

The cost of each product may now be compiled as shown in the following table:

SUMMARY OF PRODUCTS COSTS

January 19—

Source of Cost	*Product M*		*Product N*	
	Total Cost	Unit Cost	Total Cost	Unit Cost
Department A	$8,000	$0.80	—	—
Department B	—	—	$12,000	$0.60
Department E	500	0.05	1,000	0.05
Department F	1,000	0.10	—	—
Department G	—	—	1,600	0.08
Totals	$9,500	$0.95	$14,600	$0.73

Source of Cost	Product O		Product P	
	Total Cost	Unit Cost	Total Cost	Unit Cost
Department C	$10,000	$0.25	—	—
Department D	—	—	$ 6,000	$0.20
Department E	2,000	0.05	—	—
Department F	4,000	0.10	3,000	0.10
Department G	—	—	1,200	0.04
Totals	$16,000	$0.40	$10,200	$0.34

The departmental accounts can now be closed out by direct entry to finished product accounts without transfer from one department to another.

As in the case of the sequential process method, when a combined output basis, either weighted or unweighted, is not available for the allocation of common process costs among several products, a record of processing time must be kept and used for this purpose.

The Department Cost Sheet

The functions of the department cost sheet under the process method are:

1. To summarize the departmental expenditures, showing all major items of expenses, preferably classified to distinguish variable from fixed, and direct from apportioned charges.
2. To recapitulate the department output, showing:
   a. Physical units carried over from the previous period, either finished, or still in process.
   b. Physical units started in production during the current period.
   c. Physical units received from other departments.
   d. Physical units transferred to succeeding departments.
   e. Physical units on hand at the end of the period, finished, and unfinished, and as to the latter, the degree of completion.
   f. The number of equivalent units in which the department performance is to be stated and the department unit processing costs determined.
3. To record the unit processing costs for the period.
4. To show the calculation of the valuation of the in-process inventory at the end of the period.
5. To show the calculation of the cost of work completed and transferred to succeeding departments or to finished goods.

The form of the department cost sheets depends upon the detail required, and must be designed to fit the needs of each case. Some variations of this form are shown above.

Difficulties in Using the Process Method

Some of the problems and difficulties of applying the process method in any but the simplest production circumstances have been indicated above. Other problems have not been pointed out or illustrated. Some of the major difficulties, whether or not previously commented upon, are summarized below.

1. The necessity of estimating the degree of completion of the in-process inventory within each department at the end of the period. Obviously the difficulty of applying the process method is closely related to the status of in-process inventory. These three conditions are found among different companies.

a. The process period being short, all work started is finished; hence there is no inventory.
b. The in-process inventory is small and constant; hence may be neglected in the monthly computations, and carried at a fixed figure in the balance sheet, subject to annual verification.
c. The in-process inventory varies considerably from month to month.

In this case it cannot be neglected. The quantities in process must be determined from production records and verified by physical count; the degree of completion must be estimated; equivalent units of performance must be calculated; and the value assignable to the in-process inventory must be compiled. This valuation is important because it affects also the cost of work completed.

2. A second major difficulty is encountered in connection with direct material. When multiple products are manufactured, the direct material cost may be excluded from the department accounts and separately determined for each product. When this procedure is not followed, the following situations may be encountered, each presenting increased difficulty in accounting for this element.

a. All material may be introduced at the outset of the first process. This was the assumption used in the section on selective process accounting.
b. Material may be introduced at the outset not only of the first but of some or all of the succeeding processes.
c. Material may be introduced evenly within some or all of the processes, so that a stated degree of completion for the work in process also indicates the proportion of material applied within the process. This was the assumption used in the illustration of sequential process accounting.
d. Material may be introduced at certain specified points within some or all of the processes.

In the latter case it must be known, in valuing the in-process inventories, whether the products have reached the points at which further materials are added.

3. Difficulty may be encountered with the unit to be used in calculating the cost of each process. Wherever possible the final product unit should be used throughout all processes. This procedure provides a consistent basis for summarizing final product costs. In some cases a series of units differing from the final product unit must be used. In this event the relationship of these units to the final product unit must be known. A related problem exists when, by the addition of material at later processes, the quantity of output of previous departments is in effect changed. Care must be taken, then, in valuing the transfers to succeeding departments and the in-process inventory.

4. Difficulty is encountered in accounting for losses in the initial and in subsequent departments. The loss will normally be absorbed by the remaining good units. This has the effect, however, of increasing the per unit cost from the preceding department. Also in determining the unit cost of performance within the department where the loss occurs it must be decided whether the loss is to be considered as having happened:

a. After the department has performed its full work on the lost or spoiled units.
b. After the department has performed only some stated proportion of its work.
c. Before any work has been performed in the department.

Each of these assumptions will give a different valuation to the unit activity of the department and hence effect the valuation of in-process and finished inventories and work transferred to succeeding departments.

5. Difficulty of allocating common processing costs to several or many products when a weighted unit or time basis must be used. The use of a weighted basis has been illustrated above. It should also be pointed out that considerable difficulty may be encountered in determining an accurate weighted unit basis, and the keeping of a record of the processing time for individual products entails added expense.

Decision must be made in each case as to whether these problems can be solved in a manner to permit the use of the process method. In general, this method is less expensive to operate than the order method and should be used in preference to the latter wherever satisfactory results can be secured.

Another outstanding advantage of the process method, in comparison with order procedure, is that the type of information supplied is superior for control purposes. Department performance in terms of output stated in consistent units period by period, and in terms of total and unit costs is directly available for comparative purposes.

Combinations of the Order and Process Methods

Practically every company will use both the order and the process methods in some form. Various combinations are possible.

1. The order method may be used in certain productive departments, and the process method in others.
2. The order method may be used exclusively for product cost determination. A form of process costs is nevertheless used in determining unit service activity costs.
3. The process method may be used exclusively in product cost determination. Nevertheless, a form of order cost procedure is used in accounting for property additions, betterments, and retirements, and for major repair jobs.

These two methods of historical cost procedure are therefore of universal application. Many companies using standard cost procedure in connection with product costs will also use the order method in accounting for property changes, and the process method for certain service activities.

Class Costs

Both the order method and the process method may be applied to the determination of product costs for classes or groups of items rather than to single product items. A classification of products for this purpose should be based upon the similarity as to cost of the items within each class—that is, the product items of which each class is composed should be substantially homogeneous. This type of grouping is necessary, otherwise the average unit cost of the class will be meaningless and misleading.

Operations Cost Procedure

General Nature

A procedure closely resembling the selective process method is sometimes employed in industries where a variety of products are manufactured through a series of standardized operations. An operation is a more limited type of productive effort than the process. The latter is composed of a number of sequential operations that are always performed together. Accounting for operations provides a more minute record of the cost of productive activity. The operation also is the characteristic division of productive effort used in industries manufacturing like articles each of which must be individually handled and cut, shaped, formed, and finished through the use of general and special purpose machinery—in the machining industries as distinct from the continuous processing types of industry.

The operations method is used in machine tool industries where, because of the variety of operations performed under conditions of intermittent processing, the process method in any of its forms as described above is not applicable, and the order method is too expensive or otherwise unsatisfactory.

Procedure

Procedure for applying the operations method is outlined briefly below.

1. The direct material cost for each product is separately recorded and summarized from requisitions or bills of material.
2. A cost card is set up for each factory operation. Each operation may be performed on a single, or on several, products.
3. Each time the operation is performed its total direct labor cost is entered on the cost card with information as to the number of pieces on which performed. The unit labor cost of each occurrence of the operation can be calculated from this data, and also the average unit cost for the month.
4. Burden, applied to the operation on a direct labor cost, direct labor hour, machine hour, or other basis is also entered on the cost card.
5. Product cost is determined for products finished in the month by summarizing the operations performed on each, at the average unit cost shown by the operations cards, and adding the separately recorded materials cost. Data as to the operations performed on each part are available through the production planning and control department route sheets, copies of which are filed with the cost department.

The major cost record under this method is the file of operations cards, or the operations cost sheets, if the record is kept in the latter form. This record is subsidiary to a single conversion cost in process account, or to separate labor in process and burden in process accounts. Each time the operation is performed entry is made in this record of the date, quantity, direct labor cost, and burden applied. In order that the record be maintained in balance with the conversion cost in process control accounts, space must also be provided to show the amount of cost allocated to completed production.

Advantages of the Operations Method

In contrast with the order cost method for which it may be substituted, the operations cost method has these advantages:

1. It eliminates to some extent, through the procedure of averaging the cost of each operation over a period of time, the wide fluctuations that may be reflected in individual

order costs. The product costs therefore become more useful in establishing sales prices and policies, and for other purposes.

2. It provides a superior type of cost control. By recording in one place, the operations cost card, the cost of each operation every time it is performed, comparisons of the cost of identical operating activity may be made readily and immediately, and causes of variations may be ascertained.

3. Operations costs accumulated over a period of time may be the starting point for the establishment of operations standard costs and hence facilitate the introduction of standard cost procedure.

The operations method, although superior and less expensive, when applicable, than the order method, is not widely employed because the use of standard cost procedure is preferable in these circumstances.

Standard Cost Procedure

Advantages of the Standard Cost Method

It is not proposed at this point to discuss standard cost procedure in full. The general nature and purposes of this method have been mentioned previously. A brief summary is given below of (1) the advantages of standard cost procedure, (2) the kinds of standards employed, and (3) the major types of standard procedure used. This brief summary is followed by a description of a standard cost procedure applied in a continuous processing industry.

The outstanding advantages of standard cost procedure are summarized below:

1. By predetermining costs under standard conditions, management is supplied with stabilized product costs more useful in the formulation of policies than the fluctuating actual costs supplied by the retrospective or historical procedures.

2. By concentrating accounting effort upon the disclosure and analysis of off-standard performance, data are provided for a positive type of management control.

3. Standard cost procedure is less expensive. Under complete standard cost procedure value figures are eliminated from subsidiary perpetual stock records for materials and finished products; it is not necessary to price and extend individual requisitions; entries on order cost sheets are not required. The savings in clerical effort and cost can be expended in providing more useful control information.

4. Standard costs greatly facilitate the introduction and use of complete budgeting procedure.

Kinds of Cost Standards

The following kinds of cost standards are found among different companies using standard cost procedure.

1. Ideal Standards.—These represent the best possible performance. They assume the plant to be arranged for the most efficient production under the best operating conditions. Material quantity standards eliminate all avoidable waste. Labor time standards are based on the most efficient workmen operating under ideal conditions. In the burden standards, the plant is assumed to be running at capacity.

2. Normal Standards.—Standards of this type reflect efficiency and costs under normal operating conditions, with the plant operating at normal capacity.

3. Budgeted standards reflect the expectancies of the budget period as to percentage of plant capacity to be utilized, material use and price, and labor efficiency and rates.

4. Fixed or Measure Standards.—This type of standard sets up fixed amounts per unit for the various elements of cost. These amounts may be neither budgeted, normal, nor ideal standards. Hence they do not represent costs that are to be attained under any of these assumptions. Rather they represent fixed points of measurement in terms of which the costs of successive periods are to be gauged. They provide a fixed point for the calculation of a series of index numbers showing performance in relation to the standard and to past periods.

5. Past Average Costs.—These are sometimes used as standards, but they are not satisfactory because standard cost procedure implies a standardization of the operating methods and conditions, a thorough engineering study of equipment and procedure, and the elimination of avoidable inefficiencies before the standards are established. Past average costs may, however, be useful during a limited period while these studies are being made.

A combination of these types may be useful. Where satisfactory operating methods and conditions have been established, ideal standards may be used for material quantities and labor time, normal standards set for overhead, and budgeted standards employed for material prices and labor rates.

Types of Standard Cost Procedure

There are several major varieties of standard cost procedure. The outstanding basis of distinction among them is the extent to which the standard costs are introduced into the inventory accounts for direct materials, work in process, and finished goods. On this basis the following types of procedure are distinguished:

1. The direct material, the work in process, and the finished inventory control accounts are all charged and credited with standard costs only. Differences between actual and standard costs are entered directly to variance accounts without affecting the inventory accounts.

2. The direct material account is kept at actual cost, and the in-process and finished inventories are recorded at standard.

3. The direct material and work in process accounts are both charged at actual. Direct material is credited at actual for materials used, and work in process accounts are credited at standard for production finished. Variances are then removed from work in process accounts to variance accounts. Finished goods are stated at standard.

4. Both actual and standard costs are charged and credited to all inventory control accounts through the use of special double-column ledger sheets.

In addition to these variations in procedure, standard costs may be set up in statistical records not tied in with the financial accounts.

Illustration Applicable to a Processing Industry

The following description of a type of standard cost procedure, using budgeted standards, is adapted from National Association of Cost Accountants' Bulletin of January 1, 1934 entitled "Standard Costs and Flexible Budgets in the Brewing Industry," by John W. Dixon. The following conditions exist in the business to which this procedure is applicable:

1. One brand of beer is manufactured.

2. There are three productive departments—brewery, racking room, and bottling house.

3. Bottled beer is sold only in cases of twenty-four twelve-ounce bottles.

The classification of accounts used was presented in connection with the discussion of ledgers. The system is built upon a comparatively simple general ledger with an accompanying detailed analysis of expenses effected through periodic departmental statements.

The steps required in the accounting for product costs are outlined below.

Procedure for Predetermining and Recording Product Costs

A. The product cost is predetermined at each of the productive stages—brewery, racking room, and bottling house—through the following steps:

1. The normal output for each productive department is estimated.
2. The normal expenditure required in each department to produce the normal output is determined. This requires estimating not only the amount of normal direct expenses in the productive departments, but also the normal distribution of General Plant and Power Plant expenses to the Brewery, Racking Room, and Bottling House.
3. The normal expenditure of each productive department (including service department distributions) divided by the normal output gives the three elements of predetermined product cost:
   a. Standard brewing cost per barrel
   b. Standard racking cost per barrel
   c. Standard bottling cost per case

B. The actual operating costs for the period are accounted for as follows:

1. They are first reported on raw material used reports, supply requisitions, and other sources of original entry.
2. They are charged in total to general ledger account 150, Unearned Burden and Manufacturing Variances. Charges to this account, which controls the entire distribution of expense in accordance with the expense classification, include delivery, selling, and administrative expenses as well as factory expense. The totals of the 700, 800, and 900 expenses are, however, transferred at the end of the four-week period to accounts 160, 163, and 166.
3. Operating costs are analyzed in accordance with the expense classification through the mechanism of a Distribution Record, and then are entered on the departmental expense analysis statements. At this point all of the factory operating costs have been accumulated in the single control account and analyzed in detail on the departmental statements.

C. The product output is costed and transferred to the four inventory accounts (Bulk Beer in Brewery, Keg Beer in Racking Room, Bulk Beer in Bottling House, and Case Beer in Bottling House) by means of the following procedure:

1. A monthly production report is prepared for the brewery from a daily record of output. This report shows the number of barrels produced and barrels removed to the bottling house.
   a. The quantity of beer produced, extended at standard brewery cost per barrel, gives the cost of bulk beer produced. This amount is charged to Bulk Beer in Brewery and is credited to Unearned Burden and Manufacturing Variance.
   b. The quantity of beer transferred, extended at standard brewery cost per barrel, gives the cost of bulk beer transferred to the bottling house. This amount is charged to Bulk Beer in Bottling House and is credited to Bulk Beer in Brewery.
2. A monthly production report is prepared for the racking room from a daily record of the output of this department. This report gives quantity figures

which, when extended at the appropriate standard unit cost, provide total cost figures for the following entries.

a. The quantity at bulk beer transferred to the racking room, extended at standard brewing cost per barrel, is charged to Keg Beer in Racking Room and is credited to Bulk Beer in Brewery.
b. The quantity racked, extended at the standard racking cost per barrel, is charged to Keg Beer in Racking Room and is credited to Unearned Burden and Manufacturing Variance.
c. The quantity of beer lost or consumed in the process of racking, extended at the standard brewing cost plus the standard racking cost is charged to Unearned Burden and Manufacturing Variances (the particular expense account is number 541) and is credited to Keg Beer in Racking Room.

3. A monthly production report is prepared for the bottling house from a daily record of the output of this department. The report gives the quantity output figure which, when extended at the appropriate standard unit cost, provides the total cost figures for the following entries:
   a. The quantity of beer bottled (stated in units of barrels) extended at the standard brewing cost per barrel, is charged to Case Beer in Bottling House, and is credited to Bulk Beer in Bottling House.
   b. The quantity of beer bottled (stated in units of cases) extended at the standard bottling cost per case, is charged to Case Beer in Bottling House and is credited to Unearned Burden and Manufacturing Variances.
   c. The quantity of beer lost in the bottling process, stated in barrels and extended at the standard brewing cost per barrel, is charged to Unearned Burden and Manufacturing Variances (Account Number 641) and is credited to Bulk Beer in Bottling House.
4. Monthly reports of shipments are prepared upon which the following entries are based:
   a. The quantity of keg beer shipped, stated in barrels, extended at the sum of the standard brewing cost plus the standard racking cost, gives the cost of keg sales. This amount is charged to Cost of Sales, Kegs, and is credited to Keg Beer in Racking Room.
   b. The quantity of case beer shipped, stated in cases, is extended at the sum of the standard brewing cost per case (9.258% of the standard brewing cost per barrel) and the standard bottling cost per case. This account is charged to Cost of Sales, Cases, and is credited to Case Beer in Bottling House.

Use of Data for the Control of Costs

The control of factory costs is the main objective of the detailed classification of expenses. This control requires three sets of figures for each department, expressed in terms of the detailed classification of expenses applicable to the department. The figures are:

1. The normal expenditures at the normal volume. The standard unit costs used in costing the output as described in the last section, are based on these amounts.
2. The actual expenditures of the period as analyzed in the departmental statements.
3. The allowed variable and fixed expenses for the quantity of actual output. These figures must be calculated at the end of the period.

These calculations are the basis for the determination of overearned or unearned burden, and controllable and volume variances in the factory. These calculations

for the brewery department are shown in Exhibit 1 below. The figures are taken from Mr. Dixon's article. The methods of calculation are:

1. The overearned or unearned burden is the difference between the total of the allowed expenditures for the actual output, and the total standard cost of the actual output. This amount is shown as the last item on the statement.
2. The controllable variance is the difference between the allowed expenses for the actual output and the actual expenditures incurred for that output. This amount is analyzed in detail in Exhibit 1 under the column headed "Variance."
3. The volume variance is the difference between the amount of the unearned or overearned burden and the controllable variance.

The allowed variable expenses in Exhibit 1 are determined by applying the per cent of normal operation to the normal amounts. The allowed fixed expenses for the actual output are the same as the allowed fixed expenses for the normal output, inasmuch as this type of expense does not fluctuate with volume.

This type of analysis points to the existence of differences between actual expenditures and allowed expenditures, and separates them into two main classes. The making of the analysis does not in itself affect the expenditures. It does bring them out into the open. Control is achieved only by appropriate management action in determining the causes of the differences and applying the remedy. Bringing the variances to the attention of management is the significant contribution of standard cost procedure.

Statements similar to Exhibit 1 are prepared for all other factory departments and for delivery, selling, and administrative expenses. Other control may also be employed—for example, for the physical control of output. Losses in the racking room and bottling house may require standards. Using such standards, actual yields and losses can be compared with standard yields and losses.

The department cost analyses described above are supplemented and summarized by an analysis of profit and loss in which the budgeted sales and costs for the period are compared with the actual, and the actual at the budget rates. This comparison is shown in Exhibit 2. The summarized statement of net sales, standard cost of sales, and gross profit shown in Exhibit 2 is based upon the detailed analysis of these elements shown in Exhibit 3.

Comparisons similar to the above are made not only for each period of four weeks, but also cumulatively for the year to date.

BREWERY DEPARTMENT

Departmental Expense and Variance Statement

For the four weeks ended December 2

		Normal	Allowed	Actual	Variance
Variable Expense:					
401–9	Raw Materials	$20,000	$17,420	$17,463	$ 43*
421	Departmental Labor	1,500	1,307	1,367	60*
431	Water	110	96	90	6
432	Purchased Power	182	159	169	10*
436	Misc. Supplies	400	348	323	25
440	Compensation Insurance	16	14	16	2*
449	Misc. Freight and Cartage	20	17	7	10
450	Misc. Expense	236	206	159	47
	Total Variable	$22,464	$19,567	$19,594	$ 27*
Redistributed Expense:					
200	General Plant Burden	$ 2,784	$ 2,662	$ 2,662	xxx
300	Power Plant	2,169	1,911	1,911	xxx
	Total Redistributed	$ 4,953	$ 4,573	$ 4,573	
Fixed Expense:					
428	Superintendence	$ 480	$ 480	$ 480	$ —
429	Repair Labor—Bldgs. and Equip.	300	300	206	94
437	Repair Material—Bldgs. and Equip.	130	130	65	65
438	Purchased Repairs	60	60	75	15*
640-9	Fixed Charges	1,354	1,354	1,354	—
	Total Fixed	$ 2,324	$ 2,324	$ 2,180	$144
	Grand Total	$29,741	$26,464	$26,347	$117
Production—Barrels		10,000		8,710	
Standard Cost per Barrel		$ 2.9741			
Per Cent of Normal Operation				87.1	
Earned Burden—8710 barrels at $2.9741			$25,904		
Unearned Burden			$ 560*		

* Losses.

Exhibit 1.

PROFITS AND LOSS STATEMENT

For the four weeks period ended December 2

	Budget	Actual at Budget Rates	Actual	Variances Due to Volume	Variances Due to Other Causes
Net Sales	$169,934	$173,167	$170,710	$3,233	$2,457*
Standard Cost of Sales	96,816	98,320	98,320	1,504*	xxx
Gross Profit based on Standard Cost	$ 73,118	$ 74,847	$ 72,390	$1,729	$2,457*
Cost Adjustments					
Over-(Under-*) Earned Burden	$ 1,820*	$ 1,423*	$ 1,423*	$ 397	xxx
Manufacturing Variances					
General Plant	xxx	xxx	180*	xxx	180*
Power Plant	xxx	xxx	220*	xxx	220*
Brewery (see Exhibit 1)	xxx	xxx	117	xxx	117
Racking Room	xxx	xxx	60	xxx	60
Bottling House	xxx	xxx	214	xxx	214
151 Interest Charged to Cost	4,316	4,316	4,316	xxx	xxx
152 Express Depreciation Charged to Cost	560	560	560	xxx	
153 Fixed Charge Variances	xxx	xxx		xxx	
154 Material Price Variances	xxx	xxx	495*	xxx	495*
155 Inventory Adjustments	xxx	xxx		xxx	
Gross Profit after Cost Adjustments	$ 76,174	$ 78,300	$ 75,339	$2,126	$2,961*
160 Delivery Cost	$ 10,800	$ 11,180	$ 10,977	$ 380*	$ 203
163 Selling Expense	12,260	12,395	12,900	135*	505*
166 Administration Expense	8,580	8,625	8,710	45*	85*
Total Non-manufacturing Expense	$ 31,640	$ 32,200	$ 32,587	$ 560*	$ 387*
Operating Profit	$ 44,534	$ 46,100	$ 42,752	$1,566	$3,348*
Other Income					
170-2 Interest, Discount, etc.	300	300	240	xxx	60*
	$ 44,834	$ 46,400	$ 42,992		
Other Expense					
180 Interest Paid	600	600	420	xxx	180
Net Income before Federal Tax	$ 44,234	$ 45,800	$ 42,572	$1,566	$3,228*
190-2 Allowance for Federal Income Taxes	$ 6,635	$ 6,870	$ 6,386	$ 235 *	$ 484
Net Income	$ 37,599	$ 38,930	$ 36,186	$1,331	$2,744*

Note—The spaces marked with x's are so marked because, from the nature of the item, they will never be used.

* Losses.

Exhibit 2.

STATEMENT OF SALES AND GROSS PROFIT

For the four week period ended December 2

	Budget	Actual at Budget Rates	Actual	Variances Due to Volume	Variances Due to Other Causes
Case Beer Sales					
101—Private 9410 Cases	$ 20,400	$ 21,172	$ 21,172	$ 772	$
102—Dealers 26470 Cases	45,200	47,646	46,322	2,446	1,324*
103—Distributors 30220 Cases	50,100	49,863	49,863	237*	
Total Case Sales	$115,700	$118,681	$117,357		
120—Less Returns and Allowances	289	297	182	8*	115
Net Case Sales	$115,411	$118,384	$117,175	$2,973	$1,209*
130—Standard Cost of Case Sales	64,710	66,100	66,100	1,390*	xxx
Gross Profit based on Standard Cost	$ 50,701	$ 52,284	$ 51,075	$1,583	$1,209*
Keg Beer Sales					
111—Private 70 Barrels	$ 1,260	$ 1,400	$ 1,400	$ 140	$
112—Dealers 2190 Barrels	33,900	35,040	33,945	1,140	1,095*
113—Distributors 1320 Barrels	19,500	18,480	18,480	1,020*	
Total Keg Sales	$ 54,660	$ 54,920	$ 53,825		
121—Less Returns and Allowances	137	137	290		153*
Net Keg Sales	$ 54,523	$ 54,783	$ 53,535	$ 260	$1,248*
140—Standard Cost of Keg Sales	32,106	32,220	32,220	114*	xxx
Gross Profit based on Standard Cost	$ 22,417	$ 22,563	$ 21,315	$ 146	$1,248*
Total					
Net Sales	$169,934	$173,167	$170,710	$3,233	$2,457*
Standard Cost of Sales	96,816	98,320	98,320	1,504*	xxx
Gross Profit based on Standard Cost	$ 73,118	$ 74,847	$ 72,390	$1,729	$2,457*

* Losses.

Exhibit 3.

Chapter 18

TYPES EVOLVED AS SYSTEMS OF COSTING

By
J. B. C. Woods *

1. Unintegrated Systems—Estimating Types

In describing the various types and mixed types or adaptations of cost systems —types and hybrids evolved as systems of costing—an attempt is made to describe and explain cost systems in words without reliance upon references to specimen forms. The object is to develop an understanding of the various systems and embryonic systems or substitutes for systems of costing rather than to deal with cost accounting techniques presented elsewhere in this volume, or with the detailed application of such techniques in cost systems for specific industries described in Section II of this volume.

Introduction

There are innumerable varieties of the basic forms, ledger accounts, and journal sheets, such as production orders, purchase orders, orders for materials issues, time cards, payroll distribution sheets, cost sheets, stores ledger sheets, cost ledger accounts, and factory journal sheets. The points to be considered here are not which variety of a specific form to use, but primarily which system of costing is applicable under given circumstances, of what the system is comprised, how it arises from, or is related to, financial or general accounting, and how it compares or contrasts with some other cost system. Incidental to the description of cost systems reference will be made to forms and ledger accounts to be used, but the reader must look elsewhere in this volume for an evaluation of the various kinds of production order forms or other specific forms, or for specimen forms suited to particular techniques of accounting (machine bookkeeping, for instance) or to specific industries.

Kinds of Cost Systems

This chapter is devoted to a description of cost systems and methods of estimating or approximating costs which have not developed to the stage of systems. Some indication will be made of their relationships to the two principal systems under which historical costs are determined—namely, process costing and job costing, and to standard costs which constitute a highly developed synthesis of costing —each of which is the subject of a separate part of this chapter. In a fifth Part, uniform systems are compared with made-to-order systems. The systems discussed are limited to those concerned with the determination of costs of manufacturing and do not embrace costs of distribution, treated elsewhere in this volume.

In general or financial accounting, fundamental difficulties arise in connection

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with the problems of determining results of operations of a business for an arbitrary and definite fiscal period. These difficulties concern the matching of revenues and expenditures related both as to time and purpose, and the carrying forward of expenditures destined for application to future operating periods. Expenditures are apportioned to fiscal periods and classified in their relationship to other items of outlay and in relationship to revenues resulting from the charges incurred.

Cost accounting rests not only on an analysis of expenditures and an accounting by fiscal periods. It also requires a further subdivision of expenditures into costs of departments, processes, operations, and groups of operations. These, in turn, are subjected to further subdivision into production periods as weekly, daily, hourly, or the time required for a given operation or series of operations. Cost accounting then synthesizes these data through the accumulation or assembly of such costs of operations and costs of periods into costs of measured output in definite periods. The end results determined are costs by operations, by production periods, and by units of output. Where general accounting analyzes expenditures by periods and again by kinds of outlay, cost accounting breaks down the total expenditure in various ways, producing innumerable sections of costs. Then from these sections it builds synthetic blocks of costs which are again sliced in one or more ways to produce meaningful small parts of the total outlay, each containing a mixture of all elements of cost and related to some intermediate or end result of production.

Obviously, the degree of refinement or minuteness to which cost accounting is developed in any instance should be related to the purposes to be served and the expense of operating the cost accounting department. Similarly, the nature of the cost accounting methods to be employed in a given factory is dependent on the kind of manufacturing operations conducted.

While cost accounting procedures are constantly being developed, the choice of a cost accounting system for a given industry or business should be directed not necessarily to the latest cost accounting techniques. Many of these are applicable to various systems and are to be selected more by reason of the size of the enterprise and the volume and nature of transactions than the kind of system. The cost accounting procedures should be those most readily adaptable to the manufacturing operations and should provide for that degree of minuteness required to meet the purposes of the costing. They should be chosen after full consideration of the comparative cost of operating rival systems.

Costing is usually thought of, in the first place, as the determination of actual or historical costs, such as the cost of manufacturing goods or rendering services during an elapsed accounting period.

The term "cost system" usually connotes a controlled cost system; that is, one in which the cost accounts and records are so related to the general books that it is transparently evident that all elements of manufacturing costs incurred by the business, as shown by the general books, are treated in the cost accounts. Also, the term "cost system" implies that the cost accounts and the cost procedures extend throughout the manufacturing operations.

Principal Kinds of Cost Systems

The principal kinds of costing, which are concerned primarily with actual or historical costs and which are operated as controlled cost systems extending to all

manufacturing operations, are process costing and job costing, separately discussed. Process costing is discussed first because of its close relationship to general accounting, its relative simplicity and adaptability. The particular features of job costing are noted and the system compared to process costing.

Standard costs, being based on predetermined standards rather than on actual expenditures and production of an elapsed period, are not in the first place considered as actual or historical costs. However, by application of variances from predetermined standards, accounting determinations are made which result in actual or historical costs. The determination of variances requires that for the sake of completeness and accuracy a standard cost system be controlled by the general books.

In practice there are no definite dividing lines separating the three principal controlled cost systems. On the contrary each takes on some features ordinarily considered to be applicable to another system. Under process costing where there is a variety of products, some features of job costing, as in the determination of unit costs of each of several products, may be introduced in order to continue process costing as the predominant system. In both process and job costing, the use of predetermined rates for the distribution of overhead indicates a leaning toward a fundamental feature of standard costs. This development in job costing may be extended considerably further in using predetermined rates for production center operations. In their turn, standard cost systems may so develop and apply variances as to give results equivalent to those obtained in historical costing. Moreover, standard costs are based to some extent on a routine of production and costing found in either process costing or job costing.

There are so-called estimated cost systems other than those referred to below among the unintegrated systems. These estimated cost systems are incompletely developed standard cost systems or modifications of standard cost systems in which estimates play the role of standards. The estimated cost system is more easily installed than a standard cost system and is therefore sometimes preferred on grounds of economy or may be introduced as a preliminary step to the installation of a standard cost system. Variances are used in this kind of estimated cost system in the same manner as in standard cost systems.

Other Methods of Costing

Outside of and as substitutes for these controlled, comprehensive, integrated cost systems—process costing, job costing, and standard costs—and various combinations of them, there are to be found the unintegrated systems. These are usually limited in scope and loosely related to the general books of account. They treat in a traditional manner only the more important elements of cost. This general description is not given in disparagement of the unintegrated systems as a whole, because, although some are worse than useless, others are designed and operated to approximate fairly effectively the more essential costs, with that economy which accompanies a minimum use of accounting procedures.

These unintegrated systems may be used with some degree of appropriateness in industries and plants where production techniques are simple and constant and the output stable and uniform, and where variations in costs may be related to market prices of raw materials: or, of course, for a division of manufacturing operations where such conditions exist. These incomplete systems are used in process industries

where process costing would be more appropriate; in industries where a combination of process costing and job costing should be used, and to take the place of job costing for some part of the output. The underlying justification for such incomplete costing is to be found in the economies which flow from the omission of accounting procedures or from their occasional and restricted application.

Just as single-entry bookkeeping continues to be found in some businesses, so the unintegrated, incomplete, traditional, rule-of-thumb, estimating procedures survive in, or are sometimes introduced into, some factories, and prevail in some industries. The systems described by industries in Section II of this Handbook perhaps constitute the best readily available cross-section of the variety of costing and estimating procedures loosely described as cost systems, including simple and incomplete systems and fully developed controlled cost systems.

Cost accounting has been developed primarily to serve management but also in its later stages as an aid in general accounting, particularly in maintaining book inventories in quantities and values and in determining cost of goods sold without awaiting the taking, pricing, and computing of physical inventories. It was to meet one of the most fundamental needs of management, the fixing or quoting of sales prices in relation to costs of production, that cost accounting first arose. And it was to meet this elementary need that attempts were first made to approximate costs.

Apart from the lack of control and bookkeeping proof of accuracy in incomplete costing methods, perhaps the most significant shortcoming is the failure to include any systematic treatment of manufacturing expenses. As a rule these primitive systems provide for adding to material and labor costs an amount variously determined—such as a percentage of labor cost or a percentage of total material and labor cost—to cover overhead, margin of error in costing and, in some instances, profit.

While in fully developed systems of process costing and job costing overhead is applied on a basis of formulas, in such systems the rates in the various formulas are derived from a study of total overhead applicable and the volume of work normally performed. Then, by accounting for overhead and productive operations, a substantiation is obtained of the formulas and the rates are varied in accordance with changes in the elements of overhead and the factors of production. Under incomplete costing methods there is no accounting determination of the percentage of overhead to be added except by general and occasional reference to a periodic profit and loss statement; and there is no accounting determination of the results of applying a predetermined rule-of-thumb rate for overhead, error and profit, except perhaps as a post-mortem on an unexpected loss on operations. So often there is little or no conception of the amount of indirect labor expense and the cost of expense materials and supplies consumed which are accounted for neither as overhead nor as direct cost.

In many crafts—such as job printing, cabinet making, tailoring—traditional estimating prevails in the older shops until the competition, tempo, and complexities of modern industrialization demand the introduction of a controlled cost system.

Materials in estimated costing may be included on the basis of an occasional careful measuring of quantities used in a given process or for a given output, costed at prevailing prices. While this method is related to standard costs, using currently attainable costs as the standards, it usually involves too crude an application or conversion to current prices to produce results which accurately approximate

actual costs. This is so particularly where several kinds and qualities of materials are used in the manufacturing process and purchases are not well coordinated with production requirements.

The same may be said as to costing for labor. Here there may be a careful timing and counting of output as a basis for estimating the cost of labor per process or volume of output, and a costing revised occasionally as wage rates change. What is usually lacking is any method of correcting labor cost as production ebbs or flows. The correctives present in standard costs as variances are not found in these simple estimating methods.

Accordingly, it is understandable that from crude estimating, under which each element of cost, materials, labor, and overhead were incompletely conceived and inadequately treated, there should have arisen controlled cost systems—process and job costing—to trace all elements of cost and apply them at an appropriate stage of production. Subsequently standard costs were developed in order, among other things, to recapture the advantages of prompt cost determination through a scientific application of predetermined costs first used in crude estimating systems.

There is a cost system which is not complete and not controlled, and which cannot be classified as process costing, job costing or standard costs, but which partakes of the nature of each system. It is applicable to mass production where the assembly line and some of the preceding operations could be the subject of process costing, but where the number and variety of operations by logic or tradition indicate a preference for job costing. In such instances occasional trial runs are costed for recurring operations and for the assembly line. Cost sheets are prepared for the finished product embodying the latest applicable costs, adjusted for variations in material costs, labor costs and overhead costs as indicated since costs of various operations were determined. Such variations in labor costs take into account labor time per operation and wage rates, and changes in overhead reflect the amount of manufacturing expenses and the basis of application to production. Cost sheets thus prepared are used for current reports to management and are also used for the purpose of determining cost of goods sold and hence book inventories of finished goods. Under such systems stores accounts are usually maintained for raw materials and supplies, while work in process may be approximated according to the operating schedules of each department or production center. Although such a system is not integrated, it may, if maintained and used with care, serve many of the purposes of a detailed cost system, at an accounting expense which is relatively low. This kind of system is particularly appropriate where production is planned for a season or a year and purchase contracts made to cover all materials required, and perhaps a trade union agreement for wage rates running contemporaneously, so that variations in costs are reduced to a minimum.

Limitations of Costing

In any consideration of cost systems, whether controlled or memorandum, historical or predetermined, estimated or standard, it is always well to bear in mind that the results obtained, no matter how minutely computed, rest upon certain given premises. In the first place, no costs are more accurate than the general accounts by which the cost system is controlled or on which an uncontrolled system rests. Secondly, all costs, especially as to the element of overhead, are based upon an assumed volume of output or an assumed use of available capacity. Given a

proposed or an actual set of conditions which differ fundamentally and materially from those assumed for cost purposes, it is necessary to redetermine costs or to supplement determined costs by differential costs applicable to output produced as an addltion to assumed output. Complexities in computations of differential costs vary with the situation but the whole concept of differentials rests upon the fundamental premise that normal or assumed output has been charged with all manufacturing expenses. Other production runs in extra shifts may be added and costed at the direct cost of materials and labor plus only that overhead which represents manufacturing expenses incurred by reason of the extra shifts. Or, alternatively, if the extra shift is to be a more or less permanent feature of production, a new assumption should be made as to capacity and related manufacturing expenses for all shifts. If changed conditions are not sufficiently significant or definite as to require a revision in costing or the use of differentials, but are merely the cause of a considerable amount of overabsorbed or underabsorbed overhead, it is nevertheless essential to bear in mind, both for practical purposes and as a factor in understanding costing and cost systems, that determined costs have their limitations.

Choice of System

In order to recommend or install a cost system the accountant should acquire a general familiarity with all kinds of cost systems, the principles on which they are based, and the objectives of each. Cost accounting literature contains innumerable examples of cost systems illustrated by forms. Many are presented dogmatically as constituting the only cost system of its type—process costs or job costs—or the only type for a particular industry. While it is true that by tradition or by suitability a given type of cost system predominates or ordinarily should be used in a given industry, it is more important, except where uniformity is established for the benefit of an industry, that each individual factory be surveyed and supplied with the cost system suited to its manufacturing routine and the needs of the management. Even when a choice of system is made it should not be installed complete according to any textbook, but it should be adapted, using the features of process costing, job costing, and standard costs best suited to the circumstances, after taking into consideration the expense of installing and maintaining the system. In cost accounting literature there will be found not only dogmatic statements, but also statements which flatly contradict those made by authorities of equal standing. These will not disturb the student or practitioner who masters the subject: he will recognize in them either a preference or a prejudice emphasized to an undue degree or the persistence of a blind spot. Cost accounting has developed by trying and adopting new methods, and its further development is probably to be found as much in an experimental attitude as in adherence to methods and systems which appear to have been perfected.

As to the kind of cost systems now prevailing, process costs or job costing probably predominate in the smaller enterprises which have cost systems. In all except the smaller concerns a knowledge and practice of standard costs is by now well diffused, with current standard costs still favored in practice over constant or basic standards, although the best theory favors basic standard costs. Many of the smaller businesses still have no cost systems, and in many other concerns merely uncontrolled, memorandum, approximating methods are used. In the larger plants are found the more complex or composite systems comprising features of process

costing, job costing, and standard costs. Uniform cost systems, which tend more and more to follow systems of standard costs, have special advantages; their growing acceptance merits separate consideration.

2. Process Costing

In general, the simplest type of a controlled cost system is process costing because the records used and the statements prepared under this system are closely related to general or financial accounting. For the same reason, process costing is comparatively inexpensive to install and operate. Accordingly, wherever this method is approximately applicable it should be used in preference to more complex and costly methods unless the benefits to be derived from another method can be clearly demonstrated to be worth while. This is not to be regarded as a recommendation to introduce process costing where another system is more definitely applicable but merely as a suggestion to give consideration to this simple kind of costing in those instances where the nature of the manufacturing operations permits the use of process costing.

Its Nature and Applicability

Process costing is applicable where factory operations comprise or include the manufacture of a product or similar products by means of continuous processes so nearly standardized that either the variety of products does not require a significant variation in any process or, if variations do occur, they are for a sufficient volume of output as to constitute standardization for a period. Where processes are modified it is necessary to identify the run for the period of modification, and where the modifications are sufficient to prevent standardization of processes, it is necessary that process costing be supplemented or superseded by job costing.

In this outline of the essentials of process costing the subject is considered in its simplest form as a determination of costs on a historical basis. The further development of process costing from historical costs to standard costs may be visualized readily after noting the general features of standard costs presented in a later part of this chapter. However, standard costs are more generally used in industries otherwise suited to job costing.

Process costing is a refinement and supplementation of departmental accounting which is in turn an obvious and simple development of financial accounting in relation to the income or profit-and-loss statement and supporting analytical data. This is so because what is sought is primarily the cost of operations, for a period, by departments or by processes; and from such findings, and the output for the period costed, there is deduced the cost per unit produced. More specifically, what is sought is a fine departmental accounting supplemented by a breakdown of fiscal periods into periods appropriate to the processes comprising the production operations, and a quantitative measurement of production in each process.

For example, there is first set up an accounting for each department or process, charges being made for materials used, direct or productive labor and all indirect expenses—usually termed manufacturing overhead or overhead—suitably apportioned. Here it should be noted that the classification of the elements of cost into materials, labor and overhead is not absolute. Some items of materials used in two or more processes or over a cycle of operations, difficult to measure and relatively

unimportant in value, may be included in overhead. Similarly, some kinds of labor, of the nature which is usually considered productive, may be more readily applied to costs if treated as overhead. Conversely, material which is not direct and labor which is not productive, but peculiar to the process, may be classified as direct material and labor as a convenience in costing.

Leaving for the moment the question of idle capacity, all costs of production are charged to one process or another either as direct materials and direct labor or as overhead, subject to adjustment for overabsorbed or underabsorbed overhead. Overhead is applied to each process on a basis designed to absorb the estimated manufacturing expenses for an accounting period and to charge each process with an appropriate portion of the total charge.

Production Routine of a Process Industry

The next stage is to determine and adopt suitable process periods to be used for costing. Merely as an aid to the presentation of the essentials of process costing, and not as a duplication of costing techniques or of the cost system of any industry described elsewhere in this volume, an example is given.

Assume a series of five successive processes, supplemented by two contributory mixing operations to provide processed material for use in two of the successive processes, the factory procedure which would be followed in the cost accounting might be as follows:

Mixing Operations:

A. Chemicals, for use in Process 2.
B. Paint, for use in Process 3.

Processes:

1. Cutting and layout of material.
2. Treating with chemicals (from Mixing Operation A).
3. Spraying with paint (from Mixing Operation B).
4. Drying.
5. Cutting and packing.

Sufficient material is prepared in a week by Process 1 to supply one of two treating departments performing Process 2 which takes two weeks. Obviously, Operation A, if it is to be continuous and synchronized, must produce each week the chemicals required for one of two treating departments performing Process 2. Operation B produces weekly the paint required for spraying in Process 3, which also each week takes care of the output of one of the two treating departments, which are staggered, one being completed each week. Drying and cutting and packing, Processes 4 and 5, respectively, are synchronized to consume another week each.

The operations as arranged are suited for a thirteen-month production year of four weeks each. In this way the problem of measuring work in process is reduced to a minimum, each operation and process being complete at the end of a four-week period (except for an overlap in one run of Process 2) and the product of each operation or process constituting the processed materials of the next, until the finished product emerges from Process 5 packed ready for shipping or seasonal warehousing.

In such a case it is clear that accounting is on the basis of a year of thirteen

four-week months and that financial and departmental accounting are first established for periods of four weeks each. Within each of the seven productive departments there is a further breakdown into periods of one week, except in Process 2 where treating with chemicals requires two weeks and the period costed is therefore two weeks.

What is next needed in this process costing is a measurement of output of each department. For instance, materials purchased for Process 1 are in square yards and, after wastage in cutting, a different quantity of square yards is prepared for treating in Process 2. The total costs charged to Process 1, including materials, labor, and overhead, constitute the cost of production of the total yardage output which is taken into Process 2. To insure accuracy, measurement is made at a specified time on the last production day in the week and at a specified location in the factory, such as when all racks are complete or as racks enter the chemical treatment department for Process 2.

For Operation A, dry chemicals are purchased in various sized containers in pound and gallon units. After mixing there is produced a liquid measured in gallons. This solution is costed per gallon on the basis of total costs charged to Operation A, including materials, labor, and overhead. Before being applied to Process 2, the output of Operation A is measured, gauges or meters being installed in positions for reading weekly as the solution leaves Operation A or enters Process 2.

Similarly in each operation suitable units of measurement are adopted and recordings taken until standard-sized rolls of the finished product emerge from Process 5 and are counted. The finished product is costed per roll for the total cost of materials, labor, and overhead which entered into the final processes of cutting and packing. Obviously, this total cost includes the total cost of materials, labor, and overhead which entered into all operations and processes which produced these given rolls because the output of each operation was used in one of the processes, and the relative cost transferred, and the output of each of the four preceding processes moved forward to its succeeding process, with the cost likewise transferred and so accumulated.

Although the cost of the finished goods contains the cost of materials, labor, and overhead used or applied in each operation and process, the total of such costs entering into production as shown in the profit-and-loss statement for a year, divided by the number of units (rolls, pieces, yards, or the like) produced, would not give the average cost per unit. The reason is, of course, that there are items of work in process at the beginning and end of each fiscal period consisting of processed chemicals at the end of Operation A, paint produced in Operation B, processed material leaving Process 1, treated material from Process 2 and partly treated material in that process, sprayed yardage from Process 3, and the dried product of Process 4 ready for the final process. Accordingly, process costing, as illustrated, not only gives costs by processes, which in some instances the management might feel it could do without, but also, without stopping production, gives the information necessary for determining the cost of work in process, an essential factor in the profit-and-loss statement and in the determination of cost of production for the period, which constitutes a necessary step in finding the cost per unit produced regardless of the cost of each operation or process.

Modifications of the costing would be necessary under various conditions, as, for instance, if the chemicals of Operations A were used repeatedly in Process 2 instead

of being fully absorbed as in the example considered. The modification becomes largely a matter of measurement: how much is added to the tanks in Process 2 for each lot treated and how much remains after the treated product is transferred to Process 3.

Or, suppose a residue of chemicals from Operation A is used in Operation B. Here it is more than a question of measurement. How should the total cost of Operation A be apportioned to the chemicals used in Process 2 and the residue used in Operation B? All factors should be considered. Are the chemicals and residue of equal importance, or is the residue merely incidental to the mixing of the chemicals for Process 1? Could either or both be purchased outside? Perhaps the costs of Operation A should be divided on the basis of the market value of chemicals produced and residue produced, not by substituting market value for cost but merely using market values as a basis for apportioning costs. Or perhaps the market value of the residue, less a percentage for suppliers' profit and handling charges, should be credited to the total cost of Operation A and the balance regarded as the cost of chemicals to be transferred to Process 2.

Other modifications of the costing would be necessary or desirable if different grades of materials were put into production, as a different quality or strength of material used in Process 1, or different colors of paint mixed in Operation B. Under such circumstances it would be necessary to identify the lots processed beginning with Process 1 or with the spraying in Process 3. There would be no real departure from simple process costing but instead of weekly cost records merely being maintained for each operation and process, the records would show separately weekly runs or lots containing grade I, II and III materials and weekly runs or lots sprayed with red, blue, and gold paint. Commencing in Process 4 there would be separate accounting for grade I red, grade I blue, grade I gold; grade II red, grade II blue, etc. Where runs can be restricted to one variety, even if costs of processing vary from those applicable to other items, process costing may be used without resort to job costing.

The example of a thirteen-month year used as a basis for the description of process costing is merely an example and is not to be taken as an essential of this type of costing. To be noted are the benefits to be derived from synchronizing a series of successive processes and contributory operations, with cost accounting precisely paralleling factory procedure in this respect. Although it is desirable that monthly or quarterly statements of operations cover complete process periods without unnecessary overlapping, where processes cannot be arranged in such time periods, process costing may be applied nevertheless. In such instances the inventorying and pricing of work in process is burdened with problems relating to the costing of processes begun but not ended rather than the mere costing of completed processes as in the example under consideration. With the difficulty or impossibility of measuring and pricing material being processed the problem is usually solved by using for inventory purposes the costs accumulated in that process since the current process began. This is not too objectionable if costs are closed out regularly as the process ends or are broken off at not too infrequent intervals.

Controlled Cost Accounts Parallel to the Production Routine

In process costing it is relatively simple and worth while to keep separate, throughout the cost accounts, the costs of materials, labor, and overhead. For exam-

ple, in Operation A, the cost of chemicals produced should be shown in a four-column account with columns for total, materials, labor, and overhead. When the output is carried to Process 2, along with the output of Process 1, similarly costed in four-column accounts, the cost accounts for Process 2 take over the costs from Operation A and Process 1 into four-column accounts which are also charged with materials, labor, and overhead separately incurred for Process 2. That is to say, the output of Process 1 is not costed as material used in Process 2, but the costs preserve their identity as materials, labor, and overhead. In this manner the cost of the finished product is expressed in the form of materials, labor, and overhead, each element being the subject of reconcilement with related control accounts.

The separation and continued identification of the three elements of cost, materials, labor, and overhead, throughout the cost accounts, has advantages apart from the advantage of separate control and the benefits to be derived from detailed comparisons that are particularly valuable where a variety of grades of material and styles or patterns are produced. The effects of a retroactive or proposed change in labor costs can be readily determined from such records. A change in overhead rates resulting from either a variation in volume of production or increases or decreases in the elements of factory expense can be more easily applied if such records are maintained. Also, there is an over-all test of the reasonableness of the cost of inventories where materials, labor, and overhead costs are identified, and a consequent guarding against the possibility of overhead accumulating in inventory instead of being included on an equitable basis in costs taken up as cost of goods sold.

As a means of illustrating the foregoing outline of the essentials of process costing, there is presented in following eight paragraphs a description of the practical operation of this type of costing. This description is not intended to, and does not, take the place of the discussion of accounting techniques and controls employed, as presented in Part III of this Section; nor should it direct attention from the forms and procedures appropriate to a specific industry for which a system is outlined in Section II of this volume.

Included in the general ledger chart of accounts are accounts for raw materials, work in process, finished goods, overhead, overhead absorbed, and cost of goods sold, each of which (except perhaps the last mentioned) controls a subsidiary ledger which constitutes part of the cost system.

In the subsidiary records raw materials accounts are credited and charges made to departments, or, as in the example, to process or operation accounts through a stores account for weekly or other periodical withdrawals for material put into production. The process or operation accounts thus established are controlled by the work in process account. They are further charged with labor cost from the payroll analysis, and with overhead absorbed credited to an account of the same name which is an offset to the overhead account.

The overhead account controls an expense ledger showing factory expenses by kind (rent, insurance, indirect labor, depreciation, etc.).

In addition, each detail expense account is keyed to indicate its treatment as the basis for allocation of overhead. Accounts or items marked or columnized Operation A or Process 4 indicate that overhead of that amount should be absorbed by a direct charge, through the overhead absorbed entry mentioned above, to Operation A or Process 4, respectively. Accounts or items marked or columnized in some

specific manner, as I, II, III, etc., indicate that such amounts are to be apportioned to two or more operations or processes (or an intermediate service account, such as for a trolley system or power plant expense) on one of a variety of bases such as a predetermined percentage of direct labor or in proportion to space occupied or service rendered as a result of the given group of expenses incurred. It is usual and proper to eliminate from overhead expenses those charges and expenses which relate to idle capacity, and to make a direct charge to profit and loss for such costs.

None of the detail expense accounts, whether absorbed as a direct charge to a process or absorbed on an allocated basis, is closed out by transfers to process accounts. Instead, they are merely offset by accounts controlled by the overhead absorbed account.

The process or operation accounts, with amount columns for total, materials, labor and overhead, and columns for quantities used and produced, are closed out as processes are completed (weekly in the example) and charged to the successive process account. The last process (Process 5, in the example) is closed out to finished goods, for which a subsidiary ledger is also maintained with an account for each completed run or kind of product.

As shipments are made, on the basis of monthly summaries of quantities of each kind of product sold, entries are made crediting finished goods account (and its subsidiary accounts) and charging cost of goods sold.

The difference between the overhead account and the overhead absorbed account constitutes overhead overabsorbed or underabsorbed which at the close of each fiscal period or oftener is taken up as an adjustment of overhead absorbed. It is technically preferable for such differences to be passed through work-in-process account (and the subsidiary process and operation accounts), to finished goods account (and its subsidiary accounts) and thence to cost of goods sold, with only appropriate amounts remaining in the inventory accounts. As a practical matter the amount of overhead over- or underabsorbed may be disposed of by an apportionment between inventory accounts (work in process and finished goods) on the one hand and cost of goods sold on the other hand.

Cost Reports

The present description of process costing and illustrative outline of related accounting procedures would not be complete without some reference to appropriate cost forms. Thus far the records mentioned are simple developments of ledger accounts required in financial accounting. The extent to which other forms are to be used is dependent on the minuteness and frequency of cost data required by the management in a particular case.

Readily available are data as to cost per unit of output for each process and operation, with separate costs for materials, labor and overhead per unit of output. Similarly the quantities of materials consumed per unit of output may be determined; the hours of labor per unit of output; and the cost per hour of labor in each process.

If management requires such information as to each weekly run, forms should be provided to tabulate the pertinent statistics, items being picked up from the work in process (detailed process and operation) accounts and finished goods accounts. In such a case the cost forms may be conveniently of the same size as ledger sheets and filed alternately with supporting ledger accounts.

It may be desirable to obtain detailed cost data only on occasional runs, as for instance following a marked change in material costs, labor costs or overhead rates (through a significant net increase or decrease in expenses or change in volume of output). Under such circumstances the forms to be prepared may be only reporting forms. In using such occasional reporting forms special care should be taken to prepare a recent report on each kind of run, covering each combination of varying grades of material used and of various colors applied. In this way essential cost data may be on file meeting all ordinary requirements of management where production is normal, cost variations infrequent and special runs readily identifiable. If discretion is used it is not always necessary to cost each process of each run. That is one definite advantage of process costing: the basic data can be assembled but need not be made the subject of cost computations except to the extent that detailed costs are required by management. Cost of sales may be determined on the basis of the more recent appropriate costs, whereas in job costing the cost of each item must be determined, if only for purpose of costing items sold.

The costing of items sold, in complete detail or through the use of determined costs for a regular run for all similar runs, is essential if one accounting advantage of costing is to be achieved—namely, that of maintaining the money value and quantities of inventories, the former for use in interim financial statements (balance sheets and profit-and-loss statements) without the requirement of physical inventories; and similarly, for checking book inventories against physical inventories when taken, not only as a proof of the money value and quantities of inventories but also as a test of the general over-all accuracy of the cost system.

3. Job Costing

Superseding and growing out of attempts to estimate costs of individual jobs done or products made, and out of uncontrolled memorandum methods of determining costs where products vary, there has arisen a type of controlled costing known as job costing.

Job costing and process costing are the two principal kinds of cost accounting for the determination of actual or historical costs and the bases on which standard cost systems are built. Modifications and combinations of the two basic methods are in use. On to straight job costing there may be grafted process costing techniques in order to simplify the costing of some operations. On the other hand, as explained in the preceding chapter, process costing may be developed to a point where it covers cost determination of specific products which otherwise might be the subject of job costing. In addition, in one and the same factory, by careful planning of manufacturing procedures, there may exist two distinct kinds of production, the one requiring job costing and the other process costing.

Comparison with Process Costing

Job costing should not be installed where process costing or a simple modification thereof may serve the purpose. Job costing requires more precise accounting than process costing, with more routine detail in routing work through the factory and more accounting detail in allocating and assembling costs. In industries suited to process costing, work flows through the factory and cost statistics are derived readily from financial accounting records supplemented by analysis. Where job

costing is needed, work requires constant routing through the various stages of production and cost data rest more on factory reports than directly on the general books of account, although the cost system is controlled by the general books.

Accordingly, where there has been no cost system in operation, or only a method of estimating costs, it is often found advisable first to introduce a form of process costing and then, where it is inadequate, to supersede it by job costing to the extent necessary, preserving for as many operations or departments as possible the system of process costing. In this manner, unnecessary elaboration may be avoided and the burdensome detail of job costing not imposed where process costing could be used.

Where such products as machines or machine tools are made to order or in relatively small quantities for each kind of product, job costing is found. Building contractors and shipbuilders also use job costing except where ships are built on a mass production basis, in which case a specialization of process costing is more nearly appropriate for most operations.

Moreover, where machines are made in sufficient quantity, it is sometimes possible to use process costing for departments manufacturing standardized interchangeable parts and for the assembly-line operations, installing or retaining job costing for the manufacture of special parts and unusual assemblies. It is in such industries that job costing and process costing can be used to advantage side by side, the one complementing the other.

In the case of the crafts, such as job printing, tailoring and cabinet making, where mass production techniques have not been applied, costing is by job costing. Job costing falls down and becomes a mass of burdensome and unnecessary detail when it is retained beyond the time that mass production takes over. Cost accounting, to be effective and workable, must be related to the routine of production. A cost system should never impose job costing on operations geared or suited to be geared to a flow of production. The belt line should not be interrupted by a system of reporting which is unnecessary and meaningless when cost data may be obtained more easily and appropriately through departmental analysis, the basis of process costing.

Essentials of Job Costing

For the purpose of presenting the essentials of job costing, and not as a duplication of the cost system of any industry described elsewhere in this volume, an example of job costing is given below. In this outline of job costing the subject is considered in its simplest form as a determination of costs on a historical basis. The development of job costing from historical costs to standard costs is treated under standard costs.

It is perhaps in the accumulation of costs under job costing that there is particularly evident the fundamentals of costing. As the purpose of manufacturing is to embody in a new product those values or costs which already exist in fixed assets (plant and machinery) plus the cost of materials, labor, and supervision, so the first objective of costing is to trace these values or costs from their existing locations or depositaries to the finished product. In job costing this transference of values is recorded in detail and accumulated at each step or stage in production.

In industries to which job costing is applicable, production commences and proceeds on the basis of individual production orders. This is in contrast to plants operating under process costing where production for a period—a season or a year

—is planned and proceeds on that basis until superseded by operation under another arrangement for mass production.

The production order is of two general kinds, the one specifying a job to be done or products to be produced for a customer and the other specifying products to be made for stock. Except where there is an emergency arising from a shortage of specific items in stock, it is obvious that production for a customer is entitled to priority over production for stock. This point is of significance in routing and planning production, discussed below, and is emphasized in some way, as by using different colors for the two kinds of production orders, and further clarified by datings shown on each of the orders—namely, date on which production should begin, and date on which production should be completed. For use in costing, a third date is required, the date of completion of the job. The production order bears a consecutive number for identification and control.

Given a production order, or a series of production orders for different kinds of work or products entering into a completed job or finished product, it is necessary to implement each order in two ways, first by orders for issuance of materials for the job, and second by instructions to subject the materials to definite processes, such as labor, machine, chemical, testing, or maturing operations.

Orders for materials issues may be complete for a production order or may consist of a series of orders for materials issues to be used at successive stages of production. Production instructions may similarly comprise one instruction sheet complete for the job or may consist of a series, each applicable at a definite stage of production. In any event orders for materials issues and production instructions each bear a number identical with or coordinated with the production order to which they relate, and which they accompany through a production routine.

Orders for material issues show kinds and quantities to be issued, and as issued. The copy for the cost department is completed to show unit costs and total costs of material used.

Production instructions result in a labor, machine, or other operation being applied to materials in production. As the work is done, time cards or labor tickets are prepared showing time and kind of labor performed identified by the production order number. The time cards are used by the payroll department as the basis for determining wages payable whether on the time or piecework basis. The same cards or copies of them are also used in the cost department for preparing a distribution of labor costs by production orders for direct labor and by suitable classifications in the case of indirect labor.

From the foregoing it may be observed that a production order, and its related orders for materials issues and production instructions, when prepared prior to the commencement of a job, indicate the routing of the work through the factory. Production orders and related production instructions should be listed, or copies filed, by production centers, to show the work planned for each production center in the factory. In this manner potential bottlenecks are foreseen before they occur and arrangements made to relieve them by setting up additional centers or by working overtime or extra shifts. Similarly, potentially idle centers are foreseen and the question of production for stock or other remedial measures are given consideration. At the same time, priority of work is noted by taking cognizance of dates when work should be completed and differentiating production orders for customers and for stock, as noted above.

The schedule of production consisting of a list, or file of copies, of production orders and production instructions should be kept up to date by checking off on the list, or removing from the file, operations performed, thus leaving only live orders and instructions to be taken into account in planning future production. Also, in this manner the possibility of an operation being omitted on a production order is reduced to a minimum.

The cost department assembles cost data for each production order primarily from two sources, namely, copies of costed orders for issuance of materials and payroll distributions. Details are entered in materials and labor columns on a separate ledger sheet or form for each production order. A column is also provided for overhead which is entered at an amount based on a rate determined as applicable to the particular operation, such as a predetermined rate per hour or per dollar of direct labor. Machine rates or production center rates, constituting a charge per hour or per other unit (such as per operation) to embrace all charges and expenses relative to the service or operation performed by the machine or production center, may be used for costing some operations instead of the separate labor charge and overhead rates.

Control of Cost Accounts

The group of individual ledger sheets used for production order costing comprises a work in process ledger until cleared to finished goods and thence to cost of sales. From this point on the control and procedures of job costing follow in general the method outlined in the chapter devoted to process costing, although in job costing the procedures are more complex by reason of the variety of products on jobs.

Where operations are to be costed separately, work in process account also controls intermediate accounts for production centers showing the cost of all labor and overhead relative to each center costed. Offset accounts for the application to or absorption in production order costs of production center costs are used to show the extent to which these costs have been absorbed. Amounts remaining over- or underabsorbed in these intermediate production center accounts must be allocated to production costs as an adjustment of costs or otherwise cleared instead of remaining in work in process, which is, of course, an inventory account.

Also under the control of work in process account are costs of defective work, waste, scrap net of sales value, etc., until disposed of by being charged to the related production order, to a production center cost, or to manufacturing expenses.

Instead of here outlining the general ledger accounts and subsidiary ledgers used in a controlled system of job costing, reference is made to the outline included under process costing. The similarities to be noted are that the control accounts for raw materials, work in process, finished goods, overhead, overhead absorbed, and cost of goods sold bear the same relationship to subsidiary ledgers in job costing as in process costing. There may be one control account, factory ledger, to cover all production accounts to finished goods. The differences to be noted are in the methods of accumulating the data that support the entries to the control accounts and their subsidiary ledgers.

Materials in job costing are charged to work in process and production order accounts from material used summaries showing the charges assembled from a file

of orders for materials issues, whereas in process costing a regular (such as weekly or for some other production period) issue of materials is made for each process.

Similarly, labor is charged to work in process and production orders from payroll distributions prepared from time cards showing time by jobs, whereas in process costing the payroll distribution is a departmentalization according to the regular continuous functions performed by each employee.

Overhead accounting, although similar under each system, presents more complexities as to absorbing or applying overhead under job costing where there are usually more points of application than under process costing. Under process costing there are usually a few departments or processes and contributory operations, all functioning continuously, whereas for job costing there is a large variety of operations carried on irregularly to meet the requirements of specialized production orders.

By reason of the difficulties encountered in equitably absorbing overhead in job costing consequent upon the specialized and varied nature of production operations, the problems connected with the disposition of overabsorbed and underabsorbed overhead are multiplied in number and enhanced in significance. For this reason the overhead to be applied may be broken down into groups and several items of over- and underabsorbed overhead thus determined so that rates for each operation may be more accurately predetermined or subsequently adjusted whether applied on the basis of a relationship to direct labor or as machine or production center rates.

Side by side with job costing, with the accumulation of all elements of cost—materials, labor, and overhead—by jobs, there may also be a departmentalization of operations. For example, many of the jobs performed or products manufactured may each require the application of various machine operations and also be subject to painting processes. In such instances, accounting may be departmentalized to show costs and output or performance by shops, the machine shop, and the paint shop. This merely means that materials, labor, and overhead must be separated first by departments and then by jobs.

It is not usual in job costing to follow through each operation, through each production center of cost accumulation, from the first operation to the final assembly or packing, the three elements of cost separately, in order to show the materials, labor and overhead components in the finished product. This is so for many reasons: First, the variety of production, for customers' orders, for stock, and for interchangeable parts for stock and orders. Second, the number of points of direct cost accumulation. Third, the number of points of overhead application. Fourth, the use of production center rates for application of combined elements of cost, usually composites of labor and overhead but in some instances also of materials where small parts are applied in a process of riveting, belting, or the like. It is this merging of elements of cost—by transfers from one department to another, by transfers from production of one period to inventory and thence to production of another period, and by composite applications of the elements of cost, for example —which causes job-costing statements to be less transparently related to the elements of cost of production found in the profit-and-loss statement. And it is for the same reason that any correction in the elements of cost is more difficult to trace through to work in process, finished parts, finished goods and cost of goods sold, than in the case of simple process costing. Finally, it is this feature of job

costing, the resulting conglomerate, congealed unit cost, which calls for the application of standard costs for purposes of analysis and explanation of the causes of variations in costs.

Cost Reports

There remains the question of the purposes to be served by job costing. Primarily the determined costs are used for finding the cost of individual operations performed at specific centers, and for finding the cost of each job.

The degree to which individual operations may be costed depends upon the extent to which centers are set up and used as intermediate steps in costing, requiring the assembly of all labor and overhead costs relative to an operation or center, including overhead specifically applied and an allocation of general overhead. Costs per operation may be variously stated as costs per unit of output and costs per hour or other unit of operation.

Costs of each job are not only useful for determination of, and comparison with, selling prices and for estimating on future orders, and for all general managerial purposes served by costing, but are an essential factor in the determination of the cost of goods produced and sold. Under job costing, except as similiar jobs are repeated, there is no short cut in the determination of cost of goods sold, as in process costing, where a normal run may be costed and used as a basis for determining cost per unit and of cost of goods sold, with other similar runs not costed to the ultimate detail.

Hence, in job costing the cost sheets to be used are related to costs per operation and costs per job, respectively providing for summarization of all elements of cost and the reduction to cost per operation and per unit of output. The cost sheets may be standardized and filed alternately with related work in process accounts for production orders and intermediate accounts for production centers.

As in process costing, so in job costing, the determination of costs of the finished product and of costs of goods sold serves not only managerial purposes but also serves accounting needs. These include the determination of cost of goods sold and the maintenance of book inventories in money values and quantities for use in preparation of financial statements where physical inventories are not taken, and for use in checking with physical inventories when taken and thus also in proving the general accuracy of the cost system as a whole. However, in the case of job costing, the accounting purposes to be served extend to cost accounting needs because the cost of operations and parts made are used in more ways and over longer periods of time than are costs under process costing. Costs of operations, including costs of machine and other production centers, require constant study in order to approach a reasonable degree of accuracy in costing, so necessary where rates derived therefrom are to be used frequently in the cost of a variety of jobs. Similarly, costs of parts made not only enter into current costs of goods sold and inventories but in some instances remain in inventories for many periods and hence affect a series of financial statements. It is for such reasons that job costing, more detailed by nature than process costing, tends to extend to the determination of more detail than is superficially evident in advance, and to the further refinement of detail for the cost accounting purposes of interpreting, correcting, experimenting with, and perfecting costs for use in a variety of cost accounting aspects.

4. Standard Costs—Their Use and Application

One of the main features and purposes of standard costs, made possible by the use of predetermined constants in place of actual items entering into costs, is promptness in preparation of cost reports for management. It is that feature which explains in part why standard costs are of particular advantage in industries in which job costing prevails because it is in job costing that the recording and accumulation of costs require voluminous and time-consuming accounting routine. Standard costs, largely or exclusively for other reasons, may also be applied where process costing is ordinarily used even though the saving in time and effort of the cost accounting department is not so marked or is either nonexistent or a negative factor, the addition of standard costing actually requiring more accounting routine in such instances.

The Need for Standard Costs

Moreover, as indicated in the discussion of job costing, standard costs are particularly useful in explaining differences in costs, and in explaining whether the differences are from variations in costs of materials, labor, or overhead. As to the variation in materials cost, does it arise from variations in purchase prices, spoilage, scrap, or some factor related to the quality of materials used or the conditions under which they are used? As to the variation in labor cost, how much is due to variations in wages per hour or per piece, to overtime, to effectiveness? Similarly, as to variation in overhead cost, analysis should show whether it arises from variations in manufacturing expenses or in effectiveness of operation, that is, from the amount of overhead applicable to actual processes and operations according to time consumed or, conversely, from the number of operations performed per hour or other period. Standard costs may provide the answers to these questions where job costing does not, except to some extent as the result of prolonged analysis and extensive comparisons usually completed too late to be of real advantage to management.

It is for the foregoing reasons that job costing has been largely superseded by standard costs in progressive manufacturing enterprises where management insists on comprehensive and prompt information as the basis for policy making. Too often reports prepared under job-costing systems are both too late and insufficiently informative to be useful to management, their findings being more or less limited to serving requirements of accounting including cost accounting, such as in the determination of inventories and cost of goods sold or in providing data to establish new rates for overhead application or new rates for production centers.

In general, the more complex the manufacturing operations, the greater the variety of products, the further removed from a situation in which process costing or an adaptation of process costing is appropriate, the greater is the need for standard costs. It is the complexity of manufacturing operations which makes process costing inapplicable and which makes impracticable the pedestrian routine under which job costs are accumulated. A standard cost system, by eliminating the detail distribution, collection and recapitulation of items and elements entering into job costs, and by substituting constant or standard rates and amounts applicable to departments or production centers instead of to production orders, is able to determine standard costs and explain the differences between standard costs and actual

costs. Bear in mind, also, that the subject of costing in a standard cost system is usually primarily by operations rather than by jobs or units of output.

Essentials of Standard Costing

Obviously, the basic record in a standard cost system is a schedule or file of standards. Prices of materials must be listed for each item used in production. The cost of labor per operation must be determined and scheduled. Similarly, the cost of overhead applicable to each operation under standard conditions must be predetermined and included in the basic record.

Before explaining the use of the information thus gathered together, some consideration should be given to the terms standard, standard price, standard effectiveness, and pay of labor resulting in a standard labor cost per operation, and standard conditions for application of overhead to determine a standard rate per operation. Standard, as applied to costs, means either attainable costs or merely a constant used as a measure of costs. Standard, therefore, is that which is typical of specific given or assumed conditions.

Current Standards Versus Basic Standards

If a standard cost system is built upon approximately, or reasonably, currently attainable standard costs, obviously the basic record of standards requires frequent revision to meet all changes more or less beyond control, such as market prices of raw materials, wage rates, and fixed factory expenses, as well as to give effect to changes considered more or less controllable such as efficiency in production which affect labor cost rates and overhead cost rates. In place of a standard there is a variable standard, and moreover if the variable standard is to be the attainable cost in any given month, there is substituted for the day-to-day cost accounting routine of job costing the frequent cost accounting determination of attainable costs. The frequent revision of standards resulting in variable standards as bases of comparison destroys the stability and simplicity of using standards, because comparisons are between variables instead of between one variable, the actual, and one standard, maintained as a constant. Furthermore, if a comparison is desired between actual costs and attainable or expected costs it is often preferable to show each in comparison with a constant standard than to make a direct comparison of those two variables.

On the other hand, by using constant costs, determined as a yardstick rather than as a currently attainable objective, a cost system is developed that rests upon standards which do not require frequent revision but whose virtue is that they may be used as bases of comparison over long periods of time. Of course, as different kinds of materials are used, or manufacturing operations changed, such as welding substituted for riveting or machine finishing for hand finishing, or factory layout changed with new production centers or departments established, new standards must be set. But otherwise, and after allowing for such revisions, the standards used remain as measuring rods with which are compared current actual performance and also current estimates determined for purposes of budgeting or quotations for orders.

It must be acknowledged that differences of opinion remain as to whether constant, permanent, or basic standards on the one hand, or attainable standards on the other hand, should be used in a standard cost system. While for the reason

stated preference is here given to the use of constant or basic standards, the possibilities of using attainable standards should not be ruled out, especially for industries and for periods where relative stability prevails.

Setting the Standards

Even where constant or basic standards are used, the standards set are carefully determined and closely related to reality and the several standards set are consistent with each other. The procedures involved in setting standards extend far beyond the job costing of a series of operations. The necessary surveys of purchasing, employment, and productive functions, as well as of factory layout, are so extensive as to constitute an overhauling of manufacturing operations and procedures from beginning to end. Such a survey is a nonrecurring expense which may pay for itself in two ways: First, concrete advantages may be realized by the enhanced effectiveness of the plant derived from the introduction of remedial measures and improvements in manufacturing operations developed from the findings of the survey. This may result in cheaper or better products by the use of more appropriate materials, or perhaps in the choice of the better alternative productive operations or in the selection of a more efficient layout and routine. Second, economies may follow the installation of a standard cost system that is operated more expeditiously than a job costing system. Many functions, which are performed only once for the standard-setting survey, would otherwise need to be performed repeatedly for every job done or group of products made.

The setting of standards for materials used requires a study of the various kinds of materials available for the range of products to be manufactured. It is from this study that materials ordinarily available in the market are classified and graded and a selection made of the materials to be used in each instance, with alternatives specified for use if market prices fluctuate making it more economical to use substitutes of better or inferior materials. Market prices, f.o.b. the plant, of course, for quantities related to appropriate buying policies and warehousing facilities, are examined over a period, and prices are taken as standard which conform to a reasonable market price. Specifications are then prepared to show the kind and quantity of materials to be used for various purposes, and thence is deduced a set of standards to be applied for materials. In determining the quantity of materials to be used allowance is made for conditions peculiar to the manufacturing operations, such as shrinkage, waste, residual products or scrap, and perhaps separate standards set for each such addition to, or deduction from, materials cost.

Standard labor costs can only be set for each productive operation as the result of a determination of time consumed, usually by time studies, for a given output. The equivalent of job costing is performed, not for the purpose of determining the cost of a given product but to prepare cost sheets as a basis for study. From such a survey a statistic is obtained that constitutes a standard time per operation. Next, wage rates, whether piecework or by the hour, are selected as a reasonable standard for the industry and location of the plant, and from such rates there is deduced a statistic representing a standard rate of pay. From these two statistics there is derived a standard labor cost per operation.

In the case of overhead, a budget of manufacturing expenses is prepared for normal plant operations, normal in this instance being a volume applicable to one shift or the ordinary number of shifts customary to the industry if, for instance,

twenty-four hour operation prevails. On the basis of fully absorbing the estimated overhead for an estimated volume of production, overhead rates are established as standard for each operation.

For some operations composite rates, machine rates or production center rates may be established for use as standards, in place of standard labor cost rates and standard overhead rates.

Applying Standards of Costs

Having established the standard costs for materials, labor, and overhead, the standards are applied to each process or activity entering into each job or group of products made. Specification sheets or pro-forma cost sheets are then prepared for each job and extended at standard costs. These standard cost sheets may be prepared as soon as it is known what is to be produced. In this manner the way is prepared for completing the cost sheets by the application of variances, that is, applying to each operation on each job the variances from actual costs applicable to the period of production. Thus, part of the costing, the costing at standard costs, is performed before the job is completed—even as soon as specifications and a production order are prepared—and the costing is completed promptly by the application of variances, determined as explained below. For purposes of budgeting or of quoting sales prices, the cost sheets may be prepared at standard costs and adjusted for variances estimated according to recent experience or expected conditions. Estimating thus prepared is usually both simpler and more accurate than estimating under a job-costing system where it is necessary to make a synthesis of estimated costs derived from the costs of more or less similar jobs previously performed. It should be borne in mind that the usual case is considered in which the standards set and used are standards of operations entering into any job, not standards of jobs. Under such a procedure the standards may then be applied to any job done or group of products made.

Standard Costs, Actual Costs, and Variances

Before considering the determination and use of variances it is necessary to recapitulate what data are available for reflecting variances in costs of materials, labor, and overhead. In one of several ways there are accumulated in a standard cost system both the actual expenditures for the three elements of cost—materials, labor, and overhead—and the standard amounts applicable for the given production. It is between the standard and the actual that comparisons are made and variances determined and interpreted. This is done whether the standards used are attainable standards frequently revised or constant standards maintained more or less permanently as measures or yardsticks. Also, for purposes of budgeting, quoting sales prices or any other study requiring an element of forecasting, standard costs are compared to expected costs and variances thus established and interpreted.

In which of the several ways both actual and standard costs for each element of cost are accumulated is not of decisive importance for the purposes of understanding standard costs except in two particulars. First, it must be repeated that actual costs are not accumulated on production orders, a procedure which would vitiate many of the advantages of a standard cost system. Second, it is important that actual and standard costs be available for inventories and cost of goods so that a decision may be made, from the point of view of general or financial accounting, as to which

costs are to be used for purposes of balance-sheet inventories and in the income statement for cost of goods sold. The kind of cost system used, as distinct from the costs determined, should not be permitted to be a decisive factor in fiscal policies in the matter of the determination of profit or loss and the presentation of financial statements.

Cost Accounts

Perhaps the simplest way to understand a standard cost system is first to visualize every account for inventories, production, and cost of goods sold being maintained in parallel columns for actual and standard amounts, or with the accounts at actual being supplemented or complemented by accounts at standard amounts. For such a hypothetical double accounting two points must be resolved, namely, how are the *actual* amounts determined, and second, how are the *standard* amounts determined, for all entries from purchases through work in process, for manufacturing expenses absorbed in work in process, and thence to cost of production entering into finished goods. For the solution of the two foregoing questions in relation to the three elements of cost the key is to be found in principles already used in process costing for the application of overhead absorbed at predetermined rates and of the distribution of service department costs at predetermined rates. Similar principles were applied in job costing for the same purposes and also for the charging of production center costs at predetermined rates and, in each instance, for the disposition of the unabsorbed costs in some appropriate manner.

In standard costs the use of predetermined rates is not limited to overhead, service department expenses, and production center costs as in process costing and job costing, but extends to all elements of costs at all points of application. The differences appear as favorable or unfavorable variances used as interpretations of performance rather than as the subject of adjustment for over- or underabsorbed expenses or costs, although for purposes of deriving actual costs from standard costs such variances are in effect applied as adjustments.

Continuing to visualize a hypothetical set of double accounts, let us first follow through the entries for actual expenditures. Raw materials account is charged for purchases and credited for requisitions for materials entering production, also priced at actual, with a corresponding charge to work in process. Similarly, payroll is charged to work in process, and overhead is so charged by means of an offset to total manufacturing expenses. In order to relieve work in process, at actual costs, and charge finished goods, it is necessary to use amounts representing the cost of production, at actual costs. Inasmuch as this cost of production is not accumulated in production orders it must be determined in another manner: It is determined by the application, in one manner or another, of actual costs to standard costs through variances, as explained below.

In the same hypothetical set of double accounts, entries for standard costs should be visualized. The accounts for raw materials are charged at standard costs, the data being derived from simultaneously entering purchase invoices at actual and standard amounts. Requisitions of materials used in production are also priced at standard and form the basis for a charge to work in process at standard costs. Labor and overhead are also applied at standard rate. Next come entries for charging finished goods at standard based upon a costing of production. In some manner or another, as indicated below, this production, by the application of variances,

becomes the basis for entries which relieve actual work in process and charge finished goods at actual costs for the output.

In practice there are many deviations and adaptations of the foregoing outline of a set of double accounts for manufacturing operations and production, leading to cost of goods sold and inventories. Whatever short cuts or ramifications may be introduced to the hypothetical example, the objectives remain the same—namely, the determination of costs at standard to be compared to costs at actual, and from such comparisons the development of variances to interpret production performance.

The manner in which practice deviates from the hypothetical double accounting outlined may be illustrated by a few examples. Instead of parallel accounts for raw materials being fully developed, a purchase variance account is usually used to account for the difference between actual and standard prices of materials purchased. Or variances in costs of materials may be ignored at this point and only introduced at the stage where materials enter production. In such a case raw materials inventory appears only at actual cost. Other examples may be cited where only standard costs are shown for inventories of work in process and finished goods. This procedure may well be followed where the standards set are attainable standards closely related to actual achievement by frequent revisions of standards. In such cases only standard costs are used in entries charging and relieving work in process and finished goods. Alternatively, these inventory accounts may be maintained only at actual costs. In either case, where work in process and finished goods accounts are maintained on only one basis—whether actual or standard—variance accounts take up the differences.

Variances Shown in Accounts or Only Statistically

From the foregoing we may proceed to the variance accounts. Theoretically there need be no *accounts* for variances if a complete double accounting were kept as in the hypothetical example given. In that case variances would be shown not as account balances but merely as statistics derived from a comparison of costs shown on cost sheets controlled by the actual and standard cost accounts comprising the double accounting. In practice some such variances are shown that way, but variance accounts are used to show differences between actual and standard costs at several stages of production. There are purchase variance accounts set up for differences at the point of purchase or the point at which materials enter production. There are materials-used variances reflecting the standard cost of variations in quantities of materials used. Related variance accounts may be set up to account for variations from standard in spoilage, waste, and scrap. Similarly, variance accounts are used for labor cost fluctuations, showing variances separately for rate of wages and production performance or effectiveness in each department or operation. Overhead variances by departments or operations are also shown in separate variance accounts. Statistically, outside of the accounts, there may be developed combined variances for each department or operation, for labor and overhead together. In any event combined variances may be developed for a given product made or for a given period of production to account for materials, labor, and overhead deviations from standard.

Variances are the difference in amount between actual and standard prices or costs. They are expressed as ratios or percentages of standards. These percentages are not only used for comparative and interpretive purposes but are also applied

to production costs of a job or units of output costed at standard from an accumulation of standard costs of the several component operations. In this manner actual costs may be determined for jobs or products constituting the output of a given period. Variances are statistical while variance accounts are not only statistical but also serve a bookkeeping purpose.

Relation of Standard Costs to Financial Statements

Some mention should be made of the kind of income statement or profit-and-loss statement that results from the operation of a standard cost system. Theoretically, again, there need be no difference between the income statement prepared under a standard cost system and an actual cost system if a complete double accounting in actual and standard costs were maintained as in the hypothetical example discussed. Whether or not it is desirable to substitute standard for actual costs in balance sheets and income statements constitutes a general or financial accounting question. To the extent that actual costs are not currently typical it is proper to replace them by attainable standard costs, provided that unrealized or hypothetical profits are not thereby taken into account. One point to be decided here is to what extent the form of the income statement should differ from the ordinary form by reason of a standard cost system being operated. Too often the cost system is permitted to "wag" the general accounting in this respect, as the tail wagging the dog, with the result that the income statement degenerates to the point of being almost meaningless. For instance, a gross profit is shown, with cost of goods sold at standard, and this is followed by a series of variances. If the standards set are measures or yardsticks and the variances from standard substantial, the income statement may show, for instance, a gross profit or loss, relatively small compared with the large net charge or credit for variances. Inasmuch as the variances are from a more or less remote, although stable, standard, these variances have little or no current meaning in an income statement but, on the contrary, are confusing to accountants as well as to management. The relative variances as between periods are of immense significance to management in understanding manufacturing operations but they should not be allowed to enter the income statement. Instead, there should be available something approaching what is determined under the complete double accounting discussed here as an example. From such an accounting there may be prepared income statements based on actual costs or such costs as modified for the purpose of relating actual costs to currently typical costs more correctly applicable to general or financial accounting.

To reiterate, standard costs should not be permitted to introduce unrealistic figures into balance sheets and income statements or to present profits based on hypothetical conditions far removed from actuality, even if such hypothetical conditions are called standard. In cases where standard cost systems are in use, it is especially necessary to maintain or restore the jurisdictional balance between general or financial accounting and cost accounting.

Another danger to be guarded against in a standard cost system is the possible development of the system to the point where it is more cumbersome in operation than the job-cost system which it superseded or for which it substitutes; and where its results and interpretations are not presented promptly or in a form readily digested by the management. Such deterioration occurs where standards set are not applicable to operations predominantly conducted, or where the operations costed

are not clearly defined, thus resulting in the need for frequent supplementary accountings for supposedly infrequent operations which in practice continue to occur.

Arithmetic of Variances

No detailed discussion is given here of the arithmetic related to the determination and use of variances between standard costs and actual costs. Variances are shown in amounts merely by subtracting actual from standards to show a favorable (positive) or unfavorable (negative) variance. In addition, by using the standard cost of any item, operation or series of operations, as an index of 100, variations in actual are shown in percentages by dividing the index or standard figure into the actual, in which case a percentage which is less than 100 is favorable and a percentage which exceeds 100 is unfavorable. Standard costs are therefore maintained by ordinary double-entry bookkeeping entering into the general books of account parallel to the general accounts or a modification in which double accounts are not entirely carried throughout the cost system. And the arithmetic of variances is quite elementary, complexities appearing merely as the result of multitudinous comparisons, each of which is simple. That is to say, once standards have been set and applied, the complexities of standard costing arise by reason of the many forms of statements which may be prepared for the information and guidance of management, complications related to the extensive potential usefulness of standard costs.

5. Uniform Systems Versus Tailored-to-Order Types

A comparison between industry-wide uniform cost systems and cost systems devised and installed specially for individual enterprises requires a consideration not only of cost accounting and its ordinary uses but also, more particularly, of the economics of an industry and the relative positions within the industry of the individual members. It is from the point of view of the industry as a whole, and on general economic grounds, that the justification of the uniform cost system is to be found. The advantages and disadvantages from a strictly accounting viewpoint are of subsidiary importance.

The Industry-Wide Role of Uniform Systems

Obviously an appraisal of the benefits derived by an industry through the installation of uniform costing does not involve a comparison between a uniform cost system and any one example of a specially devised system. It is only as to individual enterprises within an industry that such comparisons are valid. What is here pertinent, and what is first attempted, is an evaluation of the advantages to an industry which introduces and maintains a uniform cost system. Subsequently, consideration is given to the advantages and disadvantages to the individual business of a uniform cost system, which advantages are of an accounting nature and require a comparison with the specially devised or tailored-to-order system.

A discussion of the industry-wide objectives and accomplishments of the uniform cost system might well begin with a quotation from *The Acceptance and Installation of Uniform Methods of Cost Accounting* issued by the Department of Manufacture of the Chamber of Commerce of the United States. In advocating uniform cost systems that publication lists the advantages as follows:

1. Provides the "one best way" known to the industry to figure costs, although cost accounting is a progressive science and provision should be made for keeping the uniform methods up to date, thereby eliminating expensive experimentation by the members of the industry individually and independently.
2. Results in a better informed competition within the industry.
3. Enables the industry instantly to place facts before regulatory bodies.
4. Inspires confidence in the public that selling prices are established by producers who have full knowledge of the costs of the articles offered for sale.
5. Tends to make the manufacturer who otherwise would fail to see the advantages of good cost accounting convinced of the desirability of adopting the methods which his competitors are successfully using.
6. Reveals lines of individual products which have been marketed on unprofitable basis.
7. Provides in addition to the above specific reasons all of the valuable features of good cost accounting generally, among which are the following:
   (a) Shows the danger line below which goods cannot be sold at a profit; thus serving as an insurer of profits.
   (b) Acts as a guide to the value, efficiency, and waste of workers, machines, methods, operations, and entire plants.
   (c) Provides a reliable guide and basis for estimating the cost of prospective business.
   (d) Furnishes current reports for comparing major cost items with standards which are predetermined and thereby measures and increases operating efficiency.
   (e) Establishes a standard manual of accounting practice so that if your cost clerk, bookkeeper, or accountant leaves you his successor will find a system the operation of which has been fully and completely developed.

All of the points made in the foregoing statement are fairly obvious except perhaps Point 2 as to which a difference of opinion exists. It would be more true in this respect to say not that "better informed competition within the industry" is a result of the installation and operation of a uniform cost system but that whatever attitude toward competition or noncompetition is taken will be based on better information. There is a difference.

Uniform Systems in Relation to Competition

In the first place, it is not true that businesses which know their costs do not sell below cost. There are points within the business cycle and occasions in the competitive relationships when some or all members of an industry knowingly sell below cost. Of course, when competition is at its keenest, trade associations, if they exist, find it difficult to introduce or maintain a uniform cost system and reporting of industry-wide statistics derived therefrom. When the uniform system and reporting are introduced after such a competitive period the introduction is a symptom rather than a cause of the end to, or interruption in, competition.

Secondly, competition or monopoly, or a trend toward monopoly, constitutes an aspect of economic conditions that is not changed by the introduction of an industry-wide uniform cost system. Trade associations find uniform cost systems an aid toward the elimination of ignorant, haphazard, ill-considered practices of selling below cost, or of selling at prices that do not cover cost of production, cost of distribution, administrative expenses, and yield a profit to the manufacturer. While uniform cost systems do not eliminate competition, they may contribute toward its restriction or elimination. On the other hand, such systems may result in competition being continued on the basis of more accurate information as to costs of pro-

duction. However, where competition is eliminated it is the result of conditions within the industry and in the market for the manufactured products. If one or a few businesses dominate the industry and the market, monopoly, or something approaching it, results, in which case the trade association and its uniform cost system for the industry tend to serve the ends and needs of the dominant members of the industry: in such a case the uniform cost system does not result in better informed, or any other kind of, competition within the industry.

Sometimes it is not a question of competition within an industry but of competition between the industry and other industries that compete for the consumers' dollars. In such instances the uniform cost system may be used as a means of raising the technological level of the industry for the purpose of seeking the largest total profit through maximum sales at low cost production. In other cases the objective may be profits through maintenance or increase of prices, with the statistics drawn from uniform costing in the industry being used to justify the prices charged.

Uniform Systems Inform and Regulate

Accordingly, the uniform cost system cannot be regarded as playing an economic role of either eliminating or extending competition, or of raising or lowering prices. Its role within an industry is, in the first place, comparable to the part played by a cost system within any business: primarily it serves the business purpose of determining, and informing management of, the costs of production and of forecasting future costs of production. Secondly, as in the case of cost systems in general, it contributes to efficient production by pointing out the more economical methods of production and aiding in the installation of effective routine within the factory. In fact, all of the objectives of a specially devised cost system are objectives of the uniform cost system and, in addition, the latter usually serves the industry as well as the individual enterprise. In each instance the question of business policy is controlling as to whether the individual business or the members of an industry should seek profit through lower prices or higher, through maximum production or limited output.

Inasmuch as the uniform cost system seeks to serve the industry rather than only the individual enterprise, specific aspects of its role within industry should be emphasized. Generally speaking its function is regulatory. If introduced by the trade association of the industry the uniform cost system may become a factor in self-regulation or adoption of common policies, if not directly as to selling prices then as to selling prices in relation to costs; as to depreciation rates claimed as deductions for purposes of income taxes, and as to manufacturing practices. For the last-mentioned purpose especially, as in the case, for instance, of seeking maximum output per given type of machine, the uniform cost system is supplemented by, and integrated with, industry-wide reporting and dissemination of cost data.

Similarly, the uniform cost system may be introduced or relied upon by the Government as a means of temporary regulation of business and industrial practices during a general economic crisis, as in the days of NRA; or of a crisis in a specific industry, whether during a war or a reconversion period or as a result of over- or under-production in ordinary peacetime. In the case of public utilities and railroads and wherever Government regulation of an industry through commissions is apparently permanently established, prescribed accounting systems are a recognized part of the regulatory function.

Accounting Advantages of Uniform Systems

Bearing in mind the foregoing, the role of uniform cost systems from the point of view of industry and economics in general, it is possible to specify some of the factors to be considered in comparing and weighing the relative advantages and disadvantages to individual businesses of uniform cost systems and specially devised individual cost systems, or tailored-to-order types. In this connection reference may also be made to the quotation given above from the publication of the Chamber of Commerce of the United States.

In the case of the individual enterprise, and therefore largely from an accounting point of view, the advantages first to be noted are those which flow from raising the level of accounting techniques for all members of the industry whose practices are below the average. To achieve this end, the economic and social forces which normally work toward better accounting are supplemented by, or exemplified in, group pressure exerted through the trade association or other sponsoring agency. Moreover, the cost of installation and operation of a cost system tends to be less if the expenses incident to the preliminary survey of like plants, and incident to devising a system generally applicable, are borne cooperatively by being spread over a number of concerns on some basis or other. Also, the uniform system being better than the prevailing system, although perhaps no better or not so good as some of the best, raises the standard of accounting for most members of the industry. One reason why the uniform system represents an advance in accounting practices is to be found in the fact that it incorporates many of the tested features of the best systems applicable to the industry. Accordingly, the uniform cost system usually represents an advance in accounting practices by introducing a system above the prevailing average and by making it available where it is most needed, that is, in enterprises which for one reason or another had not and probably would not at an early date recognize the need and incur the expense of installing a custom-made cost system.

Accounting Disadvantages

Offsetting these advantages are, first, the accounting disadvantages of seeking to use a uniform cost system to serve the needs of an enterprise which has individual methods of production and therefore cost accounting problems not provided for in the uniform system. These disadvantages may be overcome by providing for flexibility in the uniform system, or even of giving a choice of uniform systems, one kind for the small enterprise and one for the large producer, for instance. The other important accounting disadvantage is the obverse of the advantage of the raising of accounting standards as a result of specific pressure to install modern accounting practices through a uniform cost system. When once installed the uniform cost system being endorsed by the whole industry may, if it tends toward rigidity, become a hindrance to accounting progress inasmuch as experimentation in new costing methods may be discouraged. Improvements in a uniform cost system must thereafter be introduced only on an industry-wide basis or by those firms temporarily willing to abandon uniformity. In the one case progress may be slow by reason of the greater inertia incident to the larger number of parties resistant to change and the special opposition to change from those who place uniformity of

practice above sound accounting principles, while in the other case, where individual experimentation is resumed or resorted to, uniformity ceases to exist.

Extent of Uniformity

On the whole the accounting advantages of uniform cost systems may be achieved and maintained for most members of an industry if the uniform system is well conceived and reasonably prescribed and maintained. The uniform cost system should not ordinarily be designed to cover all procedures and techniques although the manual describing the system may illustrate the preferred routine to be followed. Uniformity should extend to, and in some cases be restricted to, cost accounting principles and account classification. For instance, as to materials used, the line of demarcation between direct materials and expense materials should be defined. Likewise, there should be a definition of what constitutes direct labor and indirect labor. Manufacturing expenses should be classified clearly and in detail in order to separate them in a uniform way from selling and administrative expenses. The methods of applying overhead should be uniform, whether by grouping by departments before being subject to absorption on stated bases, or whether the entire overhead is to be subject to absorption without prior sub-grouping. Where production centers are to be used for cost purposes they should be defined and the basis for charging overhead prescribed, as well as the method of applying production-center rates to production. If standard costs are to be used the determination or setting of standards should be uniform, whether standards are constant, basic, or permanent on the one hand, or currently attainable on the other.

In mature and relatively stable industries the manual describing the system may be much more comprehensive and specific, actually illustrating and prescribing some or all of the principal records and forms to be used to achieve uniformity of costing. Especially in such instances may a simpler system be devised for the smaller concerns in the industry. In any case, however, in practice a newly devised uniform cost system usually will not be installed *in toto* by all members of the industry, but in many instances it will be merely followed as a means of modifying an existing system, leading toward uniformity. For the purpose of achieving and maintaining uniformity, members of a trade association which prescribes a uniform cost system should be required to file descriptions of their existing systems, of modifications made toward uniformity, and of subsequent revisions, or should permit representatives of the association to compile such information. Such information is needed not only as a means toward uniformity but also as a means of interpreting cost data reported to the association.

General Evaluation of Uniform Systems

Theoretically and ideally, from a cost accounting point of view, a uniform cost system may be said to offer the advantages of incorporating the best thought and the broadest experience in accounting practices of like or similar enterprises. Such a system should approach perfection and be (1) relatively simple to install, because difficulties usually encountered should have been overcome by experience, and (2) easy to operate, because only the essential applicable features should be retained.

In practice, however, and again from a cost accounting point of view, the question of a choice between a uniform cost system and a specially devised cost system is not so simple. In the first place, an industry does not consist of enterprises of like

kind in all respects, but of enterprises whose output is predominantly of like or similar products. Each enterprise within the industry may have its own specialties, its own side lines, and therefore its own cost accounting problems. Indeed, by industrial classification, some enterprises, even businesses having only one plant, may fall more or less equally within two or more industries, not as being predominantly in any industry but as having an output constituting a significant factor in two or more industries. Furthermore, the matter of the relative size of the members of an industry has a distinct bearing upon the question of comparative manufacturing techniques, such as relative use of machinery, applicability of belt or assembly lines, and other distinctive procedures or methods, each of which requires separate treatment in cost accounting. Secondly, the uneven development of accounting practices within an industry may have left some members of the industry with no cost system while others may have installed cost systems highly suited to their needs, and yet differing markedly from each other so that the substitution of any uniform system would necessarily require for some members the acceptance of a system inferior to the existing specially devised system. Uniform systems tend to be better than no system, better than the average individual system, and, from an accounting point of view, not as good as the best specially devised and installed systems.

Nevertheless, and still from an accounting point of view, the very feature noted above—the uneven development of accounting practices within an industry—constitutes a substantial reason in favor of the installation of a uniform system designed to raise the level of cost accounting throughout most of the industry. The uniform cost system when devised, explained, introduced, and installed for an industry constitutes a contribution to accounting education not readily achieved in any other manner. Likewise, the operation of a uniform cost system marks a step forward in accounting practice which otherwise might not be taken within a reasonable time.

Finally, on the one hand, no cost system should be devised or installed for a business without inquiry being made as to the practices in the industry, especially as to whether a uniform cost system has been prescribed or recommended and, if so, the extent to which it has been accepted and maintained. On the other hand, no uniform cost system should be devised for an industry without a survey of existing systems used by individual members of the industry and a study of any uniform systems which may have been previously devised for the industry. Because standard costs constitute the highest general development of costing—apart perhaps from some specialized systems embodying features of process costing, job costing and standard costs—uniform cost systems tend toward standard costs.

Chapter 19

SYSTEM DESIGN AND INSTALLATION

By
C. W. SARGENT *

INTRODUCTION

The Task of Management

The administration and management of a modern business enterprise require the recording, analysis, summarization, and reporting of a vast quantity of information and data, financial and otherwise, about its activities. The executives of such a business, from the board of directors to the lowest sub-foreman, require a great variety of facts in order that they may:

1. Plan the business, establish its organization and framework, and set up its operating structure; determine lines of authority, responsibility, and accountability; design the products and devise methods for their manufacture; sketch the layout of machines and equipment; and arrange its channels of distribution and the attraction of customers.
2. Conceive and plan the operation of the business; formulate its policies and objectives; project its activities into the near and the more distant future; coordinate the efforts of its various functional and divisional personnel; design a program or budget, intelligently adjusted to external economic circumstances and internal limitations, for the guidance of those who carry on its purchasing, manufacturing, selling, and financial activities; and forecast the probable profit from periodic operations, and the probable financial position of the business at the completion of these operations.
3. Control the operations of the business by means of a constant daily effort to see that (a) the business is conducted in accordance with its objectives, policies, plans, and budgets; (b) the results achieved are consonant with the expenditures made for their accomplishment; (c) all departures of actual expenditure from allowed expenditure, based upon the cost standards, are disclosed, and that their internal and external causes are analyzed, and that responsibilities for these variances are fixed, and corrective measures are inaugurated and followed up.

The achievement of control, a constant objective of management, in one sense requires the carrying on of the capital and operating transactions of the business with a maximum of efficiency and a minimum of waste. To accomplish this degree of economy there must be established a constant process of comparison between the expenditures expected to be incurred for the planned efforts and accomplishments, and the expenditure made for the work actually done. In another sense, control means making the right business decisions at the right time. Business administration and management involves a continuous selection among alternatives, a selection between different plans, policies, products, methods, machines, and personnel. There is rarely only one plan or one way of doing something, or only a single choice of what is to be done. In this sense, control is achieved by making

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intelligent, rather than spur-of-the-moment, selection among alternatives. Control, in either sense of the word, is impossible without pertinent and adequate facts.

Accounting Data

Accounting is the chief fact collecting, recording, analyzing, and interpreting instrumentality of management. In a narrow sense, accounting seems to be concerned primarily with the money-value aspect of business activities and transactions. Financial or general accounting is largely concerned with this type of fact. In a broader sense, the facts with which accounting must be concerned include also the whole range of quantitative data associated with expenditure—the quantities of material purchased and used; the number of labor hours, machine hours, and of operations performed; the number of units of finished parts and final products completed and sold. Dollars of expenditure are almost without significance, in a cost sense, without knowing also the associated quantity data. A company may spend $1000 for the performance of a stated operation, but what does this mean without also knowing whether the operation was performed one, one thousand, or ten thousand times? Cost accounting particularly involves this process of dual measurement, the recording of the quantitative aspects of transactions, as well as, indeed often as a means of determining, their money values. In the widest sense, which includes all statistical data and analyses, accounting is concerned with all facts of whatever nature which seem to be of sufficient usefulness to management to justify collection, recording, and interpretation.

Definition of an Accounting System

An accounting system is the coordinated group of records and procedures by means of which the accountant collects, summarizes, analyzes, reports and interprets financial and other data about the operation and condition of a particular business enterprise. Inasmuch as there are many kinds of business enterprise, some engaged in the manufacture of products, and others in merchandising and providing a great variety of services, and because in each general line of business there are many individual entities, there are many different variations in accounting systems.

The word "system" is somewhat loosely used to indicate (1) the aggregate of records and procedures used by a particular business entity, the sense in which the word was used above; (2) the main divisions of this aggregate, such as the cost accounting system and the financial accounting system; and (3) lesser subdivisions of these main divisions, such as the material accounting system, the payroll system, the cash disbursement system, and others.

Objectives of the Accounting System

A full discussion of the objectives of the accounting system would require much the same subdivision just discussed in relation to the use of the word system. There are main objectives, and objectives for each of the subsidiary parts. In the broadest sense these objectives are identical with the most general objectives of management, the protection of the investment committed to the enterprise, and the realization of the maximum profit from the long-run viewpoint. Systems must be constructed, not to please the systematizer alone, but to serve the purposes of management, to provide management with the facts it must have, when needed, as was

pointed out in the early paragraphs of this chapter. More detailed objectives are discussed in later sections.

Purposes of this Chapter

In a sense this entire Handbook is a discussion of cost systems. Previous chapters of Section I have explained many aspects of and problems related to cost methods and procedures. Section II demonstrates the application of cost procedures to particular industries. The purposes of the current chapter are (1) to review and compress some aspects of cost systems already discussed, thus bringing them into sharper focus as interrelated parts of an integrated system; (2) to emphasize some aspects of cost procedures developed in earlier sections only in general terms; and (3) to explain not only the relationships of various parts of the accounting system to the whole, but also to explain the relationships of the various parts to associated procedures. In short, a main purpose of the chapter is to give perspective. The discussions are pointed particularly to manufacturing industries.

Preliminaries to Cost System Installation

Before a new cost system can be installed, or an old one substantially remodeled, certain antecedent requirements must have been met, and a competent systems man must have been selected.

Antecedent Requirements

A cost system cannot be expected to be effective and should not be installed until a plant is thoroughly systematized in other aspects of its organization and management. The more important preliminary essentials or antecedent requirements are listed below:

1. The organization structure should be well defined, with staff and operating lines of authority and responsibility clarified.
2. The plant layout and departmentalization must have been determined.
3. The products will have been carefully designed.
4. Material specifications will have been listed in detail.
5. Operations on each part and product will have been described, their sequence established, blue prints provided, and directions for performing these operations written out.
6. Material handling and material transportation equipment must be available.
7. A system of storerooms under responsible direction must be in operation, and stock ledger procedure and inventory control methods, if not already in use, must be introduced.
8. A plant ledger system, with detailed information about the nature, location, cost, and other facts about machinery and equipment and other plant property should be introduced.
9. Procedures for job analysis, time and motion study, methods engineering, and compilation of cost standards should be utilized.
10. Adequate employee relationships, employee training, and perhaps also incentive wage plans, should have been established.
11. Purchase records and routines must be effective.
12. Production planning, scheduling, and dispatching must have been initiated.
13. A tool specification and control system should be in operation.
14. Production counters and time recording instruments must be available.

Many of the matters listed above are obviously the subject of continuous management attention and improvement. The introduction of cost methods cannot await their full development. Perfection in these, as well as in costing, procedures will probably never be attained. They are nevertheless requirements anteceding the introduction of cost methods, in the sense that the more fully they have been perfected, the more useful and reliable the cost system will be.

Qualification of the Systems Man

The person who undertakes the installation or development of a cost system, whether he is already in the employ of the company or an outsider, should possess certain specific qualifications.

1. He should have a wide knowledge of accounting theory and extensive experience in accounting practice. This knowledge and experience should provide detailed information about the available means of doing accounting work, the manual and machine procedures that may be utilized.
2. He must have the capacity to appraise the accounting needs of the enterprise, and be able to exercise good judgment in differentiating between what are essential and important objectives, and what is unimportant or superfluous. The exercise of this discrimination requires an appreciation of the managerial problems of all phases and divisions of the business, and knowledge of what and how accounting methods may contribute to their solution or alleviation.
3. The systems man must have the ability to outline and describe the various procedures of the accounting system in full detail, and to coordinate these procedures into an integrated whole.
4. The systems man must be able to impress others by his sincerity and capacity, and be able to secure their cooperation.

Preliminary Steps

The systems man, having been designated, must take certain preliminary steps before he can start formulating his methods and procedures.

1. He must become thoroughly familiar with the organization plan and structure, and the responsibilities of each major and minor executive. This is particularly important because the cost and financial accounting procedures must be fitted to the organization. Establishment of accountability for expenditure and performance must always be among the most important objectives of the accounting methods.
2. The systems man must discover the desires and wishes of all responsible executives in respect to what they think the accounting system should accomplish, what they wish it to do for them. He must be prepared to persuade and to compromise, and also to realize that he will find many useful ideas in this process of adapting accounting techniques to the service of others.
3. He must become thoroughly familiar, if he is not already, with the production methods used in and the flow of work through all production departments, and the services rendered by all service departments, to whom rendered, and how these services may be measured. He must have a good knowledge of the materials used and the processes and operations necessary to their conversion.
4. He must know the product output, and with engineering and operating help be able to recognize those classes of items which possess substantial homogeneity of conversion cost and therefore may be costed as a group, and those other product items which must be costed individually. He must, in other words, define the products to be costed, as discussed in Chapter 4.

5. The systems man, before undertaking changes in an existing system, must become thoroughly informed about the system as it is already functioning—the forms, records and reports made out, the responsibilities for originating each of these, the entire procedure of which each is a part, and the usefulness of each.

6. The systems man must know the policies of the company, the objectives and general rules which have been formulated, whether written or not, for guidance in the conduct of its internal and external affairs and relationships.

Components of an Accounting System

An accounting system is composed of certain definite parts—the classification of accounts, the primary papers or original evidences of transactions, journals, ledgers, and reports. All of these components have been mentioned and discussed in earlier chapters of this section. The nature and functions of each are briefly reviewed at this point.

The Classification of Accounts

The account classification is the framework on which the accounting analysis is based. It includes the account number or code symbol, the account name, and often also a brief description of the purpose of the account, and the kind of item to be charged or credited thereto. Account titles should be clear and indicate the nature of the item to be recorded therein. The contents of a single account should be homogeneous. When necessary to assure uniformity of use or to avoid possible ambiguity or overlapping among accounts, the kind of item to be included in each account should be specified in detail.

Accounts are normally listed in the classification in the sequence in which they appear in the balance sheet, profit-and-loss, and factory cost statements. Main divisions of the classification include accounts for:

Assets
Liabilities
Reserves
Capital and Surplus
Revenue
Factory Costs
Selling Expense
Administrative Expense
Nonoperating Income and Expense

Each one of these divisions may include several subdivisions and many individual accounts. The subdivision proceeds from the general to the particular, as illustrated below for the asset section:

1. Main group—Assets
2. Sub-group—Fixed Assets
3. Objective group—Machinery
4. Functional group—Power Plant Machinery

For factory costs the classification might be arranged as follows:

1. Main group—Factory Costs
2. Sub-group—Overhead Expense

3. Objective group—Indirect Material Expense
4. Functional group—Department 10

In any event, the factory cost division should indicate the departmental and objective accounts required. The objective may precede, followed by the departmental subdivision, or the order may be reversed. It is of course desirable for some report purposes that the totals be known by object of expenditure (indirect materials, indirect labor, depreciation, supervision, and other items) as well as by departments. The selling expense section of the classification will likewise indicate the various sub-functional and territorial expense accounts required.

The account classification in the broadest sense includes all the accounts used in the general ledger, private ledger, factory ledger, and all other subsidiary ledgers other than those containing proper-name or personal accounts such as are found in the accounts receivable, accounts payable, investment, and stockholders ledgers. The classification will therefore provide a detailed list of material and supply accounts and plant asset accounts, each properly identified, arranged, and coded.

The account classification, in order to perform its function in the accounting system to best advantage must: (1) Be clear and unambiguous; (2) be adapted to the organizational structure of the business so as to aid in fixing responsibility and in measuring accountability of the various departmental, divisional, functional, and general executives; (3) be flexible so as to be capable of adjustment, correction, and expansion; and (4) provide the information needed for various company, industry, tax and other governmental reports.

The classification of accounts will normally be a portion of an accounting manual which will also describe the other components of the system, and the detailed procedures for their use.

The classification of accounts is also discussed in Chapters 11 and 16 of Section I.

Original Evidences of Transactions

Original evidences of transactions are the forms used to record the nature of and data about individual transactions at the time of their occurrence. Examples of these primary papers are: Purchase orders and invoices, material received reports, material requisitions, labor time tickets, in and out clock records, spoiled work reports, output records, production orders, shipping orders, and sales invoices. The accounting system must provide adequate primary papers evidencing the occurrence of all internal and external transactions. Their nature, form, content and use must be specified and described in detail. They are a most important component of the system so far as adequacy and accuracy of information is concerned. If this part of the accounting system is properly devised, and its operation protected, subsequent summarizations and analyses, whether made by hand or machine, can be correct and complete. If, however, the data on the primary papers are inaccurate or incomplete, no subsequent effort can overcome this deficiency.

The importance of primary papers arises from the fact that they are the means of:

1. Making a record of transactions at the time of their occurrence.
2. Preserving a record of transactions.
3. Requiring that repetitive transactions be stated consistently in a given manner.
4. Systematically analyzing transactions.

5. Stating the financial effect of transactions in accordance with the classification of accounts.
6. Fixing the responsibility for transactions and accountability for the values involved.
7. Providing subsidiary ledger posting media for many transactions.
8. Providing amounts for direct entry into journals, or into summaries as a step preliminary to journalization.

In view of the importance of primary papers, the designer of an accounting system must give careful attention to:

1. The contents, size, color, and arrangement of each form.
2. The prevention of the unauthorized use of all forms, including in some cases provision of protection for blank copies and unused supplies.
3. The designation of responsibility for their preparation and for approval.
4. The number of copies to be prepared.
5. The specification of the flow of each copy of a primary paper from the time of its preparation and approval through its immediate use, disposition, and preservation, until perhaps years later its destruction is authorized.
6. The description of use to be made of the data shown at each stage of its use as a medium for posting subsidiary ledgers, and as a basis for preparing summaries and journal entries.

Primary papers have been illustrated and discussed in Chapters 12, 13, and 15 of Section I. Their nature and function are still further explained in connection with the discussion of important accounting procedures in later subdivisions of this chapter. Numerous examples of their use are presented in Section II.

Journals and the Journal Function

The journal originally was simply a straight chronological record of transactions. There was no summarization and no classification of transactions in that each element of each entry had to be posted separately. Modern journal procedures have greatly improved upon earlier practice by subdividing the journal into several or many parts, and by introducing columnization where desirable into each part. As a result journals are now important means of summarizing and classifying a great volume of like transactions of frequent reoccurrence. Subdivision, the creation of special journals, permits the summarization in one place of like transactions which have an identical effect upon certain general accounts. Columnization makes possible the inclusion in a given special journal of like transactions even when all of them do not have an identical effect in all respects so long as there is some common element.

A special journal is a formal accounting record in which a like kind of transaction (sales, purchases, vouchers, material requisitions) are entered in chronological order. The general journal is a place where all transactions not recorded in special journals are entered. The transactions so entered may be single transactions, for example, one voucher or one sales invoice. More frequently now, when the volume of like transactions for many companies is large, transactions are grouped by bringing together the primary papers in batches for the hour, the day, the week, or the month. These batches are summarized and the totals only entered in the journal record, each entry being identified as related to the group of primary papers which supports it. The journal record in this case is two steps removed from the original

evidences of transactions, a more or less formally prepared summary having intervened.

In addition to these tendencies to (1) subdivide the journal, (2) columnarize the journal, and (3) enter groups instead of individual transactions, two more modifications may be observed, particularly with the use of bookkeeping and tabulating machines. These further developments are:

1. The simultaneous preparation of several records relating to the transaction, including the making of the journal record for it. This practice has very wide acceptance and is believed often to save time, to provide a better record and to assure greater accuracy.

2. The elimination of the journal as a formal book record. The journal functions of classification and summarization cannot of course be eliminated. They can, however, be performed in other ways. The data about transactions having been transcribed to tabulating cards, for example, these cards can be sorted for any period into groups of like transaction, and the data which they individually show may be printed and totaled so as to constitute a journal record, or without individual printing they may be totaled so as to provide monthly figures for record on a journal voucher. Much of the work formerly involved in the manual entry of transactions into journals may thus be accomplished mechanically.

Further descriptions of the journal function and of journal methods are found in Chapter 15.

Ledgers and the Ledger Structure

The account is the final medium in an accounting system for combining data from the several journals, for totaling the opposing tendencies of debit and credit, and arriving at the net balance, so far as these matters relate to each of the separate financial aspects of the business recognized by the classification of accounts. Ledgers are composed of individual accounts, coded, titled, and used as provided in the classification. The ledger structure is composed of the several ledgers used in a single accounting system.

The ledger function may be performed in many ways, and ledger accounts take many forms. Some ledgers are kept manually; some are posted by bookkeeping and accounting machines; others are presented in the form of summaries prepared by tabulating machines. Whatever the form of the ledger or the manner of its preparation, the record presented is a greatly condensed and classified summary. At the top level of the formal accounting system, the control accounts of the general ledger, the financial effects of thousands of transactions on financial position and operating results are reduced to a comparatively few figures.

Ledgers and the ledger structure are described at some length in Chapter 16 of Section I.

Reports

Reports are in many ways the most important component, from a management standpoint, of the accounting system. They are its end product, the means by which the accountant conveys cost and other information to the various departmental, functional, and general executives. Through them the accountant aids management in discovering and interpreting significant trends and conditions of the business at all levels. They are important instruments for directing management attention and effort toward the correction of operational weaknesses.

Reports have been discussed and illustrated in earlier chapters of this section, particularly Chapters 4, 10, 14, and 18. Their nature and function are further described in later subdivisions of this chapter and in Section II.

Accounting Procedures

The Nature of Accounting Procedures

The components of an accounting system just described—the primary papers, journals, ledgers, classification of accounts, and reports—are the framework, the anatomy, of the system. Procedures are the circulation, the physiology, the functioning of the system, the interaction of the components at work. Procedures must be set up separately for each activity that requires an accounting record, such as the purchase of material, the issuance of material, the completion of production orders, shipment, and sales. They may be broadly divided into two groups; cost accounting procedures and financial accounting procedures. In a complete system both groups must be fully integrated and there is no point in attempting to draw a hard and fast line between them. For the purpose of the current discussion, cost accounting procedures include those related to:

1. Material purchase, or acquisition
2. Material storage
3. Material issuance
4. Physical inventory
5. Payroll
6. Labor cost distribution
7. Salary payroll and distribution
8. Vouchers payable
9. Plant property accounts and depreciation
10. Patents and other intangible property accounts and amortization
11. Property insurance
12. Property taxes
13. Overhead cost accumulation
14. Apportionment of service department overhead cost
15. Allocation of overhead cost to products
16. Costing output
17. Finished inventories
18. Costing shipments
19. Distribution costs
20. Closing and reporting schedules

Financial accounting procedures include, for the purpose of the current discussion, those related to:

1. The granting of credit
2. Sales
3. Accounts receivable
4. Collections
5. Cash receipts
6. Notes receivable
7. Investment securities and associated income
8. Notes payable
9. Bonds

10 .Capital stock
11. Dividends
12. Petty cash
13. Cash disbursements

The procedures classified above as cost accounting procedures are further described in later subdivisions of this chapter or reference is made to other chapters of Section I where discussion is to be found. For coverage of financial accounting procedures, as classified above, reference is made to Section I of *Handbook of Accounting Methods*.[1]

The Elements of a Procedure

A full description of any accounting procedure requires:

1. A statement of the objectives of the procedure.
2. A description and illustration of the forms or primary papers used:
   - The name of each form
   - Its purpose.
   - Its contents, including accounts affected.
   - Who originates it.
   - Who approves it.
   - The number of copies required.
   - To whom each copy is sent, when, and for what purpose.
3. The use to be made of each copy received by anyone within the organization:
   - What information each recipient is required to add.
   - How pricing is to be done and extensions are to be made, by the maker or recipient.
   - What subsidiary records are to be posted from the information on the form, and how and when.
   - How the forms are to be accumulated, grouped, and summarized for journal entry.
   - How and where the forms are to be filed, and how they are to be marked and identified.
   - How long they must be preserved.
4. What journal records are required; when, how, and by whom the entry is to be made.
5. What mechanical equipment is to be used in making, extending, totaling, recapitulating, and journalizing.
6. What internal checks are provided against errors of commission or omission.
7. What internal auditing procedures are to be followed.
8. What reports are required: By whom, when, for whom, covering what matters.
9. A time schedule for the performance of each step if necessary.
10. The interaction of the procedure with associated procedures.

Procedures Relate to Concrete Situations

It is impossible to describe a procedure in detail other than in relation to a concrete situation, the requirements of a particular company. Then the background circumstances are tangible, and the accounting methods can be adapted to the particular needs, personnel, and facilities involved. The following discussion of cost accounting procedures is therefore limited to general phases of these procedures,

[1] J. K. Lasser, Editor, D. Van Nostrand Company, Inc., 1943.

their "what-has-to-be-done" aspects, without the references possible in a specific installation to the "by-whom," "when," and "how" aspects. These what-has-to-be-done aspects of procedures are not changed essentially by differences in the by-whom and when aspects, nor even by substantial modifications of how the procedures are performed. On the latter point, it is usually said that a major difference exists between procedures that are organized for manual performance and those that are carried out by machine processes. Obvious differences do exist between hand and machine methods of performing office routines and accounting procedures, differences in the arrangement of the forms required and in the sequence, speed, and economy with which the necessary operations are accomplished. Under machine methods, steps and phases that necessarily must be done separately by manual methods may be combined and done simultaneously with the aid of equipment which types, multiplies, repeats, and accumulates several totals. The primary paper or original evidence of the transactions, the journal record, and the ledger record may all be made at once with assurance that they are identical, and also with totals and distributions. These facts, however, are not changes in what has to be done, but rather in when or how the several steps of a procedure are performed.

The Art of Designing Systems

There are many variations in the ways of performing a given cost or financial accounting procedure, and in the adaptations of procedures to businesses differing in size, in products and productive processes, and in needs for accounting information. The art of designing systems resides in:

1. The skillfulness with which the systems man appraises the needs of the company for cost and other accounting data; how well he evaluates the job that should be done in terms of the end products of the system.
2. The mastery with which he understands the means available to meet the needs as appraised, his knowledge of the variety of methods, machines, and procedures from which he can choose.
3. The facility with which he adjusts the means to the needs, so as to achieve the goal of fulfilling the needs in the most economical way.
4. His proficiency in smoothing the way of change, overcoming prejudice and opposition, securing cooperation in operating the procedures as planned.
5. His capacity to educate others in an appreciation of the benefits to be had from a full utilization of the system.

Procedures Relating to Materials and Supplies

In the broadest sense materials may be regarded as including all tangible items held for use or sale—direct or raw materials, supplies, goods in process, finished parts, and finished products. Many of the procedures described below apply without great modification to most of these classes. The present discussion is concerned principally with production materials used or consumed in factory operations, particularly:

1. Direct materials, including parts purchased ready for use, which enter into the product and are eventually shipped to customers as a tangible part of the product.
2. Indirect or expense materials, which facilitate production but are wholly consumed within the factory.

Production materials may be handled in two ways:

1. Stocked or stored—bought in advance of use and held to be issued as required. They are inventoried in the sense of this word which means carrying on hand, as distinct from the act of counting, listing, pricing, and summarizing materials on hand at a given moment. The inventory acts as a bank of materials, a reservoir between the sources of supply and the production facilities and requirements. A most important objective of material control and accounting is to reduce this bank to the minimum consistent with economical operations, thereby shifting in part at least the responsibility for the inventory to the supplier. The determination of the minimum, an important analytical task, is discussed in Chapter 6 of Section I.

2. Non-stocked—materials sent directly to the factory without preliminary storage. If the user were wholly successful in transferring the inventory function to the supplier, all materials could be handled in this way. This type of production material will presumably be charged to proper in-process and overhead expense accounts from the distribution of vouchers, and is involved in the procedures here described only in part. The planning, requisitioning, ordering, and receiving phases of material procedures are of course applicable to these as well as to stocked materials.

Objectives of Material Procedures

To be an effective tool of management material accounting must aid in:

1. Determining the need for materials, item by item, so that the factory will have the right items on hand in the desired quantity at the proper time at a reasonable cost. Material procedures contribute toward this goal by participating in planning future material requirements through budgeting; by supplying constant, up-to-date information about quantities on order, on reserve, on hand, and available; and in other ways.

2. Establishing the correct liability to creditors for material acquisition by providing a full record of purchase requisition, order, receipt, inspection, rejection and return of incorrect or defective items.

3. Protecting the investment of the company in materials against loss, theft, and misuse by establishing accountability, holding specified individuals responsible for proper care and disposition.

4. Providing a record of use, and the accounts to be charged for materials consumed.

5. Economic utilization of materials through the comparison of actual quantities used with quantities allowed by the standards, and otherwise aiding in the reduction of deterioration, obsolescence, spoilage, and waste.

6. Furnishing total inventory values for inclusion in interim balance sheet and operating statements without the necessity of taking physical inventories.

These objectives are best accomplished by procedures of continuous accounting from the time the need for a material item is first recognized until it is finally disposed of.

Material Procedures in Broad Outline

This continuous accounting for material transactions requires:

1. Original evidences of transactions which record every step from acquisition to disposition. These primary papers must:
   - Preserve a written, verified record of what happened at each stage, giving date, description of item, quantities, cost, and accounts affected.
   - Be approved by some one having authority.
   - Be routed to departments interested in the transactions, including appropriate divisions of the accounting department.

2. Subsidiary perpetual inventory accounts (one for each material item, properly grouped by storeroom and classified by kind of material), which show quantities (and perhaps also unit and total costs) ordered, received, reserved, issued, and on hand. This record should be adjusted to the requirements of each installation.

3. Subsidiary job, process, or departmental accounts which properly classify and record charges for materials issued.

4. Summarization of transactions, made through manually prepared journals or by use of bookkeeping or tabulating machines, to provide totals for posting to accounts. These summaries will always furnish the totals used to post the control accounts. They may also provide subtotals for posting the subsidiary accounts described in (2) and (3). These summaries stand between the transactions shown by the primary papers, and the control and subsidiary ledger accounts.

5. Control accounts that provide over all summaries of material transactions. These control accounts will differentiate between direct materials and supplies, with perhaps further divisions of each by locations or classes of items.

The material procedures involving primary papers, subsidiary accounts, summarization and journalization, and control accounts are discussed below in four parts: Acquisition, storage, issuance and use, and inventory verification.

Material Acquisition

Material acquisition includes all steps or phases of purchasing and receiving from the recognition of the need to acquire an item of material until it is placed in the storeroom, liability for its purchase is recognized, and its cost is charged to proper control and subsidiary accounts. Detailed steps or phases of this procedure and forms used are described below.

1. Preliminary Steps

The preliminary steps cover a wide variety of activities among which must be included:

a. Setting up detailed specifications and identification for materials.
b. Planning material requirements through budgeting sales, production, and the need for all major material items.
c. Determination of economic purchase lot sizes.
d. Establishment of stock limits.
e. Securing sources of supply, data about prices, shipping routes, time required to secure delivery.
f. Contracting for requirements, if practiced.

2. Initiating the Purchase

The purchase requisition is a common method of indicating the need for an item of material and hence starting the immediate sequence of events leading to acquisition. It requests the purchasing department to buy specified materials for designated uses or for stock. A purchase requisition may originate with the stores department or stores clerk, the materials control department, the production planning department, department foremen, or other authorized sources according to circumstances and plans. The requisition will contain the following information:

Description of the material
Code symbol
Date of the requisition

Quantity required
Point at which delivery is to be made
Account to be charged
Date when goods should be available
Requisition number
The source of the requisition

The requisition may be made up in triplicate. The original and duplicate may be forwarded to the purchasing department and the triplicate retained by the originating department. The purchasing department may retain the original and send the duplicate back to the originating department as an acknowledgment, after information as to the purchase order date and number and the supplier's name have been inserted.

3. Placing the Purchase Order

Receipt of a requisition by the purchasing department will normally result in these steps:

a. Consultation of source and price files.
b. Mailing a price inquiry, or request for quotation and delivery information to several sources, if the company's requirements are not already covered by contracts.
c. Selection of the supplier.
d. Placing the purchase order.

Several copies of the purchase order are usually made. One or more copies are sent to the supplier; one copy may be sent to the receiving department; one copy is sent to the accounting department or retained in the purchasing department for its use; one or more copies are filed for purchasing department use. The purchase order, in addition to identifying data, description of material, quantity ordered, and price, will contain shipping and marking instructions, invoice requirements, and probably a statement of general terms and conditions. Possible accounting uses of the purchase order are: Use as source of entry of "ordered" information in stock ledger sheets; and support of voucher payable as one kind of evidence that payment is proper.

4. Receiving, Inspection, Rejection

When material arrives at the plant a separate receiving report is prepared by the receiving department, which provides the following information:

Identity of the authority to purchase.
Identity of the material.
Results of inspection of quantity and quality.
Quantity received, accepted, and rejected.
Physical disposition of the accepted and rejected quantities.

The receiving report may be prepared in triplicate, one copy being retained by the receiving department, and two being sent to the purchasing department. The latter will note receipt on copy of purchase order and add data to the receiving report about unit and total cost, and the accounts to be charged. One copy may then be sent to the stores or other department receiving the material and the other copy to the stores ledger clerk who uses it as the means of posting the proper stock ledger sheet and then returns it to the purchasing agent, who combines it with the seller's

invoice and a copy of the purchase order as a means of supporting the voucher authorizing payment to the supplier.

5. The Purchase Invoice

The purchase department will check the quantities billed as shown by the purchase invoice with the purchase order and the receiving report; verify the price, extensions and terms; approve the invoice for the corrected amount, notify the supplier of any corrections, issuing required debit and credit memoranda; and forward the approved invoice with supporting documents to the vouchers payable section of the general accounting department.

6. The Voucher and Journal Records

Upon receipt of the approved invoice and supporting papers, and after making its own verification, the vouchers payable section will prepare the voucher and voucher distribution which upon approval will authorize payment and entry into the accounts, as described in Chapter 15 of Section I.

7. Posting the Control Accounts

The several control accounts affected by material and supply purchases may be posted from the totals of the control columns of the voucher register, or from analytical summaries prepared manually or mechanically from the voucher distributions.

The procedure for handling material acquisition outlined in skeleton form above is often modified in several ways to satisfy the organizational requirements and preferences of particular companies. Also in describing the material acquisition routine of a particular company in its accounting manual, many details are necessarily added to the above description in order to clarify the nature and contents of each of the required forms, the number of copies of each to be made, the exact routes that each copy of each form is to follow, and who is to be responsible for each step in the total routine. Details are necessarily added to describe methods for some related phases of purchasing not presented above, such as procedures for handling:

Cash discounts, and methods to be followed to take advantage of discounts when payment must be made before the receipt of material.
Incoming transportation costs and their inclusion in or exclusion from unit cost.
The joint costs of lots of material that must be sorted and graded.
The accumulation and distribution of purchasing, storing, and handling costs.
The issuance of credit and debit memoranda relating to purchases.
The return of defective and rejected materials to suppliers.
The setting up of purchase price standards and their use.
Materials charged directly to in-process, overhead expense, and construction order accounts.

Other activities closely related to material acquisition are:

1. Budgeting material requirements.
2. Material control and purchase follow-up.
3. Production control.
4. Material storage and handling.
5. Vouchering accounts payable.

Forms related to the material acquisition procedures are:

Material budget forms.
Purchase requisition.
Request for quotation.
Purchase department records of previous purchases, price quotations, commodity index of suppliers, engineering specification records, suppliers catalogues, standard price lists.
Materials classification lists and code numbers.
Purchase order.
Purchase order register.
Purchase order follow-up.
Suppliers order acknowledgment.
Contract forms.
Notification to receiving department of expected shipment.
Inspection report.
Receiving report.
Return shipment notice.
Purchase invoice.
Invoice register.
Debit and credit memoranda.
Freight bill.
Invoice approval stamp.
Accounts payable voucher and voucher distribution.
Voucher register.
Perpetual stock records.

Material Storage

Acquisition procedures have physically placed the materials purchased in the storeroom and have accounted for the costs of materials purchased through the voucher register and accounts payable into the appropriate control and subsidiary ledger accounts.

Material storage, as a physical problem which cannot be dissociated from the problems of accounting for and controlling materials, requires:

1. Provision of an adequate number of storerooms conveniently placed for easy access and delivery of materials to work places.
2. Appropriate arrangement within the storeroom, planning the space allowance for each item; the advantageous placing of bulky articles and those frequently needed, supplying suitable containers, providing sufficient working space and light.
3. Suitable equipment for handling, counting, weighing, and measuring.
4. Proper marking and identification of each item or its container.
5. Provision of suitable personnel, a general storekeeper and local subordinates at each storeroom, responsible usually to the factory manager, who are charged with the protection and safeguarding of materials.

Two records are often maintained of materials on hand:

1. The storekeeper's record showing quantities only, in the form of bin tags; or if the storekeeper is charged with responsibility for maintaining the stock of standard items and requisitioning the purchasing agent for replacements, the storekeeper's record may be a loose leaf or card ledger showing quantities requisitioned, ordered, received, issued, and on hand.

2. The perpetual stock ledger, identical with or similar to the form illustrated in Section I, Chapter 12. This record will normally include unit cost and total cost figures as well as quantity figures, except that, when inventories are valued at standard cost, quantities only need be shown.

The only accounting required for materials while in storage, as distinguished from the receipt and issuance of materials, is for the reservation of materials against future orders. This transaction, if recorded at all, requires an entry on the perpetual stock ledger sheet only, with no journalization or change in control account balance. The new balance on hand is calculated after each receipt and issuance transaction.

Material Issuance and Use

"Material issuance and use" describes the physical removal of materials from the storeroom and their absorption into the productive processes as direct or indirect items dedicated to specified purposes; and the corresponding transfer of costs from inventory control and subsidiary accounts to in-process and overhead control and related subsidiary accounts. The functions of the records of issuance and use are twofold, to indicate:

1. The kind, quantity, unit cost, total cost, and authority for issuance, of all materials taken out of stock.
2. The use made of these materials in the productive processes, and the accounts to be charged with their cost.

The fulfillment of these functions requires forms and procedures that will:

1. Record the withdrawal of each item of material from inventory, properly identified as to nature and use, and costed.
2. Provide the means for posting subsidiary records:
   a. The credit to the individual stores account.
   b. The debit to the account representing use.
3. Furnish a summary and totals for entry into appropriate control accounts:
   a. The debit to the control representing use.
   b. The credit to the inventory control account.

The accounting records employed in these procedures are:

1. Original evidences of issuance and use of materials in the form of individual requisitions, bills of material, or reports of materials used.
2. Perpetual stock ledger accounts, particularly the issued section of this record; illustrated in Chapter 12.
3. Subsidiary records, such as order cost sheets, departmental material used, and overhead expense accounts.
4. Summarizing records or journals that recapitulate the cost of materials used for a specified period for entry to control accounts, and sometimes also for entry to subsidiary accounts. The control accounts are normally posted from monthly totals. The subsidiary accounts may be posted from individual requisitions or from daily, weekly, or monthly summaries.
5. Control accounts, to which the records referred to in (2) and (3) are subsidiary.

There are two main types of original record of the issuance and use of material. The first type is represented by the individual requisition and by the bill of material.

This type is used when the materials must be formally withdrawn from stores before they are available for use. The individual requisition or the bill of material serves as:

1. Authority to issue the materials, the permit for their withdrawal from stores.
2. The storekeeper's receipt for the materials taken.
3. The original accounting record of the withdrawal and use of the materials.

The second type of record is represented by reports of material used, prepared, unlike the requisition, simultaneous with or subsequent to use. This form of original record is employed for kinds of items which, because of their nature or use, are not kept in supervised storerooms. Many bulk materials, such as coal for the boiler plant, are of this nature. The proper employees have blanket authority to use the required quantities of these materials. The original record need not be an authority to issue made in advance of securing the materials; it is merely a record of an accomplished fact.

The form and use of the individual requisition differ among cost installations. It will normally contain as a minimum information identifying the

Requisition itself, its number and date.
Material issued, its code number and description, quantity, unit cost, and total cost.
Accounts to be charged and credited, both control and subsidiary.
Point of delivery.
Persons requesting and authorizing delivery.
Person receiving the material.

Procedures for using the requisition naturally differ among companies. Usually several copies are made. Not all the information required appears on all copies, nor is it all inserted at the time of issuance. Several copies usually pass from the originator to the storekeeper who inserts the quantity issued, posts his bin tag or other local record, and retains one copy as a receipt for the materials. One copy may follow the material as a move order to its destination. Another copy is sent to to the stores ledger clerk who records the quantity actually issued in the issued section of the stock ledger sheet, inserts the unit cost (unless his records are in quantities only), calculates the total cost of the requisition, recalculates and inserts the new balance on hand on the stock sheet, and sends the completed copy of the requisition to the cost department. The cost department uses the completed requisition as a basis for direct posting, or indirect posting through summaries, to all debit subsidiary accounts representing use, and to all debit and credit control accounts. There are many variations in the above manual type of procedure. Procedures using machine facilities of various kinds add other variations. But as pointed out earlier, whether manual or machine methods are used, the same essential steps must be taken, although steps that are separate under manual methods, may be combined or performed sequentially without clerical effort with the aid of machines.

The bill of material is a form of multiple requisition. It is frequently used in assembly type industries, originating often in the production control department. Printed forms are prepared in advance showing the quantities of each part required in the manufacture of one subassembly. When a production order is initiated a bill of materials is extended for the number of subassemblies required, and becomes the stores requisition for that production order.

The report of material used is not a request for issuance, but rather a statement of fact as to the quantity consumed in a given period. It usually covers bulk materials used in processing. It may be prepared in a variety of ways dependent upon the operating circumstances, such as:

1. By the foreman of the department, or the departmental clerk, based upon his own count or upon a preliminary record of weight or count kept by individual workmen, or upon the record of automatic scales or other measuring devices.
2. By the production control department on the basis of records of output.

The period covered by the report is usually a day. A longer period introduces a lag in the quantity on hand record shown in the stock ledger, and increases the risk of inaccuracy in the reports. The form of the report must be adapted to the circumstances. It may cover a single material item only. If several materials are mixed to form a batch, the report will specify the quantities of each kind of material used for each batch.

Under historical cost procedures, and under standard cost procedure if the material and supply inventories are maintained at actual cost, a major problem involves the pricing of issuances—the selection of type of average cost, the first-in first-out or the last-in first-out method for allocating cost to material used. This problem is discussed in Chapter 4 of Section I. This problem of pricing is eliminated under those standard cost procedures which remove price variances at the time of purchase. In this case also the perpetual stock ledgers may be maintained in terms of quantities only. Also, under standard cost procedures, the allowed quantities of materials may first be issued on regular requisitions. Extra quantities required beyond the standards are issued on special requisitions, distinguishable by form or color. This special requisitioning of excess quantities calls immediate attention to material use variance and facilitates its analysis and control.

Other aspects of material use accounting not described above relate to:

1. Establishment of material usage standards, and their review and revision.
2. Rejected, defective, and reconditioned materials.
3. Scrap.
4. Materials returned to the storeroom for credit.
5. Reports of actual quantities of materials used in comparison with allowed quantities, and identification of responsibility in terms of causes, operations, products, and workmen.
6. The many ways of summarizing the cost of materials used for posting to subsidiary ledger and control accounts.
7. Methods of disclosing and disposing of damaged and obsolete stock.

Forms used in connection with material issuance and use include

Requisitions—individual form, bill of material form, excess usage form
Perpetual stock ledger
Internal transportation and move orders
Material return credit ticket
Standard allowance record
Requisition journals or summaries
Bin tag
Scrap report
Recovered material report

Order cost sheets
Subsidiary expense accounts
Controlling accounts

Material accounting forms, control, and cost variances are discussed in Chapters 6, 8 and 12 of Section I.

Inventory Procedures

Physical inventories are essential, even when perpetual stock ledgers are carefully maintained, for the purpose of disclosuring errors in the book record and the existence of obsolete and defective materials. Instructions and procedures must be drawn up which will:

1. Determine the nature and the timing of the physical check, whether a continuous count is to be maintained, or a complete physical inventory is required at the end of the year.
2. Provide preparatory instructions to all departments and inventory crews, especially for the year end inventory.
3. Provide forms for the inventory process:
   - Count tags
   - Recapitulation sheets
   - Discrepancy reports
   - Price records
4. Establish methods for:
   a. Identifying, counting, checking and recording which will prevent omission and duplication
   b. Disclosing discontinued and defective items
   c. Pricing, extending, and summarizing
   d. Revaluing the inventory in view of market changes and other causes of value decline.
   e. Checking with and adjusting the perpetual stock records
   f. Journalizing the inventory discrepancies for quantity differences and valuation changes
5. Emphasize special inventory situations such as for:
   - Stock on hand, not owned
   - Stock owned, not on hand
   - Receipts during stock-taking
   - Issuances during stock-taking
   - Materials in transit
   - Excess issuances found on hand in factory departments, not being used, and not yet returned to stock

Special Procedures

The above outline of material accounting relates particularly to manual methods in what may be called normal situations. Some less usual situations are briefly noted below:

1. Materials requiring sorting and grading. This is a case of joint cost appearing at purchase. The joint purchase cost, plus also the cost of sorting and grading, may be allocated to the several grades in proportion to their relative market values.
2. Combinations of minor materials. Economy in the operation of continuous inventory records may sometimes be effected by combining several individual items of

material into a single group and accounting for this combination as if it were a single item; examples are bolt, rivets, and other items, when they are minor elements of cost.

3. Direct materials difficult to measure. Some manufacturers find it difficult, or not worth while, to measure accurately the quantities of certain materials used—difficult to know how much should be issued for a particular purpose, or how much was used on a given production order, or for a particular product. This problem may be met by arbitrary allocation to product costs, or by charging such items to overhead.

4. Loss or gain in weight due to moisture. This situation may require the adoption of standards for moisture content, and the reduction of all actual weights to equivalent weights in terms of the standards.

5. Materials not passing through the storeroom. The question arises here whether such materials should be passed through the stores ledger anyway, or distributed directly from the voucher.

6. Uncontrolled materials. This phrase refers to materials which it is thought desirable at purchase to charge to an inventory asset account but for which no continuous stock ledger is provided, and the materials themselves are not under the care of a storekeeper. Special provision must be made for estimating the use of such materials and checking the quantity on hand, or use may be calculated solely on the basis of periodic physical inventory.

7. Abolition of the raw material inventory. In rather rare instances in normal times the manufacturer may be able to shift the task of carrying the inventory entirely to the supplier by carefully planning his needs for material and correlating their arrival at the factory exactly with production requirements. Direct materials on arrival are immediately placed in production, or at least are charged immediately to in-process accounts. Perhaps also the production schedule can be planned so exactly in accordance with sales deliveries that the finished inventory is also abolished and products are carried in process until shipped.

Internal Check

Internal check in the material procedures requires a complete division of responsibility for purchasing, receiving, storing, stores record keeping, vouchering, and authorizing disbursements of company funds.

Punched-Card Method

Whenever the volume of material acquisition and issuance transactions is large, the use of some form of mechanical equipment is desirable as a means both of speeding up the work and of reducing the cost of material accounting. The punched-card method is often used in these circumstances. In order to illustrate some aspects of such an installation, a report made by H. P. Gould Company of Chicago describing the application of punched-card procedures at the Illinois Division, Bendix Aviation Corporation, (Gould Report Number 4411) is quoted in part below. This installation is described in the words of Mr. E. H. Grumich, Production Manager:

"Faced with the need of more speedy, accurate and detailed controls than they could obtain by the manual method, the executives in charge of production in the Illinois Division of Bendix Aviation Corporation adopted the Remington Rand Punched-Card Method in August, 1943.

Year's Experience with Punched-Card Method Justifies Expansion

"The Remington Rand Tabulating Equipment includes a Type 3100 Alphabetical Tabulator, a Multi-Control Reproducing Punch, 4 Automatic Punches, a Sorter and an Inter-filer.

"During the first year's operation, 9 daily and monthly reports have been tabulated, most of them concerned with production and material accounting and control. . . .

No.	*Punched-Card Report*	*Clerical Units of Labor, Tabulating Rental and Cards*
1	Monthly Parts Requirements	4
2	Daily Production Analysis	5
3	Daily Purchase Commitments	¼
4	Monthly Purchase Commitments Summary	¼
5	Periodic Scrap Report (for each 2 days)	1½
6	Monthly Scrap Report (when called for)	
7	Monthly Manufacturing Schedule	¼
8	Daily Material Distribution	3½
9	Monthly Material Distribution Analysis	¼
	Total	15 clerical units

Punched-Card Schedule Breakdown Superior to One Manually Prepared

"1. *The monthly parts requirements report* is compiled from a schedule furnished us by our main office in South Bend. The production manager of the Illinois Division harmonizes our own factory production schedule with the over-all schedule, and breaks down into their component parts the 21 models of equipment we are currently producing. Tests which we have made of manually produced schedule breakdowns as compared with punched-card reports clearly proved the greater accuracy of our present method.

Report Covers 3200 Items

"This report covers some 60 pages and about 3200 items. The Multi-Control Reproducing Punch duplicates a set of cards from the master cards, showing the part number and the quantity necessary to be produced or procured for a given number of units. Complete data include the part number, description, status and quantity, as well as the quantities involved for each model that is on order. . . .

"On the continuous forms in the tabulator, 4 copies of this report are produced. The first copy goes to the production manager; the second to his assistant; the third to the material control department; the fourth remains in the tabulating department file.

Punched-Card Report Gives Closer Control of Operations

"2. The *daily production analysis* shows through what stages every part has been processed. In our complex business, this is important because our piece-parts are produced in short cycle operations. A part may proceed through 8 or 10 operations in 24 hours. The analysis is furnished the first thing in the morning, primarily to the daily production analyst, who advises the production manager what items require his attention.

"The report shows, by part number in numerical sequence, the department number, operation number, the scheduled quantities. Under the heading of 'Production,' columns follow for the day production, night production, total for the day and night shifts, and total produced to date for the month. Under the heading of 'Rejects,' a column is provided for daily rejects and accumulative rejects for the month. The last column covers balance to produce, showing the net balance necessary to meet the factory's scheduled quantity for the current month.

"With this information before him every day, the production analyst can tell just where the plant is critically short of production on any part. He can watch the rejects and can compare what must be produced for the rest of the month with the available days remaining.

All Four Copies Put to Constructive Use

"This report covers 60 pages of the full 100-column width of the Model 3100 Alphabetical Tabulator, with 54 lines to the page.

"The first copy goes to the production analyst as described. The second copy goes to the factory material assignment department to assist in keeping material lined up ahead to make the number of parts called for on the schedule. Promptly delivered daily production reports have reduced the number of critical shortages. The third copy goes to the inspection department, where a graph is prepared to show a comparison of rejects against production. The fourth copy goes to the tabulating file.

Report Provides Accurate Control of Location of Parts in Process

"These copies furnish every morning a daily control of production. The day shift can be compared to the night shift. Information as to what stage every part has reached enables us to spot a part in the factory very quickly. We may know that we have withdrawn a certain amount of material from stores to process a given part. Suppose the assembly line needs a part very badly, and no one knows off-hand just where that part is at the time, without starting with the first processing department and going all the way through the assembly line. With these reports, all that is necessary is to refer to the daily production analysis, locate the part in its numerical order, and learn what department last processed the part, and at what operation. This gives a remarkable and very useful control of the location of every part in process. . . .

Purchases and Inventories Controlled through Daily Tabulations

"3. A *daily purchase commitment report* is tabulated every day for the accounting department from punched cards made from copies of the purchase orders. This is a daily record of what is being committed in dollars and cents. It furnishes a control against overbuying of any item and against any department's securing approval of its purchase requisitions at too great speed, or in too great quantities. Equally important, it insures that commitments are being made with sufficient speed and volume to permit us to produce the parts required for the month.

"When contract terminations are being negotiated, the accuracy and speed of our material inventory cost figures are of prime importance. Since, under government regulation, when a contract is cancelled an over-extended inventory is a liability subject to a fine, a nice balance to secure sufficient but not too high an inventory is extremely important.

"The average number of purchase orders coming through daily is about 100. This report is completed within 1 hour after the tabulating department receives the purchase order copies.

Accounting Department Relieved of Difficult Operation

"4. *A monthly summary of purchase commitments* is provided the accounting department as a basis for its postings to the ledgers. Accounts are analyzed by general ledger accounts, the accounts credited, expense accounts, factory orders, tool projects, and D.P.C. This shows the accountants the departments and accounts that are being charged and credited.

"Our accountants have devised a cross reference system between the departments and accounts charged and the account sequence. This was formerly a manual operation, and a difficult one. . . .

Scrap Report Reduces Number of Critical Shortages

"5. A *periodic scrap report* is produced each 2 days from the scrap tickets received from the plant. This is in part number sequence. It shows all the parts that have been scrapped and the stage or operation where this occurred. It shows what account number and what department have been charged with the scrap. It also shows whether the factory is being charged or the vendor. . . .

"It checks the efficiency of departments by operations, and at the same time insures the replacement of material in time to prevent delays in delivery. Our processing efficiency is constantly increasing, and we are reducing the number of critical shortages after the material is received.

Monthly Scrap Reports Needed Only When Called For

"6. A *monthly scrap report* is produced whenever called for, but the effectiveness of the periodic scrap report is such that it is unnecessary to give the time of our expanding department to the recapitulation of these figures on a monthly basis.

Production of Manufacturing Schedule Simplified

"7. The *monthly manufacturing schedule* was formerly manually prepared by the scheduling department. This involved quite a bit of clerical work, and took many hours to produce. Now the scheduling department is relieved of this operation. Through the use of punched cards it is extremely easy to produce the schedule accurately and quickly. The punched cards for the parts are sorted together with the models ordered, including our scrap percentage, and the combined report easily tabulated with a total of 2 days' work of 1 clerk for the month.

Accounting Department Provided with Data on Material Distribution

"8. The *daily material distribution report* produced for the accounting department occupies the full time of 2 tabulating operators. Unit cards are punched from the material requisitions used in the manufacturing processes.

"9. The *monthly analysis of material distribution*, produced for the accounting department, requires less than 3 days' time of 1 tabulating operator.

Broad Plans for Tabulating Expansion

"One or two of our clerks in the tabulating department are punching master cards for a monthly machine-load report, which will probably be our next undertaking. We are also working on a perpetual inventory, and expect later on to offer to help with payroll, labor distribution, and accounts payable. . . ."

Labor Procedures

Objectives of Labor Procedures

In the broadest sense labor procedures are concerned with the entire sequence of events leading to employment, and terminate only when the last pension check has been paid to the heirs of the retired employee. In a narrower sense labor accounting procedures must:

1. Determine the regular and overtime hours worked, the regular earnings and the overtime earnings, and the total gross earnings of all employees.
2. Record all deductions made from the gross earnings of each employee and arrive at the amount of net pay.

3. Provide the employee with a statement of gross earnings, deductions, and net earnings each pay period, and with an annual statement of earnings and income tax withheld.

4. Furnish the data for quarterly old-age benefit, and other social security reports.

5. Provide evidence of compliance with the Fair Labor Standards Act, the so-called Wage and Hour Law.

6. Prevent errors and fraud in connection with the payroll.

7. Furnish a detailed distribution of labor costs for all direct and indirect labor in terms of job orders, processes, operations, departments, and overhead expense accounts, so that the proper control and subsidiary accounts can be charged.

8. Provide labor cost analyses, reports, and comparisons with budget figures and with allowances based on cost standards.

The first six objectives listed above are associated with payroll procedures and the last two with labor cost distribution procedures. Labor procedures in this discussion are understood to cover all factory employees not included in the salary payroll.

Payroll Procedures

Payroll procedures extend from the authorization of employment and the making of the original evidences of earnings through payment by check or cash and the accounting for unclaimed wages. Many variations of procedure are encountered in different payroll systems. Machine methods have been more extensively applied to this task than to any other in the field of accounting except probably the keeping of customers accounts. Whether manual or machine methods are used certain specific steps or phases, listed below are met.

1. Proper authorization for placing the employee on the payroll, and for all subsequent transfers to other departments, and all subsequent changes in basic pay rate.

2. An attendance record must be kept. This frequently takes the form of an in and out clock record, one card being used for each pay period. At the end of the pay period total regular hours and overtime bonus hours are shown and extended on this form which thus records total regular and overtime earnings at hourly rates.

3. A detailed record must be made of the exact work performed by the employee in the plant. This record takes the form of an individual job card for each employee for each separate task worked on each day, or a daily time report for the employee which shows the time spent during the day at each separate task. Each task is identified by production order number, part number, operation number, and by department and overhead account number in the case of indirect labor.

4. The time shown by the attendance record for each day or each payroll period must be reconciled with the time shown by all the job cards or daily time reports for the same period. The day is the preferred period for this reconciliation. Differences between these records must be adjusted.

5. Payroll deductions must be authorized other than those required by law for social security and withholding taxes. The basis for the latter must be established.

6. Production premium and bonus tickets must be made out.

7. The payroll is prepared, listing: The employee's name, shop number and social security number; regular hours and overtime hours; regular earnings, overtime earnings, production bonus, and gross earnings; payroll deductions for such items as advances, security purchases, insurance, community chest, hospitalization plan, union dues, federal old-age benefit tax, state unemployment tax, and Federal income tax; net pay, and check number. Sometimes the payroll will also show the cumulative gross earnings and cumulative income tax withheld for the year to date.

8. Preparation of employee's cumulative earnings records.

9. Preparation of pay checks and accompanying statement of gross earnings and deductions, or preparation of an analysis of bills and coins required by denomination and of pay envelopes.
10. Preparation of the payroll check register.
11. Distribution of pay checks or envelopes.
12. Correction of payroll errors.
13. Maintenance of payroll bank account balances and periodic reconciliation.
14. Journalization of the payroll.

There are many mechanical aids available for payroll work—calculators, bookkeeping, typewriter-calculating, typewriter-bookkeeping, and tabulating machines. All assist in the detailed and complicated tasks associated with calculating and printing data on the many records now required for payroll purposes. Payroll procedures have been greatly expanded in recent years by reason of compliance with the requirements of the social security, the wage and hour, and the withholding tax laws. Some of these machines are designed primarily or exclusively for payroll purposes. They print several records in one operation, and compute and accumulate required balances automatically. The National Cash Register Company payroll machine, as an example, automatically computes and prints one to five balances (for gross earnings this pay period, total gross earnings this quarter, total gross earnings this year, total income tax withheld this year, and net pay, or other balances up to five, as indicated by individual requirements), prints these balances and other information on five different records (check register, payroll journal, pay statement, pay check or pay envelope, and cumulative employee earnings record for the year) in one operation, and provides twenty different totals for various types of earnings, deductions, and proof totals, which are cumulative and may be printed on the payroll.

Labor Distribution Procedures

The procedures here referred to are those by which the labor cost of the pay period or the month are analyzed and accumulated in order to know the amounts to charge to all direct labor control and subsidiary accounts and to all indirect labor control and subsidiary accounts. The sources of information for this distribution are the individual job tickets, and the daily or period labor tickets or reports which show the time spent at each task by each employee. This information is reconciled with the attendance record as noted under payroll procedure. The sequence of the steps by which the labor cost distribution is prepared depends upon a number of factors. Two such factors are: The manner of posting the order cost sheets under historical procedures; and the time covered by the distribution, whether one is made for each pay period or for the month. The use of machines also affects the procedure. The following description assumes that (1) the distribution is prepared for each pay period, (2) historical cost procedures are used, and (3) the subsidiary direct labor records are posted only once for the pay period, a week in this case. The subsidiary direct labor record, job order cost sheets for example, might under other procedures be posted for daily totals, or even for each job order time ticket. The latter method would be extremely expensive using manual methods.

Under these assumptions the following steps or phases are encountered:

1. The job and other time tickets are sorted by department.
2. The tickets for each department are sorted between direct and indirect labor.

3. The direct labor time tickets of each department are sorted and totaled by order number, and operation number if desired.
4. The indirect labor time tickets of each department are sorted and totaled by subsidiary expense number.
5. The entire distribution is recapitulated for the week. The grand total agrees with the total gross earnings shown by the payroll for the week.
6. The subsidiary order cost and expense ledger accounts are posted.
7. The in-process and departmental expense control accounts are posted.

As an alternative the last step may be postponed until the end of the month when the totals of the payroll distributions for the full weeks and partial weeks of the month are combined. This month end summarization and posting may be applied to subsidiary ledger posting (step 6), although usually it is desirable that subsidiary cost sheets and expense accounts show labor costs more frequently than monthly. Under standard cost procedures, (1) the keeping of order cost sheets may be eliminated, and (2) additional information must be collected to arrive at the allowed time for each job or operation so that comparisons may be made with the actual time used. Also information must be collected to explain off-standard performance and extra-allowances granted.

Payroll and Cost Reports

Labor cost may be a substantial part of total manufacturing cost. In any event management should be fully informed about this expenditure. Some reports that may be prepared are listed below:

1. Analyses by department showing amounts of wages paid under different compensation plans—day rate, straight piece rate, piece rate and bonus, standard time.
2. Labor turnover reports.
3. Comparisons of budgeted and actual labor costs.
4. Comparisons of actual and allowed direct labor costs by departments, products, operations, and operators; analyses of time and rate variances; explanations of fall-downs and extra-allowances.
5. Reports of unit output per labor hour, actual and standard.
6. Departmental ratios of direct and indirect labor costs, actual and standard.

Labor costs and reports are also discussed and illustrated in Chapters 7, 8, 10, 12, and 14. In addition to the internal labor reports referred to above, external reports of wages are required to federal and state governments for social security tax purposes, and to employees annually in support of income taxes withheld.

Associated Procedures

The entire array of activities associated with the management of labor is quite extensive. In as much as the accounting for payroll and labor cost is interrelated with many of these activities, some of the more important ones are listed below. These associated procedures relate to:

1. Hiring, transfer, and termination of employment
2. Employee orientation and training
3. Tardiness and absence
4. Upgrading and promotion
5. Product inspection
6. Job classification

7. Time study and job analysis
8. Methods improvement
9. Incentive wage plans and bonuses
10. Time and rate standards
11. Operations instructions
12. Employee responsibility for tools and other property
13. Group, health, accident, and hospitalization insurance and benefits
14. Safety training
15. Accident and unemployment claims
16. Payroll advances
17. Lost pay checks
18. Pension system
19. Over-all employee relations

Forms Used

The more important forms used in accounting for labor and associated procedures are:

Labor budget
Request for additional employees
Employment application form
Employment service record
Employee's earnings record
Employee identification card
Employment transfer card
Clock record card or roll
Time cards of various kinds
Rate card, and rate change authorization
Bonus tickets or report
Payroll advance authorization
Payroll calculation tables
Payroll
Payroll check and explanatory stub, or pay envelope
Payroll deduction authorization
Sickness and accident reports
Unemployment and compensation insurance claims

Internal Check

Internal check as related to payroll procedures requires: (1) The proper authorization of employment by an independent personnel department and adequate procedures for initiating, transferring, and terminating employment; (2) effective wage rate and rate change authorization; (3) controlled recording of attendance at plant; (4) inspection of presence at work places; (5) a record of work done; (6) protective payroll disbursement routine; and (7) separation of the employment, timekeeping, payroll preparation, payroll disbursing, and the labor cost analysis functions, placing each in the hands of different employees.

Punched-Card Method

An application of the punched-card method of labor accounting is described in a report of H. P. Gould Company of Chicago outlining procedures followed at Republic Aircraft Products Division, the Aviation Corporation (Gould Report

Number 4316) quoted in part below. This installation is described in the words of Mr. L. J. Bassin, Chief Accountant.

"Republic Aircraft Products makes precision machine products for war use. Our payroll has grown from 100 employees 5 years ago to 1500 employees in 1944. To handle our expanding payroll, and to provide adequate control of costs, we installed several units of Remington Rand Punched-Card Equipment in May, 1941. These include a Model 2 Numerical Tabulator with 25 alphabetical sectors, a Summary Punch, a Sorter and 4 Automatic Punches. . . .

Complicated Payroll Simplified by Punched-Card Method

"Our wage scale is complicated by the combination of group bonus, piece-work and day-work. The Remington Rand Punched-Card Method has been a big factor in simplifying this work.

"The individual timekeeper cards are the source from which a card is punched for each part worked upon by each workman. These unit cards are later run through the tabulator to produce cost reports, broken down by indirect labor accounts, or by operation numbers on the direct labor items, or by plant report numbers on special items. To compile, recap and submit this kind of information in almost any other way would take much more time than management feels it could allow and it would be much more expensive.

Labor Distribution Obtained Daily with Weekly Summaries

"The tabulating department addresses a clock card, or in-and-out card, which the timekeepers in the factory write up and return to tabulating. These same cards are punched as the unit card for a day's work of each operator. This becomes the payroll unit card for the day.

"Then we punch a separate unit card for each job the man worked on that day, as listed on the time ticket. Labor distribution is obtained by sorting and tabulating these unit job cards. Labor distribution is made daily by department and by account number.

"Since no daily summary by part number is necessary, the part number is not shown daily. It is shown only weekly and monthly. At the end of the week, about 10,000 cards are summarized by part number. The weekly summaries give the account number, the total hours, total pieces produced on each part number, the labor spent for each part number, and the department where that labor was performed. One copy of this report goes to the cost department.

Timekeeping Card and Labor Distribution Cards Always in Balance

"The timekeeper's card, which was punched to show the worker's earnings for the day, is balanced out to 0 on the tabulating machine, and compared with the worker's labor distribution cards. These distribution cards and payroll cards are intersorted by clock number. When balanced out to 0 by clock number, they permit ready correction of any errors that may have occurred in the punching. We always know they are in balance.

Summary Cards Prepared for Running Payroll

"When 0 balancing has disclosed the errors, and the errors have been corrected, the daily payroll total is obtained. The payroll cards are sorted and filed until the end of the week. They are then again sorted down by clock number, to ascertain the gross pay per man for the full week.

"An overtime report is run at the end of the week. This shows the gross pay, the total number of hours, and the total amount of overtime. This is extended in the cost department. The tabulating department then punches an overtime card for the overtime of each worker, showing the amount and clock number, which is intersorted with the

daily tabulating card. A preliminary payroll report is then run on the tabulator, which shows the gross pay, the overtime earnings, regular earnings, total hours. This preliminary payroll report balances with the daily payroll total. From this report, the F.O.A.B. and Withholding Tax is manually calculated with a simple calculator. Next a separate unit card is punched for each item with the amount and clock number. These unit cards are intersorted with the name cards, gross pay cards, F.O.A.B. and Withholding Tax deduction cards, plus the worker's bond, insurance, and miscellaneous deduction unit cards, and a final payroll summary card is cut to show each worker's gross pay, total deductions and net pay.

Payroll Register and Checks Tabulated

"From the payroll summary cards, we tabulate our payroll register and print 1500 checks. The checks are pre-numbered. After they are run, we stamp the check number on the payroll register with a numbering machine, and check each individual item to make sure the net amount agrees with the check amount.

Labor Distribution Always in Balance with Payroll

"We handle the payroll and labor distribution for two plants in Detroit, besides a heat-treat plant and an experimental laboratory at other locations in the city. We make three major break-downs in our labor distribution—direct labor, indirect labor, and plant order labor. Indirect labor is broken down into 30 accounts, and direct labor is broken down into from 50 to 100 operations for each of 300 odd parts. This labor distribution is always in balance with the payroll for the four plants.

Cost Data Adaptable to Many Uses

"As half the time of 5 clerks in the tabulating department is the only clerical requirement for this itemized cost report, it will be seen that, from a tabulating viewpoint, our payroll and cost work is very simple. We want to keep it that way. The cost department can, with this punched-card report data, analyze the information furnished by these tabulations, and secure from it all the details desired. We can use this data, so simply tabulated, in as many arrangements as we please for various uses. The monthly tabulated report is run by part number and operation number, with totals spent by operation. It gives the comparison, of course, of the labor costs, number of pieces produced on each type of machine, and the total cost of each operation.

Cost Reduction Reports Factor in Improving Quality of Product

"Our production of locking plates is an example of the use made of these detailed cost analyses. The direct labor cost 18 months ago was around $6 apiece. As the result of constant watching, revamping of production operations, and working out of the experimental stage, this direct labor has been reduced from $6 to $2.50. Cost reduction reports improve quality and uniformity and develop better methods—an even more important factor than the reduction of costs.

Scrap Report Puts Finger on Waste

"The scrap report is produced for less than ½ of a clerk's salary. The scrap rejection tickets, written up by the inspection department, are collected daily and unit cards are punched for each rejection. There may be 5 or 6 items on one slip. The amount of money lost is shown for each. A weekly and monthly tabulation of the scrap tickets is made by department, and by operation number. It isn't sufficient to show that a certain scrap loss has taken place in a department. It is much more effective to allocate that cost directly to a specific operation. Breakdowns like this can't be obtained manually without the expenditure of a disproportionate amount of time.

"Cost analyses should be prompt. Analyses furnished two or three weeks after a loss has occurred may be too late to do much good. Under the punched-card method, such analyses are prepared in time for action. The cost department sees that proper action is taken through redoubled efforts on the part of foremen and methods engineers. With increased female help, there has been an unavoidable increase in scrap in most factories. We know that our scrap report procedure has reduced scrap losses in this plant.

Speed and Accuracy of Punched-Card Method Assured

"The speed of the punched-card method is shown by the fact that we print on our tabulator and later sign 1500 checks in 5 or 6 hours. With almost any type of hand or mechanical operation, this would take closer to 16 hours.

"Accuracy in the punched-card method is assured by the number of points at which balances are secured between labor distribution and payroll, as against controls, and in the comparison of weekly and the sum of daily balances. Once the figures are punched correctly in the unit card, they can't be changed. The mechanically-produced, tabulated totals can't go wrong in balancing, and if the basic figure is right, the zero-balance method provides absolute accuracy in the total, and in the resulting report. The prime information secured after zero balancing can be broken down into any number of reports, combined in any way desired, with confidence that the resulting reports will always be in balance to the penny."

Procedures Related to Property

This title refers to the accounting for investment in plant property (land, buildings, machinery and equipment), the depreciation of this property and the distribution of depreciation expense to the overhead expense accounts provided by the classification, the recording of property insurance costs and the distribution of expired insurance costs to expense on the basis of plant values or other suitable basis, the accrual of property taxes and the distribution of this expense to producing and service department expense accounts.

The Plant Ledger

Most of the procedures referred to above are associated with the plant ledger. This ledger—composed of ledger cards or sheets, or tabulating cards—is a record of each piece of land, each building, and each unit of machinery or equipment owned by the company, classified by general type of property in accordance with balance sheet presentation, and by plant, department, and cost center. It provides detailed information that is indispensable to the adequate analysis of fixed property expenses —depreciation, insurance, and taxes.

Objectives of Plant Property Procedures

The objectives of accounting in detail for property investment are:

1. Protection of the property investment through recording the description, identifying number or symbol, source, acquisition date, original cost, cost of subsequent additions or improvements, major repairs, depreciation, and final disposition of each property unit.
2. Provision of information necessary to the settlement of fire loss and other property damage claims.
3. Protection of the earnings through the preparation of more exact depreciation schedules.

4. Furnishing detailed substantiation of depreciation deducted for tax purposes.
5. Provision of a more exact distribution of depreciation expense to major functions, departments and cost centers.
6. Provision of bases for the proration of fire insurance expense to functions, departments, and cost centers.
7. Provision of bases for the proration of property tax expense to functions, departments, and cost centers.
8. Provision of data for the proration of the costs of such joint facilities as buildings which house several departments.
9. Facilitation of the timing of replacements and provision of some of the data by which the relative operating costs of old and proposed replacement units may be compared.

Phases of Accounting for Plant Assets and Depreciation

The following phases are encountered in providing reasonably complete accounting procedures of property and depreciation.

1. Control accounts and subsidiary ledgers must be set up, segregating land, buildings, machinery, tools, and other major types of fixed assets, and separating each of these classes by location and plant. One or more control accounts must be provided for construction in progress.
2. A detailed classification of plant property should be worked out.
3. Methods of advanced planning and budgeting of new plant asset requirements should be devised, both for the near and the more distant future. Studies must be made appraising long-term growth factors as they affect the industry and the company. Future changes in the need for plant facilities at different locations must be estimated. Short-term budgeting of the expansion and improvement of particular facilities should be adopted.
4. Procedures should be set up for appraising all suggested property changes, including calculating possible cost reduction and estimating expected expenditure. Each property change—the construction of a new unit, the improvement or major overhauling, or the retirement of an old unit—should be specifically authorized.
5. Detailed property change cost records should be set up. Policies should be established relative to the capitalization of minor additions and improvements, and for distinguishing between capital and revenue charges on larger items. Procedures are required for appraising the significance and value of completed work and for disposing of its costs. Attention must be given to complying with S.E.C. and Treasury Department requirements relative to property changes and depreciation.
6. A subsidiary property ledger account form must be provided, which will display, without attempting an all inclusive list, at least the following information about each property unit:

Date of acquisition
Description, source, manufacturer's serial number
Account number, and asset number
Location—original, and transfer
Area required
Cost of construction or acquisition
Installation cost and date
Cost of subsequent improvements or retirements, with dates
Estimated salvage value
Expected life—original estimate and subsequent changes by date
Depreciation accrued by months or years, and cumulatively

Appraisals of replacement cost and insurable value, and dates

Date of retirement, value realized, net gain or loss on retirement

If maintenance costs are analyzed by property units, they may also be recorded on this form so that the maintenance history of the unit can be accumulated.

7. Studies in equipment mortality may be undertaken as a means of arriving at more accurate depreciation rates and hence at more accurate periodic operating costs.

8. Depreciation methods must be selected and routines established for the preparation of depreciation schedules monthly or annually. In the latter case the detailed schedules must provide the basis for approximating the monthly depreciation expense applicable to each cost center, department and division of the plant, and also applicable in whatever detail required to the selling and administrative functions. Rules for establishing the effective dates of property changes for depreciation purposes must be adopted.

9. Procedures must be adopted for journalizing depreciation expense and posting it to cost control and subsidiary overhead expense accounts and to reserves and subsidiary property ledger accounts.

10. Methods must be adopted for authorizing, recording, and journalizing the retirement of plant property.

11. Policies and procedures must be adopted for accounting for dies, jigs, patterns, gauges and hand tools, and for identifying, storing, and recovering them after use. The cost of these items may be accounted for in a number of ways, but even when they have been charged to expense they often still represent an important investment which must be protected by an adequate system of physical storage, issuance, and recovery.

Plant Property Reports

Periodic reports are desirable on a number of aspects of plant property investment. Some of these reports are:

1. An analysis of construction work in progress by individual project, showing the estimated original cost, cost to date, degree of completion, original estimate, and current estimate of date of completion, and current estimate of cost to complete.
2. Summary of projects currently completed with comparison of original cost estimate and actual cost, and disposition of total cost.
3. Retirement reports.
4. Comparisons of budgeted and actual construction expenditures.
5. Summaries of property investment in each factory, department, and cost center, classified by types of property.
6. Studies in plant capacity and utilization.
7. Property appraisals.
8. Replacement cost studies.

Forms

Some forms used in plant property accounting are:

1. Budget estimates.
2. Request for appropriation.
3. Plant expenditure authorization.
4. Construction order cost sheet and associated primary papers for material purchase or requisition, labor cost, and overhead allocation.
5. Property ledger card or account.
6. Depreciation schedule.
7. Property transfer notice.
8. Property retirement authorization and record.
9. Tool records.
10. Maintenance orders.

Property Insurance Procedures

The protection of plant property against fire and other forms of property damage is the main objective of the property insurance procedures. The distribution of the cost of this protection to factory departments and cost centers is closely related to plant property accounting in that the plant ledger provides the detailed information on plant investment upon which this distribution is based. Major phases of the plant insurance procedures involve:

1. Determining the need for insurance protection against fire, wind storm, and other forms of property damage. This step is greatly facilitated by detailed property records, which may indicate current sound value and current insurable value as well as depreciated original cost.
2. Adjusting the amounts of insurance to changes in replacement costs.
3. Studying the operations, types of construction, the reduction of hazards, and all other factors which will permit the application of lower insurance rates.
4. Recording the policies in effect in detail—the name of the insurer, the policy number, the type of coverage, the amount of the policy, the effective dates, the rate, the total premium, and the amount of the monthly amortization of premiums.
5. Providing a tickler file of expirations so that the insurance officer may make changes desired at that time and so that renewal and continued protection is assured.
6. Preparing and journalizing the monthly amortization schedule showing the distribution of property insurance costs to all functions, departments, and cost centers and the credit to the prepaid insurance account.
7. Preparing and pursuing the settlement of all claims for loss, and recording its effect on the property accounts.

Property Tax Procedures

Property tax procedures require:

1. Preserving a detailed record of the valuations and rates used by the tax assessors to arrive at the assessed tax in each locality. This record will show each item of real and personal property that is separately assessed, and the history of the assessment as to valuation and rate since acquisition.
2. Studies in the valuations used in taxing comparable properties owned by other companies in each locality.
3. Records of all protests, hearings, and proceedings before local tax assessors and tax equalization boards, and the adjustments secured.
4. Monthly accrual of property tax expense.
5. Preparing and journalizing the monthly distribution of tax expense to all major divisions, departments, and cost centers. The basis for this proration is the relative property ledger values, unless detailed local assessment valuations provide a more equitable basis. Amounts charged to building service or occupancy expense and to power plant and other service activities will be redistributed as a part of the cost of these services.

Procedures for Other Sources of Cost

Procedures for some of the major accounting sources of cost—direct and indirect material, direct and indirect labor, depreciation, insurance, and property taxes—have been discussed above. Other sources are briefly explained in this section.

Vouchers Payable

Vouchers payable are the frequent source of direct charges to overhead and other cost accounts, in addition to being the means of paying material purchase liabilities and the payroll. The vouchers payable procedure, or the voucher system as it is sometimes called, is a coordinated routine for recognizing, verifying, recording, and authorizing payment of liabilities that require cash disbursement in the near future, and for classifying and summarizing the expenditures so authorized. It involves, as do other accounting procedures, a combination of primary papers, originated and used in accordance with prescribed methods, and a journal record, frequently called the voucher register. In a broad sense the voucher procedure may be considered to include also the associated procedure of cash disbursement by which the payment authorized by the voucher is effected. The voucher system must be planned to fit with many other cost procedures such as those relating to:

Material and supply purchases.
Purchase returns and allowances.
Accounts payable.
Plant asset acquisition.
Factory overhead, selling, and administrative expense procedures.
Payroll.

The vouchers payable procedure and related cash disbursement methods are described in Chapter 15 of Section I.

Patents

Procedures must be established covering the acquisition of patents, whether as a result of research and experimental work by company employees, or by purchase. Amortization of patent costs must be made monthly and charged to factory departments benefited. A detailed record of patents should be maintained.

Workmen's Compensation Insurance

The cost of this type of insurance should be accrued monthly by multiplying department payrolls by applicable rates. The amounts so computed should be charged to department overhead expense.

Salary Payrolls

Salaries of employees in factory executive and clerical positions are often accounted for through separate attendance, payroll, and cost distribution records. Problems encountered are similar to, but usually much simpler than, those encountered in accounting for regular factory labor. These employees are frequently paid at weekly or monthly rates, and are normally engaged continuously at work the cost of which is chargeable to a single overhead expense.

Social Security Taxes

These taxes must be accrued. Inasmuch as they are based upon the payroll, they should for greatest accuracy be distributed to department overhead expense amounts in proportion to the payroll.

Manufacturing Overhead Procedures

Accounting for manufacturing overhead is separable into three stages:

Accumulation —the assembly of overhead from various sources so as to ascertain the actual overhead chargeable each period to each productive department and each service center.

Apportionment—the proration or distribution of the cost of all service centers to other service centers and producing departments, so that finally all overhead cost is concentrated on the latter.

Allocation —the absorption of overhead costs in, or the application of overhead cost to, the costs of products in process of manufacture, and perhaps also to the cost of plant construction work.

A fourth stage may be added for the preparation of analyses and reports. Each of these stages is discussed separately below.

Accumulation

The accumulation of overhead so as to assemble the overhead costs of all producing and service departments involves accounting for two types of items:

Direct charges
Prorated charges

Supplies charged in accordance with use indicated by supply requisitions, indirect labor costs charged in accordance with time spent as indicated by time tickets, depreciation expense incurred as indicated by detailed plant ledger records; these are examples of direct overhead charges. Each department is charged with the cost of labor, supplies, and equipment used. Costs of purchased power and light that are distributed to departments on the basis of the horsepower rating of motors and the wattage of light outlets, are examples of prorated charges.

Procedures already mentioned or discussed have provided for the departmental analysis and accumulation of:

1. Indirect material and supply costs.
2. Indirect labor costs.
3. Depreciation.
4. Supervisory costs, through the salary payroll.
5. Charges from the distribution of vouchers payable.
6. Property insurance expense.
7. Property tax expense.
8. Workingmen's compensation insurance.
9. Social security taxes.
10. Patents amortization.

Other procedures must be devised for the direct charging or proration of:

1. Repair costs, through a repair order system, or otherwise.
2. Rent expense.
3. Purchased power, light, and other services.
4. Petty cash disbursements.
5. Small tool expense.

6. Other general expenses, such as building expense, medical expense, and general factory expense if the costs of these activities are not accumulated in service department accounts.

A question frequently arises about the treatment of general expenses, (such as purchased power and building expenses) that have to be prorated to several departments. Should they be regarded merely as objective expenses that require proration, or should they be classified as service departments? In the latter case, the service department list includes not merely those tangible divisions of the plant that have a distinct physical and organizational existence, but other items of common costs also requiring proration that may be regarded as expense centers. These expense centers serve the purpose of expense accumulation as a step preliminary to proration. Whenever any overhead cost that requires proration must be accumulated from several sources, it is often convenient to account for that cost as if it were a service department. Building operating costs, as an example, must be assembled from the payroll, the supply distribution, the depreciation, insurance, and property tax distributions, and often from other sources, before the total amount to be prorated can be known.

A major problem in the proration of common overhead costs to departments is the selection of appropriate bases. Bases commonly used are direct labor costs, indirect labor cost, total payroll, direct labor hours, machine hours, kilowatt hours, horsepower hours, floor area, cubic contents, property values, and number of workmen.

Ledger accounts for the accumulation of overhead costs may be arranged in various ways in the general or factory ledger. A single Manufacturing Expense Control account may be used with appropriate departmental and objective analysis in standard ledger accounts or on analytical sheets. Objective accounts may be set up, supported by departmental analytical sheets. Objective accounts may be omitted and departmental control accounts substituted. Both objective and departmental control accounts may be used, the former being closed out to the latter either by direct credit or by credit to an offsetting Objective Expense Distributed account. Expense ledger summaries may be prepared by the use of tabulating equipment presenting, if desired, a detailed record of every item charged against each expense account from individual supply requisitions, indirect labor time tickets, and other sources.

Whether manual or mechanical methods of expense accumulation are used, it is most desirable that the account classification and the subsidiary departmental analysis group overhead expenses in accordance with their behavior as variable, semivariable, and fixed, and indicate also whether items are direct or prorated charges. Overhead costs in each department are of two general types: (1) Those associated with furnishing capacity, a place to work in, and tools and machines to work with; these are fixed costs from the short-term standpoint; and (2) costs associated with operations—indirect labor, supplies, repairs, and to some extent supervision. These costs tend to vary with output, although not necessarily in direct proportion to output. Proper control of overhead costs, the preparation of flexible budgets, and the analysis of overhead variances require these different types of cost behavior be isolated. The importance of this phase of overhead analysis is discussed in Chapter 9.

Apportionment of Service Department Costs

The accumulation of overhead provides facts for establishing responsibility for overhead cost incurrence. For the purpose of costing products, whether by historical or standard cost procedures, it is generally considered desirable to establish the total operating cost of producing departments by adding to their direct and prorated charges, as previously discussed, an assignment of service department costs based upon concepts of use made of service department facilities, or of benefits received, or of capacity to pay. In this way costs of departments or activities such as the following are concentrated on departments which turn out products:

Maintenance	Power plant
Engineering	Steam plant
Research	Inspection
Drafting	Employment
Medical	Industrial relations
Payroll	Production planning
Cost	Toolroom
Stores	Purchasing
Timekeeping	Cafeteria
Building expense	Internal transportation
Welfare	General overhead

The apportionment of service center costs involves a number of steps or phases, the main aspects of which are described briefly below:

1. Determination of which of three general plans of apportionment shall be used. These plans require alternatively the apportionment of service costs:
   a. To producing departments only.
   b. To service departments and producing departments in a fixed straight line sequence so that no back distribution to service departments already closed out is required.
   c. To service departments and producing departments in a circular fashion, so that the costs of service department A to be apportioned to service department B, for example, cannot be determined without ascertaining how much of the costs of B, including the A apportionment, is to be charged to A.

   Most accountants favor plan (a) or (b) with probably an increasing tendency toward favoring (a).

2. Decision as to whether each service department's costs shall be apportioned as an aggregate, or whether fixed and variable costs shall be separately apportioned, the former on a capacity to serve or normal demand basis, and the latter on a current utilization basis.

3. Decision as to whether service department costs shall be apportioned at standard unit figures, or at actual unit costs, per unit of the basis used for apportionment.

4. Selection of the bases, or types of quantitative measurements, upon which the several service department costs are each to be apportioned. The function of the basis is to measure the quantity of the service required or used and hence to provide the data upon which apportionment is made. Many different bases are in common use. The more remote the activities of the service center from the activities to which its costs are apportioned, the more general is the kind of quantitative measure required. Examples of bases:

   The direct measurement of the service rendered in units applicable to the service, as for example the measuring of power, light, water, steam, gas, air.

Approximate units based upon engineering estimates rather than upon direct measurement.
Direct, indirect, or total labor cost.
Direct, indirect, or total labor hours.
Special service hours, as engineering hours, truck hours, repair labor hours.
Number of employees.
Machine hours.
Weight or tonnage handled or issued.
Cost of material or supplies issued.
Floor space or area.
Number of orders, requisitions, or of other kinds of primary papers.
Units of output.

5. Calculation of the normal number of quantitative units applicable to each kind of basis, if service fixed or capacity costs are separately apportioned in this way.

6. Accumulation of the current number of quantitative units for each kind of basis for use in apportioning either the current actual variable service costs (if fixed costs are apportioned on the normal quantities), the total current actual service costs, or for extension at standard rates.

7. Accumulation of the actual current expenditures for each service department as described in the section on "Accumulation."

8. Calculation of the current variable and fixed costs per unit of the basis for each service activity. The unit costs are useful as:

a. An index to changes in unit costs.
b. A means of apportioning service costs, if apportionment is made at current actual rates.
c. A starting point for comparison with cost standards or variable budget allowances, and for analyzing variances.

9. Preparation of the overhead apportionment or distribution sheet which will show the amounts of each service department's costs assigned to other service and producing departments, and the final total cost of each producing department, now composed of direct and prorated items and apportioned service costs.

10. Journalization of the service department apportionments if required by the overhead costing methods in use.

Allocation of Overhead Costs to Products

Two general methods are in use for the allocation, absorption, or application of overhead to product costs. One method allocates current actual overhead, and the other employs predetermined rates through which some degree of averaging or normalizing is effected.

The absorption of actual current overhead into product cost may be assumed to be limited to simple cost systems where a single homogeneous product is manufactured in a given factory department, and at a fairly uniform rate of output month in and month out. In these circumstances the amount to be absorbed each month is determined with the completion of service department apportionment. The actual overhead of the month is very likely merged with direct labor cost through the departmental accounts, and the total conversion cost divided by the number of equivalent units of output gives the actual unit conversion cost. Material may also be combined with conversion costs in the same departmental account. This combination of material, labor, and actual overhead need not prevent the calculation of a unit cost for each cost element, nor for each objective type of overhead cost. The use of actual overhead cost even in these simple circumstances (where there is no

problem of allocating overhead over more than one product item worked on in a department) is not satisfactory from a product cost standpoint if either the amount of overhead or the volume of output fluctuates very substantially month to month.

In more complicated production circumstances, in a job order plant for example, the use of predetermined overhead rates, that is the absorption of an amount of overhead that differs from the current actual departmental overhead, is desirable for two reasons. The use of predetermined rates:

1. Permits the completion of the costing of orders practically at the time manufacture is finished, in contrast with the use of actual overhead which would delay the costing of all orders until after the close of the month.
2. Normalizes the amount of overhead charged to each order, thereby evening out the effect of seasonal, and more rarely of cyclical, fluctuations of output and of overhead expenditure. The resulting product unit cost is thought to be more satisfactory whether used in setting sales prices and policies or for inventory valuation.

When predetermined overhead rates are used in historical cost procedures the following phases are encountered in the allocating of overhead:

A. In advance of the Period of Use

1. The period over which the averaging of output and overhead cost is to be effected must be determined, say the fiscal year, or more rarely a longer period thought to correspond to a full swing of various levels of economic activity, the business cycle as it affects the industry in which the company is engaged.
2. The bases on which overhead is to be absorbed must be selected. Bases are quantitative measures of productive effort or output, one (rarely more) for each productive department, used as a means of determining how much overhead cost is to be allocated to each job or segment of output requiring separate costing. Bases commonly used for this purpose are:

   Actual direct labor cost
   Standard direct labor cost
   Actual direct labor hours
   Standard direct labor hours
   Actual machine hours
   Standard machine hours
   Units of product
   Material cost
   Prime cost

3. The expected output of the period must be estimated as a means of estimating the number of units of the basis to be anticipated.
4. The overhead costs expected to be incurred in the period when the rates are to be used, say the coming fiscal year, must be estimated or budgeted. To do this requires going through substantially the same procedure, on the estimated basis, described above for accumulating actual overhead and apportioning service costs. The result is to state an estimated amount of total productive department cost for the period in which the predetermined rates are to be used.
5. The predetermined overhead rates are calculated by dividing the estimated expenditure (4) by the estimated units of the basis (3). For example, if for a given productive department the overhead costs for the next fiscal year are estimated at $50,000, and the number of direct labor hours is estimated at 25,000, the predetermined rate is $2.00 per direct labor hour.

B. During the Period of Use

1. The number of units of the basis for the application of overhead in each department must be accumulated for each job or segment of the output to which overhead is to be allocated. For example, if the employees of Department X work on ten orders during the month, and direct labor hours is the basis for allocating overhead in this department, the total labor hours for the month spent on each order must be determined. When either the direct labor hours or direct labor cost is used as a basis for overhead allocation, the number of quantitative units of either may be accumulated from an analysis of the time tickets, or if the number of direct labor hours (as well as the direct labor cost) is posted to job order cost sheets the number of hours and the amount of cost may be ascertained from that record.
2. The number of units of the basis in each department for the month applicable to each order or segment of output separately costed, as ascertained in (1), multiplied by the predetermined rate, gives the amount of overhead allocated to product cost, for the month. This amount should be posted to the cost sheet. This posting is ordinarily done during the month immediately upon the completion of manufacture, at which time the costing of the order is finished, or at the end of the month for orders then unfinished and for output costed on a monthly basis. This posting is omitted under complete standard cost procedure.
3. The amount of overhead allocated to orders during and at the close of the month must be totaled and journalized at the end of the month as a charge to the work in process control account and a credit to the various departmental overhead absorbed accounts.
4. The actual overhead of the period is accumulated and apportioned as described above.
5. The use of predetermined rates brings about a difference between the actual overhead of a department for a month, and from month to month cumulatively, and the overhead absorbed for that department for the same period. Two questions arise as to this difference, in the aggregate for all departments. The first is: How should this difference, which may represent a net debit if the actual exceeds the absorbed or a net credit in reverse circumstances, be disposed of in the accounts. The answer usually given to this question is that the difference should be carried along in the accounts until the end of the year when it is closed out (by debiting the absorbed and crediting the actual) either (1) to the cost of goods sold as a debit or credit) or (2) to the cost of goods sold, the finished inventory and the goods in process, by proration among them. Neither disposition is logical if the time span of a business cycle has been used in calculating the predetermined rate. The second disposition is not convenient in any circumstances in that it requires the proration of the totals assigned to finished goods inventory and goods in process over all of the open items in their respective subsidiary ledgers which have been affected by the year's production. The second question concerns the showing of this under- or over-absorbed overhead in interim statements. The usual disposition is to add the aggregate difference, all departments combined, to or deduct it from, the cost of goods sold.

Reports

Reports will be made up at the end of the month analyzing, under actual cost procedures, the differences between the budgeted amount and the actual amount of each overhead expense item. Comparisons also may be presented with the previous

month and with the previous year to date. Under standard cost procedure, reports are prepared in detail comparing the budgeted overhead, the actual overhead, the standard overhead cost of the actual output, and the allowed cost of the actual output computed from flexible budgets, or from individual variable expense allowances per standard direct labor hour or unit of output plus fixed expense allowances. Significant conclusions are drawn about the effect of controllable and noncontrollable factors on overhead spending and their relationship to causes of and responsibility for variances.

Reports relating to overhead costs are discussed in Chapters 8, 10, and 14 of Section I and in Section II.

Other Cost Procedures

A number of other cost procedures—costing the factory output, accounting for finished products, costing shipments, and distribution costs—require brief mention. These procedures are discussed elsewhere in this volume, and their inclusion here is largely by way of reference to other chapters, in order that this chapter may provide a description or reference to all major aspects of systems installation.

Product Cost Summarization

All types of accounting systems require some way of costing the factory output, of bringing together the expenditures related to the production of each separate product item, or group of items costed as if they were a single item. This requirement is fulfilled by the product cost sheet.

The product cost sheet is titled in different ways; it is variously called the order cost sheet, the job sheet, the lot cost record, the process cost sheet, the department cost sheet, the parts cost sheet, the assembly cost sheet, and the standard cost card. In every case this record has certain specific functions to perform. The cost sheet:

1. Records in detail the costs of material, labor, and overhead which have been allocated to the product it represents. Under historical procedures these are the so-called actual costs assigned to the product by processes of direct measurement and apportionment. Under a type of standard costing where full reliance is placed upon the standards for the purpose of stating unit product cost, the standard cost card shows the quantities of material, labor and overhead allowed—for the standard number of product units covered by the card, one, one hundred, or whatever it may be—extended at their respective standard prices. In other cases the product cost sheet may show both actual and standard costs.

2. Shows the quantity of output secured for the costs displayed, in the case of the order cost sheet, the number of units manufactured or assembled. In the case of the process or department cost sheet both the number of physical and equivalent units are shown. The comparable information for the standard cost card is what may be called the standard unit, frequently one or one hundred pounds or one thousand pieces, whatever the unit customarily used in unit cost calculations.

3. Displays the conclusion of one main phase of all costing effort—it states the unit cost. In terms of this phase of the costing effort, the determination of unit cost, the cost sheet is the core of the system. Its function is to bring together expenditure and output, the recording of both of which are essential before there can be a cost system. If expenditure alone is recorded, no conclusion can be drawn as to unit cost; if output alone is recorded there is no accounting system at all. This function of the cost sheet is present even when the quantity factor is one, as it may be on the standard cost card. If the cost

sheet displays detailed information, the unit cost can be stated by cost element, even in terms of different kinds of material, labor, and overhead.

4. May also show other kinds of information. The process cost sheet, for example, may show the detailed calculation of the cost of goods in process at the end of the period and of goods transferred to subsequent processes during the period. It may summarize the cost accumulation of a product from process to process from the beginning to the end of manufacture.

Product cost summarization is discussed in detail in Chapters 17 and 18 of Section I.

Accounting for Finished Inventory

Accounting for finished inventory presents many of the same problems encountered in recording material and supply transactions, and requires substantially identical procedures. There are acquisitions, issuances, and balances. There may be a stock ledger sheet for each product item. Together these sheets are the finished stock subsidiary ledger, and are represented in the factory or general ledger by a controlling account. Subdivision of the subsidiary ledger and the controlling account may be made by plant, storeroom, or product group, as thought desirable: Under historical procedures, receipts, issuances, and balances will be shown in terms of quantity, unit cost, and total cost. Acquisition is effected by transference from the factory. Issuance is normally effected through shipment. Appropriate procedure must be provided for:

1. Planning the requirements for finished stock and setting minimum and maximum quantities for each item.
2. Requisitioning the factory for replenishment.
3. Posting the finished stock ledger for receipts. The control account is charged by summarizing the total output of the period transferred to stock.
4. Allocating the stock to, or reserving it against, specified sales or shipping orders.
5. Issuing stock on sales or shipping orders, posting the issued section of the stock ledger and recalculating the balances.
6. Accounting for returned shipments.
7. Verifying the balances on hand by processes of continuous check or periodic physical inventory, and adjusting the stock ledger and the control account for discrepancies.
8. Revaluing the finished inventory.

These procedures are obviously closely related to those for summarizing the cost of goods produced, and shipped, as the finished inventory is merely a reservoir between the factory and customers for the purpose of equalizing the flow so far as possible:

Costing Goods Shipped

Procedures bearing upon the costing of shipments require:

1. Authorizing the shipment.
2. Costing a copy of the sales order or shipping order, showing the unit cost of each item, extending these, and summarizing the total cost of the shipment.
3. Summarizing the cost of goods shipped for the period in terms of the cost of goods sold accounts to be charged, and the finished inventory control accounts to be credited.
4. Journalizing and posting the summary of the cost of goods sold for the period.

An obvious requirement of these and the related finished inventory procedures is that no goods shall be permitted to leave the possession of the company by error or fraud, and that an obligation shall be recognized on the part of some one to the company for every shipment made. Many special problems, not noted above, are often encountered. These related to intra-company shipments, on approval and C.O.D. shipments, partial shipments, routing, returnable containers, loss and damage claims, cash sales, and other matters. Procedures for costing sales are closely related not only to the finished inventory but also to the sales procedures.

Distribution Costs

Reference is made to Chapter 20 of Section I for coverage of this subject.

Other Aspects of Cost Systems

Closing and Reporting Schedules

Large cost installations particularly—where there is a minute subdivision of accounting effort, and cost and quantity data must be assembled from a great many sources and distributed to a number of points of utilization—require the adoption of a detailed schedule for the completion of each segment of the cost work, and for its reporting to interested parties. This schedule acts not only as an indispensable coordinating device, but also as a standard of performance from a completion date standpoint.

Internal Audit

The cost, and financial, procedures must operate as planned—the policies, methods, and routines set up must be followed—if the accounting system is to produce the results desired. An auditing department within the organization is often charged with the responsibility of testing and checking the performance of the accounting function in all its aspects, which include:

1. The efficiency with which the established procedures and routines are followed.
2. The accuracy of the accounting data supplied.
3. The detection of fraud, misuse, and misappropriation of company resources.
4. The improvement of accounting methods.
5. Cooperation with external auditors.

Cost Studies

Responsibilities for understanding, analyzing, and reporting cost data are not fully discharged with the completion of routine reports. The field of cost analysis outside formal procedures is large, and an appreciation of its importance is growing. The cost accountant must be equipped and ready to undertake cost studies upon an unpredictable array of matters related to business operation and management. Some of these studies are described in Chapters 4, 5, 6, 8, and 9 and are suggested at other points in this volume.

Cost Organization

The accounting function in modern business is extremely complex. It includes financial accounting, cost accounting, auditing, report preparation interpretation and analysis, statistical compilations, office management, taxes, insurance, personnel

administration, special studies and investigations, and other matters. The importance and difficulty of these matters are resulting in greater recognition of and emphasis upon the accounting function and the organization of the controller's office. The Controllers Institute of America has given much study to these problems, and the reader is referred to the publications of that association.

Uniform Systems

Trade associations particularly have done much useful work in devising uniform accounting systems for their respective industries. These systems often lay down general principles of cost accounting applicable to the industry, without attempting to state or prescribe detailed procedures. Uniform systems are discussed in Chapter 18.

Accounting Manual

The accounting manual describes the policies, principles, and methods to be followed in the performance of the accounting function for a particular enterprise. The classification of accounts, the primary papers, the journals, and ledgers are illustrated. Procedures are explained in detail and responsibility for their performance is established. The accounting manual is indispensable in large organizations and important in all. It is the written authority as to what has to be done and how it should be done. It is a constant source of information to new and old employees. It is an anchor that aids greatly in preventing the gradual drift away from prescribed procedures that seems to be inevitable with changing personnel. The manual itself is not a static document. New procedures are added; old ones are remodeled; and there must be a constant revision directed toward clarification of descriptions. One of the most difficult things is to describe what is to be done in such a way that it cannot be misunderstood. The carefully prepared manual is a tremendous improvement over memory and recollection, and the spoken word.

Conclusion

This chapter has had as its purpose the summarization of some of the major aspects of an integrated cost system. The descripitions have necessarily been on a general rather than a particular level. The latter involves the adaptation of general procedures to (1) the organization structure and plant layout of an individual company; (2) the costing problems arising from the number of products manufactured and the complexity of the combinations of materials and operations required in each plant; and (3) the needs and preferences of particular executives. The cost systems man must appraise these needs and problems and, bearing in mind that cost accounting is a tool of management which must contribute to the attainment of effective control and cost reduction, he must blend the theoretical and the practical, do what it is important to do in an economical way, and design his system to be as simple as the complexity of the operating circumstances permit.

Chapter 20

DISTRIBUTION COSTS

By
CHARLES H. SEVIN *

Distribution costs account for a large proportion of manufacturers' sales dollars, even approaching the production costs in some lines. In the sewing machine industry, for example, marketing expenses were 36.5% of sales, almost equaling the manufacturing cost ratio of 37.0%.[1] However, in itself, the fact that a large proportion of manufacturers' sales dollars go into distribution costs does not prove that they are too high, nor that marketing is inefficient as compared with production.

Owing to many factors, mass-production methods have resulted in an increase in the size of the marketing task, and therefore a rise in the proportion of marketing costs to total costs is to be expected. Also, relative costs are not a valid measure of the relative efficiency of marketing and production. Marketing and production tasks are different and cannot be compared directly.

There is, for instance, no basis, either in theory or in practice, for supposing that the cost of manufacturing a cake of soap at a far-off factory has any relation to the cost of distributing that soap from the factory to the homes of the many thousands of final purchasers. Yet, somehow, in our general thinking we have the notion that there should be a certain relationship between the cost of manufacturing and the cost of distributing.

Only to the extent that costs are not reduced when they could be, are they too high. Whether marketing operations are more or less efficient than manufacturing processes, in this sense, is an open question. There is no doubt, however, that neither marketing nor production is as efficient as it could be and consequently costs in both fields are too high.

A large part of the sales made by a firm may be unprofitable, even though the business as a whole shows a profit. If the expenses and revenues are analyzed to reveal the unprofitable commodities, customers, territories, and orders, management may be able to reduce costs and to increase net profits substantially by taking appropriate action in regard to the unprofitable elements.

There are many reasons for the existence of unprofitable sales. Some are reasons which can be justified by the objective of maximizing the firm's total profits—if not in the immediate short run, then in the longer run. More frequently, however, the reason is that the company does not know its costs. But through distribution cost analysis the relatively unprofitable sales can be dicovered.

Distribution cost analysis can also be used by management in deciding what to do about the relatively unprofitable sales. For example, the effects on costs and

* Distribution Cost Section, Marketing Division, Office of Domestic Commerce, United States Department of Commerce, Washington, D. C.

[1] "Industrial Corporation Reports, Summary, 1940 Series" Federal Trade Commission, Washington 25, D. C., March 15, 1943.

profits of eliminating unprofitable sales and substituting more profitable sales in their place can be determined. Of course, there are other important uses of distribution costing, such as expense "control," budgetary planning, and pricing policy. Different kinds of costs are adapted to different purposes, however, so we shall limit our discussion in this chapter to the costing techniques needed for the first two uses stated above. The benefits from these uses, in the way of increasing efficiency and reducing costs, can be just as great as those that resulted from so-called "scientific management" in the factory.

Production vs. Distribution Costing

In the present pioneering stage of distribution costing, it is more accurate to speak of distribution cost "analysis" than of distribution cost "accounting." The results of these analyses may be classified as "statistical" costs. That is, the distribution cost analyses are not usually tied in with the financial accounting records, but, rather, operate outside of the books of account.

It is not generally-accepted accounting practice for distribution costs to be charged to the cost of goods sold for the current period, or to inventories for application against the income of future periods.[1] A firm might allocate its distribution costs to individual products by means of statistical analyses, but the totals of such costs would be treated as expenses in the regular accounting records to be charged directly against the income of the period.

Another difference between production and distribution costing is that distribution costing is usually done on an intermittent, or even on a one-time basis, in contrast to the continuous costing in the factory.

Distribution costs are not allocated to products alone. They are also allocated to customers, territories, salesmen, order-size groups, price-discount groups, and in other ways.

Finally, distribution costing differs from production costing in the general use of historical rather than standard costs. There can be no doubt that the use of standard predetermined costs for budgetary planning and cost control is to be preferred to that of actual historical costs. However, the many difficulties of setting up standards for distribution, such as the numerous non-repetitive marketing operations, have so far proved to be too great for most firms engaged in distribution costing. Standard distribution costs probably will be developed more generally in the future, but historical cost data are useful for determining the relative profitability of different segments of the business.

In spite of the above differences, however, the basic procedures or techniques of distribution cost analysis are similar to those of production cost accounting. They are fairly simple in their statement, but they are difficult in their application. These techniques are discussed below.

Direct Expenses

Determination of the direct marketing expenses presents no particular problems of cost accounting technique, although a sufficiently detailed classification and

[1] Charging distribution costs to inventories, however, has been advocated by several writers. See W. A. Paton, "Distribution Costs and Inventory Values," *Accounting Review*, September, 1927, p. 246.

recording of expenses in order to separate the direct costs may entail much additional accounting work. The direct distribution costs may constitute a significant proportion of the total costs associated with a specific segment of sales. This may be especially true of an organization where separate sales departments are maintained for selling specific product groups and for soliciting specific customer classes.

In such an instance, if the primary-expense accounts are kept in sufficient detail originally, or if provisions are made for subsequent divisions or subclassifications of the primary-expense accounts, many selling expenses may be assigned direct to either a product or a customer class.

Functional Classification

Although the proportion of direct costs may frequently be significant, the greater part of the manufacturer's distribution costs are likely to be indirect. To facilitate their allocation, as well as for purposes of expense control, these indirect expenses are classified into functional-cost groups.[1]

The basis of the functional classification which would be used by any given manufacturer is a study of the marketing activities performed by that manufacturer. It is important that the functional classification be sufficiently detailed so that the work performed in any one function will be of the same general kind. Such homogeneity facilitates the allocation of an entire functional-cost group by the use of a single factor, as will be described hereafter.

Those natural expenses which cannot be assigned in their entirety to the various functions can be subdivided on the basis of time studies, space measurements, managerial estimates, and so on. The increased cost and effort of preparing functional-cost classifications will be much more than offset by the benefits of improved expense control, as well as by the advantages of cost analysis.

Manufacturers, especially those serving wide markets and selling a number of products, may have complicated distributing organizations and may engage in a wide range of marketing activities. Consequently, it is difficult to set forth a widely representative functional classification of distribution expenses. For illustrative purposes, however, a list of functional cost groups is shown in the left-hand column of Table 1.

Products and Customers

The functional cost groups are allocated on the basis of utilization by products and customers of the variable activities giving rise to these costs. The principle followed is to charge the product or customer with the cost of its share of the variable activity of the functional-cost group; that is, the cost of the portion of the variable marketing effort for which it is responsible or from which it benefits. For example, the variable activity responsible for the amount of the expenses in the storage function is the number of square or cubic feet occupied by the finished goods inventory. Consequently, the measure of any product's share of the storage expense is its share of the space occupied.

[1] A funtional classification puts together all the expense items that have been incurred for the same activity. A functional classification, therefore, permits the allocation of an entire cost group by means of a single factor.

TABLE 1. BASES OF MANUFACTURER'S ALLOCATION TO COMMODITIES AND CUSTOMERS

Functional Cost Groups	Bases of Allocation	
	To Commodities	To Customers
1. Investment in Finished Goods	Average inventory value	Not allocated
2. Storage of Finished Goods	Floor space occupied	Not allocated
3. Inventory Control, Finished Goods	Number of invoice lines	Not allocated
4. Order Assembly (Handling)	Number of standard handling units	Number of invoice lines
5. Packing and Shipping	Weight or number of shipping units	Weight or number of shipping units
6. Transportation	Weight or number of shipping units	Weight or number of shipping units
7. Selling	Time studies	Number of sales calls
8. Advertising	Cost of space, etc., of specific product advertising	Cost of space, etc., of specific customer advertising
9. Order Entry	Number of invoice lines	Number of orders
10. Billing	Number of invoice lines	Number of invoice lines
11. Credit Extension	Not allocated	Average amount outstanding
12. Accounts Receivable	Not allocated	Number of invoices posted

The identification of the variable activity that is involved in each functional-cost group and of the characteristics of products and customers that are related to these activities are often evident merely from study. Some functional activities vary according to certain characteristics of the commodity and are not greatly affected by customer characteristics. Others vary primarily according to certain customer characteristics regardless of what product is being purchased.

For example, the variable activity involved in the storage and investment functions depends almost solely on the bulk, weight, perishability, and inventory value of the product stored, and is affected but little by the customer who buys the product. Similarly, the credit function will vary according to the financial integrity and other credit characteristics of customers with little regard to the nature of the commodity on which credit was extended.

As regards still other functional-cost groups, the relationship between these costs and product and customer characteristics is more complicated. For there is every shade of combination of customer responsibility and commodity responsibility for the variable activity and, therefore, the amount of expense, within the different functional-cost groups.

Partial Allocation

Those functional activities which vary entirely with customer characteristics are not allocated to commodities and, conversely, those related solely to commodity characteristics are not allocated to customers. Some functional cost groups may not be allocated either to commodities or to customers. In addition to the difficulty of tracing a direct connection between the variable activity of some functions and product or customer characteristics, there is another reason for not making a full allocation of distribution costs.

For the uses of distribution cost data which we are discussing—namely, to discover the unprofitable parts of the business and to determine the appropriate action to be taken in regard to these unprofitable sales—little would be gained by making a full allocation.

A full allocation may involve the arbitrary assignment of some indirect expenses —which represent functions not being used to capacity [1]—on the basis of sales volume. This may have the effect of making some commodities, customers, etc., with large sales volume and low percentages of gross margin, appear to be relatively unprofitable. Actually, since these functions are not being used to capacity, these indirect expenses would not be affected by substitution, elimination, or an increase of sales in the short run.

For example, storage and investment costs usually would not be allocated to customers, because these activities are not usually related to customer characteristics and because they would not be affected by short-run charges in the number of customers. Likewise, credit costs usually would not be allocated to commodities since they would not be affected by addition or elimination of products "at the margin."

A desire for a full-cost allocation may involve an erroneous conception of the use of distribution cost analysis in connection with pricing policy. It appears to some that if they know the total or "real" distribution cost, plus the production cost, then they can arrive at the proper price by merely adding the desired net profit. If, however, such a pricing procedure gives insufficient recognition to demand, it may be worse than one which is not based on any knowledge of costs at all. If prices determined on this cost-plus basis are too high, in the light of demand and competition, sales volume may be lower than before, so that costs per unit will be higher than calculated, and may not be covered even at the higher prices. Or, if cost-plus prices are too low, then profits are sacrificed.

In short, distribution cost analysis does not have as its purpose the establishment of the most profitable prices. It starts with prices as "given" for the purpose of determining relative profitability.

In Table 1 bases are suggested for assigning the principal functional cost groups which would, at one time or another, be allocated to customers and products. However, as we have seen, not all these costs would be allocated in all cases. It may be difficult to decide which cost should be allocated in a given case because of the difficulty of determining which functional activities are being used at or near capacity in the short run, but each manufacturer needs to make such a decision in view of the particular circumstances in his business.

[1] Such evidence as is available indicates that important facilities or marketing functions may, in normal times, be rather consistently underutilized.

TABLE 2. DETERMINATION OF RELATIVE PROFITABILITY OF A CLASS OF PRODUCTS

Functional-Cost Group	(1) Total Functional Cost	Bases of Allocation (2) Total for Firm	(3) Commodity	(4) Commodity's Share (3 ÷ 2)	(5) Allocated Costs (4 × 1)
				Percent	
1. Investment	$ 50,000	$500,000	$50,000	10.0	$ 5,000
2. Storage	75,000	400,000 sq. ft.	20,000 sq. ft.	5.0	3,750
3. Inventory Control	25,000	$300,000	$9,000	3.0	2,500
4. Order Assembly	100,000	$500,000	$50,000	10.0	10,000
5. Packing and Shipping	60,000	$500,000	$75,000	15.0	9,000
6. Transportation	200,000	600,000 tons	125,000 tons	20.0	40,000
7. Selling	400,000	10,000 hrs.	2,000 hrs.	20.0	80,000
8. Advertising	150,000	—	Direct	—	33,300
9. Order Entry	30,000	$400,000	$40,000	10.0	3,000
10. Billing	50,000	$400,000	$40,000	10.0	5,000
Total Costs					$191,550

Sales	$850,000
Cost of Goods Sold	632,000
Gross Margin	$218,000
Less: Direct Plus Allocated Distribution Costs (from Table 2)	191,550
Excess of Gross Margin over Costs	$ 26,450

Relative Profitability

The actual allocation of costs is, in effect, made by simple proportion. For example, if the average inventory value of product group X is 1/100 of the total average inventory value of all finished products, that group is charged 1/100 of the

investment costs for the period. The sum of the shares of the various functional costs which are allocated plus any direct costs is subtracted from the dollar gross margin of the product, the difference indicating the relative profitability of the product. The results of this procedure are illustrated by the example in Table 2.

This basic procedure is, of course, the same when costing major product groups, subgroups, lines, and individual items or brands. The difference lies mainly in the detail with which merchandise sales and gross margins are classified and functional costs allocated.

The process of customer costing is the same as that of commodity costing. The total of the shares of the allocated functional-cost groups plus any direct expenses gives the total customer cost. This cost deducted from the total dollar gross margin received from that customer class during the same period indicates the relative profitability of these customers.

A ranking of product groups and customer classes in the order of the amount of their excess of dollar gross margin over allocated costs discloses the relatively less profitable commodities and customers. Those with the smallest excess of margin over costs, and also, of course, those whose allocated costs are greater than the margin, are the relatively unprofitable ones, which are tagged for remedial action.

Relating Product and Customer Costs

In the previous discussion, commodity and customer costing were described as distinct although parallel processes. In the case of most manufacturers, however, such a procedure would not be as satisfactory as one in which commodity and customer cost allocations were related processes.

Table 3 shows the procedure by which the commodity and customer allocations are related. The lines on the form represent classes of commodities while the columns represent classes of customers. The squares that result from the cross-classification represent transaction groups, that is, sales of a specific class of commodities to a specific class of customers.

One of these forms would be used for each functional-cost group that is allocated. If the variable activity of a given function is related most closely to commodity characteristics, the first allocation would be made to commodity classes. In other words, the total amount of the cost group would be distributed as commodity-class subtotals on whatever basis of allocation is used for that functional cost group, and the amounts entered in the spaces in the column on the right. The next step is to distribute these subtotals to the cells across the form on whatever basis is used to allocate the particular cost to customers.

A similiar procedure is used if the cost group is one whose activity varies primarily with customer characteristics. The first allocation would be made to customer classes, which means the total of the functional-cost group is distributed as customer-class subtotals, on whatever basis of allocation is used, and these subtotals entered in the spaces along the bottom of the form. The next step is to distribute these subtotals upward into the cells which represent the classes of commodities purchased by the customers.

When all of the cost groups have been either assigned direct or allocated on separate forms, a summary form can be used to get the totals. All of the figures appearing in the corresponding cells are added together, the totals being the costs for the individual transaction groups. The next step is to add up the columns and

TABLE 3. PROCEDURE FOR RELATING COMMODITY AND CUSTOMER COST ALLOCATIONS

Commodity Classes	Customer Classes						Commodity Cost Totals
	A Manufacturers	B Dealers	C Jobbers	D Mail Order	E Chain Stores	F, G, H, etc.	
1. Pneumatic Passenger Tires and Casings							
2. Pneumatic Truck Tires and Casings							
3. Tractor Tires and Casings							
4. Solid Tires and Casings							
5. Auto Accessories							
6. Mechanical Rubber Goods							
7. Heels and Soles							
8. Hard Rubber							
9. Footwear							
10. Tiling							
11. Rubber Thread							
12. Rubberized Fabrics							
13. Sundries							
Customer Cost Totals							(Grand Total)

enter the totals at the bottom, which gives the costs by classes of customers. Similarly, the totals of the amounts on the lines give the costs by classes of commodities.

Finally, the dollar gross margins are entered on the summary form, and the total allocated costs by transaction groups and by customer and commodity classes are subtracted from the corresponding margins. A ranking of product groups and customer classes in the order of the amount of their excess of dollar gross margin over allocated costs discloses the relatively less profitable commodities and customers.

Order-Size Groups

Cost analysis by products and customers provides a powerful tool for discovering the relatively unprofitable segments of the business. In most firms, however, the investigation would not be complete without a separate analysis by order-size groups, since the size of the order is a most important factor in its effect upon costs and profits.

Manufacturers know that there are wide differences in distribution costs and profits for different sized orders. But until they know just how the size of the order affects costs and profits they can establish many sales policies and discount schedules in only a rough and often wrong way. With cost analyses available, these policies and discounts can be formulated with assurance that they will contribute to maximum profits, (and also that they will conform to the requirements of the Robinson-Patman Act).

A determination of cost variations by size of order for individual products necessarily requires that attention be centered upon the line extension rather than on the order as a whole. The size of the order for the individual product can be measured either by the number of units of products per invoice-line extension, or by the dollar value per invoice-line extension.

Determination of cost variations by order size for individual customers can be found only from a study of the size of the order as a whole, measured either by the dollar value of the order, or by the number of invoice lines per order.

The process of getting costs by invoice lines, is, in general, similar to the process of commodity costing. Functional classifications of expenses and bases of allocation are much the same as those used for product costing. The allocation of costs by

TABLE 4. BASES OF ALLOCATION TO ORDER-SIZE GROUPS

Functional-Cost Groups	Bases of Allocation	
	To Sales Classified by Number of Units of product per Invoice Line	To Sales Classified by Dollar Value of Whole Order
1. Order Assembly (handling)	Number of units or time study	Number of invoice lines
2. Packing and Shipping	Number of units or time-and-materials study	Weight or number of shipping units
3. Transportation	Number of units or time study	Weight or number of shipping units
4. Selling	Number of invoice lines or time study	Number of invoice lines or time study
5. Order Entry	Number of invoice lines	Number of orders
6. Billing	Number of invoice lines	Number of invoice lines
7. Credit Extension	Not allocated	Number of orders
8. Accounts Receivable	Not allocated	Number of orders

total-order-size groups—whether order size is measured by dollar value or by number of invoice lines—is generally similar to the process of customer costing. Table 4 illustrates the functional classification of costs and the bases used in allocating costs to these two kinds of order-size groups.

Territories

Manufacturers are also obviously interested in analyzing distribution costs by territories. In many respects, costs by territories are the simplest ones to analyze. If the manufacturer's marketing activities are organized on a territorial basis, with the geographic limits of branches and districts clearly defined, a sufficiently detailed breakdown of the primary-expense accounts and their classification by branches and districts results in a direct assignment of a large proportion of expenses to these territorial units.

The costs for individual salesmen's territories can be satisfactorily determined for many purposes by adding up the costs allocated to customers within the territory. This can only be done, of course, if these territories are also distinct geographical units. In other words, the sales, margins, and costs by territories can be ascertained by summarizing the corresponding figures for the customers who constitute the area.

In many cases, however, it may be more satisfactory to allocate or assign directly to the territory certain branch and district expenses that are incurred jointly for several salesmen's territories. But even in such instances, there are some functional costs, difficult to allocate to commodities or customers or order-size groups, which can be assigned directly to the sales territory.

The best example of the latter situation is the salesman's salary, commissions, and traveling expenses. If the salesman devotes all of his time to one territory, these, of course, are direct expenses. On the other hand, if he specializes by products or customers and divides his time between several territories, his expenses are indirect and must be allocated to territories. This is done either on a basis similar to that used in allocating selling expenses to customers or on the basis of a time study.

Unprofitable Sales

Of course, a large number of practical possibilities for converting losses into profits are available to the manufacturer before elimination of the unprofitable sales need be considered. However, further cost analyses are necessary if the manufacturer, after studying all of the alternative courses of action, seeks to investigate the effects of eliminating those unprofitable segments of sales that cannot be turned into a source of profit. In estimating the decrease in total expense that would result, it is clear that the costs which were allocated to sales to discover the unprofitable segments would not provide the answer. For some of these costs would be nonescapable and would continue after the sales were dropped.

After a specific segment of sales has been discovered to be relatively unprofitable, the manufacturer can proceed to analyze the costs that have been allocated to it to decide what part of them could be eliminated were the sales to be dropped. Since there is no hard and fast distinction between escapable and nonescapable costs, the manufacturer must study each item of allocated expense separately, and rely on

his judgment and knowledge of the business to distinguish between the escapable and nonescapable expense attaching to a specific segment of unprofitable sales.

Deducting the gross margin that will be given up from the total escapable costs shows the net savings, or the addition to the net profits of the business, that will result from dropping the unprofitable sales. Thus, in the case illustrated in Table 5, the estimated increase in net profits amounts to $41,900.

Of course, if the gross margin that will be given up exceeds the expenses that will be saved, the manufacturer's net profits in the short run will be greater with, than without, these sales, even though they are relatively unprofitable.

In the long run, however, if an increase in the total volume of business leads to a need for expansion of facilities, the decision to retain this relatively unprofitable

TABLE 5. MANUFACTURER'S ANALYSIS OF ELIMINATION OF UNPROFITABLE COMMODITIES; NET SALES, $415,600; GROSS MARGIN, $75,600

Functional-Cost Groups	Allocated Costs	Escapable Costs	Nonescapable Costs
Investment in Finished Goods:			
Taxes on Stock	$ 5,000	$ 5,000	—
Insurance on Stock	4,500	4,500	—
Storage of Finished Goods	7,000	—	$7,000
Inventory Control:			
Salaries—Stock-Record Clerks	4,000	4,000	—
All Other	1,500	—	1,500
Order Assembly:			
Salaries—Warehouse Labor	12,000	12,000	—
Overhead	3,000	500	2,500
Packing and Shipping:			
Material	5,000	5,000	—
Labor	8,000	8,000	—
Overhead	1,000	—	1,000
Transportation:			
Freight, Express, and Parcel Post	12,000	12,000	—
Truck	3,000	500	2,500
Selling:			
Direct Selling Expense	35,000	35,000	—
Overhead	10,000	7,500	2,500
Advertising:			
Space and Other Direct Costs	15,000	15,000	—
Overhead	5,000	1,000	4,000
Order Entry:			
Salaries	3,000	2,000	1,000
Overhead	1,000	—	1,000
Billing:			
Salaries	6,000	5,000	1,000
Overhead	2,500	500	2,000
Total Costs	$143,500	$117,500	$26,000
Less: Gross Margin	—	75,600	—
Addition to Net Profits	—	$41,900	—

segment of business should be reconsidered. For if these sales are still relatively unprofitable, it may at that time be possible to substitute other more profitable sales and to operate at capacity with existing facilities. And the firm's net profits may exceed those that would result from expanding facilities and retaining the relatively unprofitable business.

It might be questioned why the nonescapable costs were allocated to sales in the first place. This is because, even though some of the costs could not be eliminated were certain sales dropped, it might be possible to shift the effort for which these expenses were incurred to other and more profitable uses.

These nonescapable costs represent a certain portion of the various functional cost groups that can be made available for alternative uses, if the relatively unprofitable segments of sales are eliminated. This may involve substitution of new commodities or customers, or merely elimination of the unprofitable ones and greater emphasis on those remaining. For example, selling effort may become available for a more intensive cultivation of the remaining customers, which may result in increased revenue with less-than-proportionate rise in expense.

In summary, efforts to reduce the ultimate cost of goods to the consumer, and at the same time to decrease the individual firm's costs and to increase its profits, might well be focused on the large segment of the consumer's dollar that distribution absorbs. Distribution cost analysis is a tool that offers to many businesses an important opportunity for reducing costs, lowering prices, and increasing net profits.

Chapter 21

A SURVEY OF COST ACCOUNTING IN INDUSTRY

By

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There is a considerable body of literature available on the subject of cost accounting. Most of it deals either with the theories upon which cost accounting procedures are, or should be, based, or with the application of the theories and procedures to specific problems of specific industries. This handbook is of itself a major contribution to that literature. This article differs in that it is not a substantive contribution to cost accounting as such. It presents the results of a survey that should be especially helpful to those who seek to learn the status and development of cost accounting in a wide range of industries. It describes cost accounting as it existed in about one hundred and fifty industries in the war years 1942-1946. The information presented will acquaint those interested in cost accounting methods to the present state of the art in a variety of industries. Everyone interested in the installation and operation of a cost system in a particular industry should become well oriented in that industry. This chapter should assist in that orientation.

The authors have drawn heavily on the data and findings of a survey conducted by them in 1946 for the Office of Price Administration. Two reports on the survey were released to the public by that agency. These had a very limited distribution. The information has been recast to be suitable for the purposes of this book and should be extremely useful in the present setting and context. The status of cost accounting in industry is set forth showing:

1. The extent to which cost accounting systems existed in the various industries.
2. The types of cost accounting systems in use in the various industries.
3. The availability of prime, manufacturing, and total unit costs in existing records and reports.

Some comments are made on cost practices in general. Brief specific comments are made on the cost practices of most of the industries covered in the study.

BACKGROUND AND METHOD OF THE STUDY

While the data presented in this chapter grew out of a project of the Office of Price Administration (OPA), the conclusions presented are not to be construed as representations of that office. The project referred to was an exhaustive examina-

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tion of the relationship between cost accounting methods and pricing policies. The extent to which unit pricing was based on costs determined by accounting was explored. Since an industrial census was too costly and impractical the studies were based on informed opinion and samples. Thousands of cost studies in the OPA were tapped by means of the questionnaire method from the OPA supervisory accountants who were in charge of particular fields and industries. The data obtained from the questionnaire were supplemented by responsible staff members and the industry analyses reviewed with the Accounting Division Directors of the OPA.

The data obtained and reported in a preliminary report (of April 8, 1946) had been used in testimony before the Banking and Currency Committee of the House of Representatives to show the impracticability of a general policy "cost-plus" pricing based on product costs (factory cost plus allocated general and selling costs). The testimony, based on the studies made, showed—

1. There is great variation in cost accounting methods.
2. Some industries were further advanced in application of cost accounting methods than others.
3. While in some industries cost could be broken down into costs by products, in other industries the necessary cost information to do so was unavailable (probably 85% of industrial companies do not allocate cost on a product basis).
4. Cost accounting tends to be more complete in larger companies—although not nearly to the extent usually supposed.

Cognizance of this testimony was taken by Congress. The Price Control Act of 1946 did not incorporate the concept of universal cost-plus pricing, but permitted the Price Administrator to base prices on the costs of a reasonable number of typical producers.

The final report on "Cost Accounting in Industry" covered the study of cost accounting in 150 industrial groups. It referred among other things to competition, industrial pricing, pricing tendencies under price control and some elaboration of cost accounting details for most of the industries surveyed.

Similar industries were grouped under the following classification:

I The Food Industries
II The Iron and Steel Industries
III The Nonferrous Metals Industries
IV The Lumber and Lumber Products Industries
V The Textiles and Apparel Industries
VI The Chemical Industries
VII The Rubber Industries
VIII The Fuel Industries
IX The Building Materials Industries
X The Paper Industries
XI The Machinery Industries
XII The Consumer Durable Goods Industries

This classification was our own and is somewhat arbitrary, although in general it conformed to the pattern used in the files of the OPA Accounting Department. The industries were selected and classified in this manner largely to keep the details of the survey within reasonable limits. Because of overlapping in multi-product companies, it is entirely possible that one company might be discussed under more than one heading.

We believe that the data secured in the survey are sufficiently representative to produce information from which broad conclusions can be drawn safely. No claim of statistical perfection or absolute accuracy is made. Since the findings are based on informed opinions and samples and not on a census, they cannot be construed as flat statements of incontrovertible fact. It is our belief that a census would not disclose great deviations from the conclusions which we have drawn. In any given instance, there might be exceptions, but we doubt that they would be important percentage-wise.

Our principal findings are presented in the accompanying tables in very brief form, because of space limitations. For this reason much explanatory material and many necessary qualifications have had to be omitted. For example, consider "Industrial Alcohol" listed under the Chemical Industries. The table shows that no company determined total cost. Actually, our findings show that no producer of industrial alcohol had accurately determined total cost. It should be further noted that most of the alcohol produced during the war was made by multi-product companies. In most of such companies, cost systems were utilized for management controls rather than the establishment of selling prices. A few small producers were single product companies. Perhaps one or more of these could have determined total costs on an average basis.

Definition of Terms

In our survey, we encountered the problem of defining terms. It was extremely difficult to define types of cost systems. Our experience indicated clearly that one or two words are not enough to use in titling a class, yet it is a common practice. For the purpose of the study, five main categories were established. These were defined as follows:

A job cost system collects each element of cost separately for each order worked on in the plant.

A process cost system collects costs and quantities by processes or operations on a time basis (usually daily, weekly, or monthly) and reduces the costs to an average cost per unit of product for each process or operation through which the product has passed.

A standard cost system provides a predetermined cost for each operation or unit of product. Standard costs are not actual current costs, but with proper adjustments for labor, material, and burden variances may be converted to actual cost. The predetermined cost is intended to represent the cost of direct material, direct labor, and manufacturing overhead normally required under efficient conditions at normal capacity to process a unit of product.

An estimating cost system provides estimates of the cost of production in advance of the actual production. In an estimating cost system, there is no attempt to establish cost standards such as are provided in a standard cost system. The costs may be based upon past actual cost, but are tempered by opinions on future actual costs. Generally, such cost estimates do not tie in with the accounting records.

Other cost systems might be called a "saving" classification. Under it appear items which cannot be placed under one of the preceding four classes.

We realize that the above definitions are not clear cut and that they are somewhat arbitrary, but we believe that they can be widely comprehended. Within each

class will be found varying kinds of systems. Standard cost systems, for example, may be good, mediocre, or worthless—depending upon whether or not the standards have been properly set and maintained. Estimating cost systems cover everything from those based upon highly accurate engineering and accounting estimations to what might be called "unreasoned guesses." These matters should be kept in mind when consulting the tabular material in this article.

In defining the stages of cost determination, we used well-established, perhaps old-fashioned, terminology. In this article, the following apply:

Prime Cost means the sum of the direct labor and the direct materials cost assigned to a specific product.

Manufacturing Cost is the sum of the prime cost and the factory burden allocated to a specific product.

Total Cost (total product cost or product cost) is the sum of the manufacturing cost and the selling and general administrative expenses allocated to a specific product. (Under certain circumstances total cost may include interest and other nonoperating charges.)

It should be borne in mind that costing a specific product in one industry may be quite different than in another. In lumber manufacture, for example, OPA found that costs are determined by product lines, but not by grades and species.

We also wish to have it clearly understood that all numbers and percentages set forth in the accompanying tables are to be regarded as approximations, since they are based on the experience of the OPA Accounting Department. It is not claimed that they are mathematically exact.

Some General Comments on Cost Practices

Generally speaking, companies with accounting systems have good records for labor and on materials. This is also true of many companies, which do not have formal cost systems. It seems reasonable to say, therefore, that prime costs are readily available or that they could be developed in most companies. In many cases, however, the development would be a very expensive and time consuming operation.

The distribution of factory overhead tends to vary from industry to industry and from plant to plant. In many individual plants, the method varies from department to department. Our experience would indicate that the most common method of applying burden is on the direct labor cost basis. Undoubtedly, the general availability of direct labor cost has had more to do with this than any other consideration. This method was found very useful for OPA purposes, because of the relative ease of verification. It seems to us that the practice ignores the fact that in many operations, expensive machinery is the prime factor. Furthermore, most fixed charges are a function of time.

The distribution of commercial overhead (selling and general expenses), by and large, leaves much to be desired. Our experience shows that the usual basis is sales dollars. All this does is to allocate such expenses on the basis of what the traffic will bear. There seems to be little effort to cost such items in accordance with rational measures of the various activities. It is true that some companies have carried the costing of distribution to great lengths, but such companies are rare.

Our general conclusion on cost practices would be that labor and materials are rather well handled in an accounting sense; that the distribution of factory over-

head leaves much to be desired; and that distribution cost accounting is more a matter of conversation than practice. The further inference can be made that prime costs are generally available and reasonably reliable; that factory costs are less so; and that total unit costs are neither generally available, nor reliable.

Some Specific Comments on Industry Cost Practices

Food Industries

The foods industries, as a whole, have not developed cost systems. In many of these industries process cost accounting is usable and, with very few exceptions, the companies where costs are determined have established such systems. Many of the companies are small, and these companies have not made use of cost data. This is illustrated in the meat industry where of the more than 12,000 processors, only the largest companies have systems. Standard cost systems have been established in only a small number of companies. In those companies with cost systems, cost can be measured generally by product classes, but it is usually impossible to measure cost by grades of the various products. Total cost is available, therefore, only as a part of the processing nature of the industry. Only in the cigarette industry were there found job order cost systems and these systems usually did not go beyond manufacturing cost. In a large number of companies material costs are determinable and allocations to products are, under the process cost systems, made on an averaging basis.

Iron and Steel Industries

The iron and steel industries appear to have a larger proportion of cost systems, and the majority of the systems are process cost. The production of iron ore is usually a single product production and total cost can be determined with a minimum of records. The beehive coke industry is ordinarily not concerned with joint costs as is encountered in the by-product coke industry. A larger percentage of the latter industry maintains costs, although the costs are not completely reliable for pricing an individual product. Very few companies are able to determine cost in the scrap field or in the warehousing of iron and steel products. Many companies in the production of castings maintain cost records, and while there are a few job costs systems, the majority of the systems are process cost or estimated cost. These industries can usually determine total cost although manufacturing cost may not be available. This is due to the fact that manufacturing overhead and selling and general expenses are usually applied together. The large majority of cost systems in use by companies producing tin cans was found to be on a basis of standard cost.

Nonferrous Metals Industries

The use of process cost accounting is almost universal among the companies in the nonferrous metals industries. Feldspar and mica are usually produced by smaller companies and few cost systems have been found. In the castings industries approximately 10% of the companies use cost records. The systems in use were found to be generally complete and reliable since many of the companies are single product companies. The cost systems do not usually allocate costs by type of casting.

Logging and Lumber Industries

It is impossible to estimate the number of producers engaged in logging operations, and probably very few producers maintain any cost records. There are numerous companies in lumber manufacturing, with about 40% of the volume being attributed to small companies; that is, companies with an annual sales volume under $250,000. None of these companies determine costs by grades of species. This is also true of the entire lumber and lumber products group of industries. Small companies account for more than 40% of the volume of the following production: Ties, poles, mine materials, piling, and industrial blocking; small dimension lumber; turned and shaped wooden products; flooring; and shingles. These small companies have few, if any, cost records. The systems which are in use in these industries are either process cost or estimated cost.

Apparel and Textile Industries

In general, with the exception of clothing manufacturing and shoe manufacturing, the producers of textiles and apparel have established cost systems. The systems are primarily either standard or estimated cost. The majority of the systems carry cost through total cost, although in the cotton textile industries experience has shown that not more than 60% of the systems are complete to this extent. Neither do the rayon, silk, and nylon manufacturers have complete systems. Not more than 25% of shirts, pajamas, underwear, and outer-wear manufacturers use cost systems, probably because this industry is composed of multi-product manufacturers. In general costs are allocated by price range and not by individual styles.

Drugs, Chemicals, and Pharmaceutical Industries

The manufacturers of drugs, which include fine chemicals, pharmaceuticals, biologicals, botanicals and narcotics, use process cost in compounding, standard cost in packaging, and batch cost in mixing. About one fourth of these companies have cost systems and apparently none of the systems determine total cost.

Industrial Alcohol, Paint, Cosmetic, and Similar Industries

Most of the industrial alcohol companies are multi-product companies and the process cost systems of those companies that attempt to determine cost do not cover total cost. The same is true of other industries in this general field. There are many producers of cosmetics and paint, but their process cost systems do not go beyond manufacturing cost. Probably not more than a dozen of the 2000 producers of naval stores have any kind of cost systems, and none go beyond manufacturing cost. In the fertilizer industry, approximately 25% of the cost systems will determine total cost.

Rubber Industries

The rubber industries, more than any other group of industries, appear to have uniformity of cost finding. This is largely due to the fact that many rubber companies base their accounting to a large extent upon the "Uniform Accounting Manual for the Rubber Manufacturing Industry" published by their trade association. The Manual presents a detailed description of cost keeping for each segment to the industry and is so devised that the procedures are useful to both large and

small companies. It gives complete descriptions of cost allocations as well as charts of the general ledger and the cost accounts. No information is given on the attached table in regard to reclaimed rubber since thousands of junk yards perform some functions in the processing and these yards keep no cost data. It should be noted that the manufacturers of tires and tubes almost universally use standard cost records. The accuracy of the standard costs of these companies, as well as the other companies in the rubber industries, at present is questionable, because many of the companies have not adjusted their standard cost for a relative long period of time and analyses have not been made of variations from standards. Without such analysis it is impossible to arrive at a current actual unit cost.

Anthracite-Bituminous Coal Industry

The producers of anthracite and bituminous coal are usually single product producers and, if these producers maintain general accounts, the determination of costs is a simple mathematical process. Crude oil producers representing about 60% of production probably have good cost systems with costs determined on a per-barrel basis for their production as a whole. About 20 integrated companies produce approximately 60% of the output, 60 large independents produce possibly 15%, and the remaining 17,000 small independents about 25%. The small companies do not have cost records. The majority of petroleum refiners use some form of process cost, and several of the larger companies use a standard predetermined cost. Refiners have the problem of joint costs and usually make their allocations of crude oil costs on the admittedly arbitrary basis of sales value of the finished product.

Building Materials Industries

The majority of the members of the building materials industries maintain cost records. Producers of brick and tile are exceptions. In these industries less than 5% of the companies have cost systems and probably as many as 40% of these systems do not go beyond prime cost. No attempts are made to divide costs between types of products. A large percentage of the producers of builders hardware, asphalt and tarred roofing, and lime use standard cost. In these industries costs are usually not broken down by grades, but are determined by product lines.

Paper Industries

All types of cost systems are found among members of the paper industries, with, possibly, a majority of the systems being based on standard cost. Job cost is used primarily in the production of boxes. The producers of pulp wood are small operators, and cost systems are rare. Many of these producers lack even financial records.

Machinery Industries Cost Practices

Under the machinery industries, we have grouped the following producers: Passenger automobiles, commercial vehicles, automotive parts, piston rings, machine tools, farm machinery, miscellaneous farm equipment, construction equipment, woodworking machinery, textile machinery, oil field equipment, transportation equipment, industrial heating, wire and cable, radio tubes, radio parts, industrial gears, plastics, drop forgings, industrial ceramics, screw machine prod-

ucts, industrial services, and dies, jigs, and tools. Since the tables at the end of the chapter do not show details of these industries, a fuller discussion is included here. The entire group of the industries was sampled and the tables contain the results of the sample.

Automobile and Automotive Parts Industries

All of the manufacturers of passenger automobiles maintain well-organized cost systems, but the systems are designed primarily to facilitate managerial control rather than to develop unit costs. The manufacturers of small and medium-sized trucks generally use standard cost systems while the manufacturers of large trucks and special order equipment usually follow the job-cost system. Most accounting systems do not tie in with the general books. The manufacturers of motorcycles generally use standard cost integrated with the general books. About 80% of the automotive parts industry use standard cost. The smaller companies have no formal cost systems of any nature, but rely upon rather infrequent time studies or upon pilot runs. The use of standard costs is almost universal among the members of the piston rings industry, although in this industry it has been found to be extremely difficult to analyze variance accounts.

Tool Manufacturing Industry

The cost accounting methods of some 80 machine tool manufacturers, accounting for approximately one third of the industry's normal sales volume, have been examined. Approximately 50% of the larger manufacturers have well-designed cost systems integrated with, and controlled by, the general books. About 20% of the smaller companies, primarily single-product companies, likewise have good cost systems.

Farm Machinery Manufacturers

The eight major manufacturers of farm machinery generally use standard cost, although during the past few years their variance accounts have become so large that they seriously impair the value of original standards. The producers of miscellaneous farm equipment (hand plows, plow parts, and nonmechanical equipment) are generally small enterprises competing for localized markets. Few of these companies have well-integrated cost systems.

Construction Equipment Industry

The very large companies in the production of construction equipment maintain well-designed standard cost systems. The smaller manufacturers generally employ only statistical cost records. A few large companies in the woodworking machinery industry employ either standard cost or job cost. Outside of these very few large companies, the remaining companies have a more or less complete lack of cost records.

Textile Machinery Manufacturing Industry

Most of the larger manufacturers of textile machinery have standard cost systems integrated with the general books, but the effect of war-caused variances has been enormous. Practically all manufacturers of textile machinery accessories were

visited by OPA accountants, and these accountants did not find even one dependable cost system in operation.

Oil Field Equipment Industry

The larger producers of oil field equipment maintain exceptionally accurate cost records which are integrated with the general books. Few of the medium-sized or small producers maintain other than a statistical record of historical cost and then only to the prime cost level.

Locomotive Manufacturing Industry

All manufacturers of locomotives employ job-cost systems and about two thirds of these systems are integrated with the general books. The manufacturers of cars also employ job cost, but less than half of the companies have their costs integrated with the general books.

Industrial Heating Equipment Industry

The industrial heating industry is dominated by three large companies, two of which maintain cost systems integrated with the general books, whereas the third maintains no cost system whatsoever. The smaller companies do not have adequate cost systems.

Wire and Cable Industry

Almost all companies in the wire and cable industry use identical costing methods; that is, a standard process cost system with predetermined overhead rates for each cost center. In general the manufacturers are using the cost systems for cost estimating purposes only and make no attempt to measure variations from standard.

Radio Tube Manufacturing Industry

Most radio tube producers use standard costs, but during the war period rapidly changing product designs and specifications wrecked all but a very small percentage of the standard cost systems. There is a distinct absence of cost finding in the radio parts industry. Less than 20% of the manufacturers of radio parts maintain cost systems integrated with the general books, although approximately one half of the industry make some attempt to estimate cost in advance of production.

Industrial Gears Industry

Experience shows that very few companies in the industrial gears industry maintain historical cost records but a great many use elaborate cost estimating records. The predominant use of machine hour rates in cost estimating coupled with the lack of time records has made the development of actual current unit cost an almost impossible task.

Plastics Industry

The fabrication of plastics is a comparatively new industry and there is much need for improvement in costing. With few exceptions, only the large producers practice cost finding. Medium-sized and small molders seldom use any cost system whatever, but rely upon the estimates of their shop superintendents.

Drop Forging Industry

The drop forgings industry is extremely cost conscious, but more emphasis is laid upon estimating cost for pricing purposes than on accumulating historical cost. Apparently the majority of companies estimate and accumulate costs on the basis of standard rates per machine hour, but, generally speaking, they fix standard rates on a theoretical level of operations and made no automatic change in rates at varying levels of plant operation.

Industrial Ceramics Industry

Producers of industrial ceramics generally employ process cost methods and experience has shown that these costs are seldom complete and accurate enough for pricing purposes since the cost systems are frequently designed to provide only a basis for cost estimating.

Screw Machine Products Industry

Companies producing screw machine products, in general, make no effort to determine historical unit cost of products through the books of account. Cost estimates based upon machine hour rates form the basis for pricing new products in practically all shops. Since these estimates make no provision for possible changes in the rate of plant utilization, the results frequently bear little relationship to actual operating cost.

Industrial Services

For industrial services, costs are usually maintained on a departmental basis, but have not been reliable because of the failure to differentiate between services performed for revenue and services performed as part of the sales function. Cost records are almost nonexistent in the thousands of small shops that offer industrial services to localized markets.

Dies, Jigs, and Tools Industry

Several comparatively large companies in the dies, jigs, and tools industry maintain job cost records by which actual costs may be determined. The vast majority of the manufacturers, however, seldom maintain cost records of any nature.

Consumer Durable Goods Industries

The majority of companies in the consumer durable goods industries do not have cost systems. This is especially true in that portion of the industries where there are many small companies. In these industries job-cost systems and estimated cost systems predominate with very few companies using process cost. The larger companies producing radio receivers and phonographs usually employ standard cost. The small companies perform mostly an assembling operation and do not have reliable cost systems. The housewares industry is dominated by small, nonintegrated, single-line companies and less than 5% of these companies have cost systems of any type. Likewise, the hardware industry and the luggage industry are predominantly small or medium-sized producers and less than 10% of these companies have any kind of cost system. The production of electrical appliances

is to a large extent accounted for by larger companies and a much larger percentage have cost systems (for small electrical appliances 50% have cost systems, whereas for major electrical appliances the percentage is 90%). These systems are to a very large extent standard cost systems. The vast majority of the one thousand producers of mattresses, pillows, and sleeping equipment are small companies and not more than 5% of these bedding manufacturers have cost systems. In the production of upholstered furniture and wood furniture the producers are also generally small or medium-sized companies, and it is estimated that not more than 10-15% have cost systems. These systems are usually job cost or estimated cost. As shown in the following tables, there are relative few cost systems among the producers of toys and games, cooking and heating stoves, and caskets.

Some Implications of the Study

The widespread absence of cost data indicates that business management in the majority of cases is failing to use the valuable tool of cost accounting for either managerial or pricing purposes. It would appear, therefore, that the much talked about "know how" that American business is supposed to possess should be subjected to a rigorous analysis. Obviously, we know how to produce, process, and manufacture commodities in astronomical quantities, when almost all emphasis is on output and cost is a minor consideration, as it was during World War II. The real question is: Do we know how to produce and fabricate commodities and then distribute them in a way that will enable us to keep the wheels rolling day after day and year after year, when cost is a major consideration?

Our economic history shows to date that much of the time our capacity to produce has outrun our ability to distribute on a continuing profitable basis. We may well expect that in the next highly competitive market era, maximum economies in both production and distribution costs will have to be effected if a given producer is to make a profit, or even stay in business. Such economies cannot be achieved without a full knowledge of costs—a full knowledge of costs requires an adequate cost accounting system.

While many companies already have good cost accounting systems and staffs of competent accountants, a substantial majority either are without cost systems or possess cost systems that are inadequate.

Public accounting firms and management firms specializing in cost accounting systems work would appear to have a much more fertile field for their services than has been previously recognized. A full exploitation of the opportunity on an ethical plane, in our opinion, would have two rewards:

1. Substantial fees would be earned.
2. A distinct public service would be rendered.

It is conceivable that widespread usage of cost accounting might do much to ameliorate the vicissitudes of the business cycle.

EXTENT OF COST SYSTEMS

	Approximate Number of Companies in the Industry	*Percentage of Companies with Cost Systems*
The Food Industries:		
Baby Food	5	80
Breakfast Cereals	50	20
Canned and Frozen Fruits and Vegetables	2,500	2
Chewing Tobacco and Snuff	50	10
Cigarettes and Smoking Tobacco	60	20
Cigars	3,200	5
Citrus Canners	30	10
Dried Fruits	34	10
Fresh Deciduous Fruit Packers	2,500	Practically none
Grape Juice	12	40
Honey (Packaging)	225	Practically none
Jams, Jellies, and Preserves	430	2
Malt Beverages	450	80
Meat	12,000	1
Olives (Spanish Imported)	35	Practically none
Peanut Butter	160	15
Peanut Shellers	60	40
Pickles (Cucumbers)	200	1
Rice Milling	75	Practically none
Sardines (Maine)	25	Practically none
Soup and Pork and Beans	120	Practically none
Sugar (Raw Cane)	40	Practically none
Sugar (Refined Cane)	17	95
Sugar (Refined Beet)	23	Not available
Tuna Fish (West Coast)	25	25
The Iron and Steel Industries:		
Iron Ore	Not available	100
Beehive Coke	75	25
By-Product Coke	84	90
Iron and Steel Scrap	8,000	5
Pig Iron (Merchant)	20	100
Steel Mills Products	300	80
Warehousing Iron and Steel	2,500	5
Tin Cans	100	20
Nuts, Bolts, Screws, and Rivets	325	50
Grey Iron Castings	3,000	25
Malleable Iron Castings	100	50
Steel Castings	250	80
The Nonferrous Metals Industries:		
Barytes	52	12½
Coated and Bonded Abrasives	9	100
Fluorspar	60	100
Zinc Oxide	11	100
Feldspar	30	10

	Approximate Number of Companies in the Industry	*Percentage of Companies with Cost Systems*
Mica	22	10
Aluminum Castings	80	10
Copper Base Castings	625	10
Magnesium Castings	40	10
The Lumber and Lumber Products Industries:		
Logging	Not available	Practically none
Lumber Manufacturing	40,000	10
Veneer	200	40
Ties, Poles, Mine Materials, Piling, Industrial Blocking	5,000	10
Plywood	300	40
Small Dimension Lumber	250	10
Turned and Shaped Wood Products	1,000	10
Flooring	500	30
Shingles	500	10
The Textiles and Apparel Industries:		
Leather Tanning	300	75
Leather (Shoe Manufacturing)	1,300	10
Cotton Textiles	1,200	90
Woolen and Worsted Textiles	1,000	85
Rayon, Nylon, and Silk Manufacturers	1,050	85
Manufacturers of Shirts, Pajamas, Underwear, and Outer Clothing	15,000	25
The Chemical Industries:		
Drugs (Manufacturing, Compounding and Importing)	300	25
Industrial Alcohol	155	20
Insecticides	100	80
Plastic Materials	300	75
Wood Distillates	50	10
Gases (Chlorine—Formaldehyde)	40	75
Acids (Citric—Phenol—Sulphuric)	75	75
Coal Tar Derivatives (Pitch—Creosote)	50	95
Tanning Extracts	25	90
Adhesives (Glue—Casein)	50	90
Perfumes and Cosmetics (Essential Oils—Coumarin)	500	50
Soap	75	50
Paints (Pigments—Shellac)	250	90
Naval Stores (Rosin—Turpentine)	2,000	1
Fertilizers and Fertilizer Materials	150	90
The Rubber Industries:		
Coated and Combined Rubber Fabrics	160	50
Drug Sundries	40	80
Rubber Footwear	11	80
Heels and Soles	30	60
Mechanical Rubber Goods	250	50

	Approximate Number of Companies in the Industry	*Percentage of Companies with Cost Systems*
Tires and Tubes	30	100
Miscellaneous Rubber Products	130	60
The Fuel Industries:		
Anthracite Coal Producers	200	75
Bituminous Coal Producers	15,000	80
Crude Petroleum	18,000	60
Petroleum Refining	500	60
The Building Materials Industries:		
Brick and Tile	500	5
Asphalt and Tarred Roofing	40	80
Builders' Hardware	100	90
Refractories	180	80
Cement	85	90
Sheet Glass	7	85
Lime	210	70
Gypsum	10	90
Prefabricated Dwelling Structures	100	90
The Paper Industries:		
Paper and Paperboard	510	90
Boxes	1,400	65
Wood Pulp	255	90
Pulp Wood	10,000	10
Miscellaneous Paper Converters	9,000	60
The Consumer Durable Goods Industries:		
Radio Receivers and Phonographs	220	10
Pianos	50	10
Small Firearms	15	33
Housewares (Cooking Utensils, Mops, Brooms, Stools, Etc.)	10,000	5
Hardware (Hand Tools, Lawn Mowers, Wheelbarrows, Blow Torches, Etc.)	800	10
Luggage	300	10
Small Electrical Appliances	70	50
Bedding	1,000	5
Wood Furniture	4,200	10
Metal Household Furniture	775	30
Upholstered Furniture	3,800	15
Wool Floor Coverings	25	60
Hard Surface Floor Coverings (Linoleum and Felt Base)	11	100
Toys and Games	1,600	30
Wheel Goods	50	50
Major Electrical Appliances (Refrigerators, Washing and Ironing Machines and Vacuum Cleaners)	50	90
Cooking and Heating Stoves	200	20
Office Machines and Equipment	60	80
Caskets	1,200	15

THE MACHINERY INDUSTRY

Sales Volume	*Number of Companies*	*Costs Integrated With Books*	*Statistical Costs*	*No Costs Available*
Under $500,000	333	24	36	273
$500,000—$2,000,000	177	41	39	97
Over $2,000,000	189	85	18	86

Note: The types of industries included under Machinery are discussed in the text material. Information was not available as to the number of companies in the various industries. A sample was taken of the cases in the OPA Accounting Department files with the results as shown above. It is believed by the authors that the relative availability of these cost data is applicable to the individual industries under this general heading.

TYPES OF COST SYSTEMS

	Of Those Companies with Cost Systems			
	Percentages Having			
	Job Cost	Process Cost	Standard Cost	Estimated Cost
The Food Industries:				
Baby Food		100		
Breakfast Cereals		90	10	
Canned and Frozen Fruits and Vegetables		100		
Chewing Tobacco and Snuff		100		
Cigarette and Smoking Tobacco	5	90	5	
Cigars		100		
Citrus Canners		100		
Dried Fruits		100		
Fresh Deciduous Fruit Packers		No cost systems		
Grape Juice		50	50	
Honey (Packaging)		No cost systems		
Jams, Jellies, and Preserves		100		
Malt Beverages		100		
Meat		100		
Olives (Spanish Imported)		No cost systems		
Peanut Butter		100		
Peanut Shellers		100		
Pickles (Cucumbers)		Insufficient number of cost systems to classify		
Rice Milling		No cost systems		
Sardines (Maine)		No cost systems		
Soup and Pork and Beans		Insufficient number of cost systems to classify		
Sugar (Raw Cane)		No cost systems		
Sugar (Refined Cane)		100		
Sugar (Refined Beet)		100		
Tuna Fish (West Coast)		50	50	

	Of Those Companies with Cost Systems			
	Percentages Having			
	Job Cost	Process Cost	Standard Cost	Estimated Cost
The Iron and Steel Industries:				
Iron Ore		100		
Beehive Coke		75		25
By-Product Coke		100		
Iron and Steel Scrap		100		
Steel Mill Products		90	5	5
Warehousing Iron and Steel		Not available		
Tin Cans			100	
Nuts, Bolts, Screws, and Rivets				100
Grey Iron Castings	25	75		
Malleable Iron Castings	20	80		
Steel Castings	10	90		
Pig Iron (Merchant)		100		
The Nonferrous Metals Industries:				
Barytes		100		
Coated and Bonded Abrasives		100		
Fluorspar		100		
Zinc Oxide		100		
Feldspar		100		
Mica		100		
Aluminum Castings		100		
Copper Base Castings		100		
Magnesium Castings		100		
The Lumber and Lumber Products Industries:				
Logging		Insufficient number of cost systems to classify		
Lumber Manufacturing		100		
Veneer		50		50
Ties, Poles, Mine Materials, Piling, Industrial Blocking		100		
Plywood		50		50
Small Dimension Lumber		100		
Turned and Shaped Woods Products		100		
Flooring		100		
Shingles		100		
The Textiles and Apparel Industries:				
Leather Tanning			100	
Leather (Shoe Manufacturing)			100	
Cotton Textiles			60	40
Woolen and Worsted Textiles			65	35
Rayon, Nylon, and Silk Manufacturers			65	35
Manufacturers of Shirts, Pajamas, Underwear, and Outer Clothing			100	

	Of Those Companies with Cost Systems			
	Percentages Having			
	Job Cost	Process Cost	Standard Cost	Estimated Cost
The Chemical Industries:				
Drugs (Manufacturing, Compounding, and Importing)		50	50	
Industrial Alcohol		100		
Insecticides		100		
Plastic Materials			50	50
Wood Distillates		75		25
Gases (Chlorine, Formaldehyde)		100		
Acids (Citric, Phenol, and Sulphuric)	20	70	10	
Coal Tar Derivatives (Pitch, Creosote)				100
Tanning Extracts		100		
Adhesives (Glue, Casein)		100		
Perfumes and Cosmetics (Essential Oils, Coumarin)			50	50
Soap		100		
Paints (Pigments, Shellac)		75	25	
Naval Stores (Rosin, Turpentine)		50		50
Fertilizers and Fertilizer Materials		50		50
The Rubber Industries:				
Coated and Combined Rubber Fabrics	50		10	40
Drug Sundries	33		33	33
Rubber Footwear			100	
Heels and Soles			50	50
Mechanical Rubber Goods	25		50	25
Reclaimed Rubber		Not available		
Tires and Tubes			100	
Miscellaneous Rubber Products	40		20	40
The Fuel Industries:				
Anthracite Coal Producers		100		
Bituminous Coal Producers		100		
Crude Petroleum		Not available		
Petroleum Refining		90	10	
The Building Materials Industries:				
Brick and Tile		100		
Asphalt and Tarred Roofing		30	70	
Builders' Hardware			80	20
Refractories		55		45
Cement		100		
Sheet Glass			67	33
Lime		100		
Gypsum		100		
Prefabricated Dwelling Structures				100

	Of Those Companies with Cost Systems			
	Percentages Having			
	Job Cost	Process Cost	Standard Cost	Estimated Cost
The Paper Industries:				
Paper and Paperboard	15	25	50	10
Boxes	60	5	5	30
Wood Pulp	10	30	60	
Pulp Wood	25	75		
Miscellaneous Paper Converters	15	70	5	10
The Consumers Durable Goods Industries:				
Radio Receivers and Phonographs			90	10
Pianos	50		50	
Small Firearms			100	
Housewares (Cooking Utensils, Mops, Brooms, Stools, etc.)	100			
Hardware (Hand Tools, Lawn Mowers, Wheelbarrows, Blow Torches)	33		33	33
Luggage	50			50
Small Electrical Appliances			75	25
Bedding			75	25
Upholstered Furniture	33		33	33
Wood Furniture	100			
Metal Household Furniture	40		20	40
Wool Floor Coverings		100		
Hard Surface Floor Coverings (Linoleum and Felt Base)		67		33
Toys and Games	10			90
Wheel Goods			20	80
Major Electrical Appliances (Refrigerators, Washing and Ironing Machines, and Vacuum Cleaners)			90	10
Cooking and Heating Stoves			67	33
Office Machines and Equipment			75	25
Caskets	20			80

THE MACHINERY INDUSTRIES

Sales Volume	*Number of Companies*	*Job Cost*	*Process Cost*	*Standard Cost*	*Unknown*
Under $500,000	60	46	3	9	2
$500,000—$2,000,000	80	51	8	18	3
Over $2,000,000	103	43	21	39	—

Note: The types of industries included under Machinery are discussed in the text material. Information was not available as to the types of systems in the various industries. A sample was taken of the cases in the OPA Accounting Department files with the results as shown above. It is believed by the authors that the above distribution is applicable to the individual industries under this general heading unless contrary comments are made in the text material.

EXTENT OF COST DETERMINATION

	Of Those Companies with Cost Systems		
	Extent of Cost Determination—in Per Cent		
	Prime Cost	Manufacturing Cost	Total Cost
The Food Industries:			
Baby Food	100	100	100
Breakfast Cereals	100	100	25
Canned and Frozen Fruits and Vegetables	100	100	100
Chewing Tobacco and Snuff	100	100	100
Cigarette and Smoking Tobacco	100	100	80
Cigars	100	100	100
Citrus Canners	50	50	50
Dried Fruit	100	100	100
Fresh Deciduous Fruit Packers		No cost systems	
Grape Juice	100	50	None
Honey (Packaging)		No cost systems	
Jams, Jellies, and Preserves	100	50	None
Malt Beverages	100	100	100
Meat	100	100	100
Olives (Spanish Imported)		No cost systems	
Peanut Butter	100	100	100
Peanut Shellers	100	100	100
Pickles (Cucumbers)	1 (Company)	1 (Company)	None
Rice Milling		No cost systems	
Sardines (Maine)		No cost systems	
Soup and Pork and Beans		100	None
Sugar (Raw Cane)		No cost systems	
Sugar (Refined Cane)	100	100	100
Sugar (Refined Beet)		Not available	
Tuna Fish (West Coast)	100	100	100
The Iron and Steel Industries:			
Iron Ore		Not available	
Beehive Coke		Not available	
By-Product Coke		Not available	
Iron and Steel Scrap	Very few	None	None
Pig Iron (Merchant)	100	100	100
Steel Mill Products	95	95	95
Warehousing Iron and Steel		Not available	
Tin Cans	100	100	Not available
Nuts, Bolts, Screws, and Rivets		Not available	
Grey Iron Castings	100	75	100
Malleable Iron Castings	100	75	100
Steel Castings	100	50	100
The Nonferrous Metals Industries:			
Barytes		100	
Coated and Bonded Abrasives	100	100	100
Fluorspar		Not available	

	Of Those Companies with Cost Systems		
	Extent of Cost Determination—in Per Cent		
	Prime Cost	Manufacturing Cost	Total Cost
Zinc Oxide	100	100	100
Feldspar	100	100	100
Mica		100	
Aluminum Castings	100	100	100
Copper Base Castings	100	100	100
Magnesium Castings	100	100	100
The Lumber and Lumber Products Industries: In these industries costs can very frequently be determined by product lines, but no company regularly determines costs by species or grades.			
The Textiles and Apparel Industries:			
Leather Tanning	100	100	100
Leather (Shoe Manufacturing)	100	100	100
Cotton Textiles	70	60	60
Woolen and Worsted Textiles	100	100	100
Rayon, Silk, and Nylon Manufacturers	65	60	60
Manufacturers of Shirts, Pajamas, Underwear, and Outer Clothing	100	100	100
The Chemical Industries:			
Drugs (Manufacturing, Compounding, and Importing)	100	50	None
Industrial Alcohol	100	100	None
Insecticides	100	100	50
Plastic Materials	100	100	5
Wood Distillates	100	100	None
Gases (Chlorine, Formaldehyde)	100	100	None
Acids (Citric, Phenol, Sulphuric)	100	100	None
Coal Tar Derivatives (Pitch, Creosote)			None
Adhesives (Glue, Casein)	100	100	2
Tanning Extracts	100	100	5
Perfumes and Cosmetics (Essential Oils, Coumarin)	100	100	None
Soap	100	100	None
Paints (Pigments, Shellac)	100	100	Not available
Naval Stores (Rosin, Turpentine)	100	100	None
Fertilizers and Fertilizer Materials	100	100	25
The Rubber Industries:			
Coated and Combined Rubber Fabrics	Not available		60
Drug Sundries	Not available		85
Rubber Footwear	100	100	75
Heels and Soles	Not available		75
Mechanical Rubber Goods	Not available		75
Reclaimed Rubber	Not available		
Tires and Tubes	Not available		
Miscellaneous Rubber Products	Not available		75

	Of Those Companies with Cost Systems		
	Extent of Cost Determination—in Per Cent		
	Prime Cost	Manufacturing Cost	Total Cost
The Fuel Industries:			
Anthracite Coal Producers	Not available		75
Bituminous Coal Producers	Not available		80
Crude Petroleum	Not available		
Petroleum Refining	Not available		
The Building Materials Industries:			
Brick and Tile	100	60	60
Asphalt and Tarred Roofing	100	90	90
Builders' Hardware	100	90	90
Refractories	100	100	90
Cement	100	100	60
Sheet Glass	100	100	75
Lime	100	100	60
Gypsum	Not available on individual types		
Prefabricated Dwelling Structures	100	40	40
The Paper Industries:			
Paper and Paperboard	90	75	50
Boxes	90	75	50
Wood Pulp	90	75	50
Pulp Wood	Not available		None
Miscellaneous Paper Converters	90	75	65
The Consumer Durable Goods Industries:			
Radio Receivers and Phonographs	Not available		
Pianos	100	100	None
Small Firearms	100	100	None
Housewares (Cooking Utensils, Mops, Brooms, Stools, Etc.)	100	100	None
Hardware (Hand Tools, Lawn Mowers, Wheelbarrows, Blow Torches, etc.)	100	Very few	Very few
Luggage	100	100	None
Small Electrical Appliances	100	100	None
Bedding	100	75	None
Upholstered Furniture	100	10	2
Wood Furniture	100	100	Very few
Metal Household Furniture	100	100	None
Wool Floor Coverings	100	100	50
Hard Surface Floor Coverings (Linoleum, Felt Base)	100	100	None
Toys and Games	100		10
Wheel Goods	100	100	10
Major Electrical Appliances	100	100	100
Cooking and Heating Stoves	100	100	Very few
Office Equipment and Machines	100	100	None
Caskets	80	20	20

Chapter 22

IMPACT OF GOVERNMENT ON COST ACCOUNTING

By
CHARLES H. TOWNS *

Introductory

The subject, "Impact of Government on Cost Accounting," is somewhat like that of the effect of environment on an individual. It is more than a matter of one factor or element. Even at one time an individual is likely to be affected by darkness or daylight, heat or cold, presence or absence of other persons, whether his train does or does not arrive on time, and by other factors too numerous to mention. Similarly, government has affected and continues to affect cost accounting by establishment of conditions under which cost accounting has been developed and is used, by regulation of interstate commerce including the related accounting, by taxation and the pertinent accounting requirements, by wartime contracts and related cost accounting regulations, and in numerous other ways.

It is probably impossible, at any given instant, to remember and estimate the effect, at that time, of all governmental factors which have a bearing on cost accounting. However, a review of the development of some of the major governmental attitudes and positions which have affected it should assist in giving at least a general idea of the present influence of government upon it. Such a review may give ideas as to future trends. However, one should frequently re-check any conclusions which he may form on this matter. There is considerable uncertainty as to the relationship which the majority of the citizens of this country will believe that government should have to business and accounting, in the postwar period. There is also much uncertainty as to the effect which our participation in international affairs may have upon the relation of our government to business and accounting. For example, we cannot now estimate reliably what government or governments will exercise any necessary or appropriate controls over international communication or transportation businesses or businesses that produce goods in one country and sell them in another. We cannot tell to what extent such controls may be exercised by national governments and to what extent they may be in the hands of some form of international government. Any such controls of business may have more or less relation to cost accounting.

In this chapter an attempt will be made to treat the subject objectively. Therefore, any wording which may seem to classify the impact of government on cost accounting as "good" or "bad," in general, is not intentional. However, we must recognize that if we had no government there would probably be no cost accounting; that if our government had not been founded and developed on a basis of

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personal freedom, private property, and freedom of individual initiative in business, we should probably not have developed cost accounting to its present status; that if government had not established monetary standards and standards of weights and measures we can scarcely imagine from what source we could have obtained such basic essentials of cost accounting; and that some sound and constructive publications on cost accounting have been issued and some thoroughly practical procedures in cost accounting have been followed, by governmental organizations. On the other hand, we must recognize that government requirements have sometimes added to the cost of cost accounting; that decisions have been made by governmental units which have interfered with the application of sound cost accounting methods; and that cost accounting reported to have been followed for some governmental operations has not set sound examples for others to follow. These points are mentioned merely as examples of the fact that the influence of government on cost accounting is not considered to be entirely favorable nor entirely unfavorable.

We turn now to more specific features of the subject and take up some of the steps of government in the past, which have particularly affected cost accounting.

Regulation of Interstate Commerce

Numerous laws have been enacted by Congress under the provision of the Constitution empowering it to regulate interstate commerce. Those which are applicable under ordinary conditions and appear to have affected cost accounting generally to a considerable degree include:

The Sherman Anti-Trust Act of July 2, 1890
The Federal Trade Commission Act of September 26, 1914
The Clayton Anti-Trust Act of October 15, 1914
Price Discrimination Act (Robinson-Patman Act) of June 19, 1936 (amending the Clayton Anti-Trust Act)

In addition to the foregoing, numerous laws have been enacted for the regulation of special industries. Several of these include provisions under which costs are described or "defined" and authorizations are given to investigate costs, have costs reported to commissions, etc.

The Sherman Anti-Trust Act

This Act provides that "Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is hereby declared to be illegal."

This relates to cost accounting chiefly in two ways. First, it bears upon methods of cost accounting and uses of cost data as those methods and uses tend to restrain trade. Secondly, this law has resulted in investigations of costs and cost accounting methods and the reports on the investigations have reacted upon cost accounting procedures; this second effect has been produced to a greater degree, however, under the Clayton Anti-Trust Act and the Federal Trade Commission Act of 1914.

With reference to the relation of cost information to restraint of trade, this subject appears to have arisen mainly in cases involving trade associations. For example, the U. S. Supreme Court is reported to have held, in Maple Flooring

Manufacturers' Association et al. vs. United States (268 U.S. 563) that trade associations which (among other things) openly and fairly gather and disseminate information as to the cost of their product, without reaching or attempting to reach any agreement or concerted action respecting prices, production, or the restraining of competion, do not thereby engage in an unlawful restraint of commerce.

A Federal District Court in New York held, in United States vs. National Container Association et al., that the association might gather and disseminate information as to trade costs, and certain other information, but without specifying the selling price to be charged.

On the other hand, in the case of United States vs. National Lumber Manufacturers Association the Federal District Court for the District of Columbia enjoined the Association (by a consent decree) from distributing statistics of production costs unless such information were made fully and fairly available to all interested persons and not in such form as to identify any particular concern.

Under a consent decree in a Federal District Court in New York, in United States vs. Bolt, Nut & Rivet Manufacturers Association, the Association was ordered dissolved and its members were enjoined from doing a number of things which included concertedly maintaining, quoting from, or using any price list, or average or arbitrary cost or profit figures prepared by the Association.

Clayton Anti-Trust Act
Federal Trade Commision Act

These two acts are closely related. They were enacted in the year 1914. Both have had substantial effects upon cost accounting practices and uses of costs.

The Clayton Act makes unlawful certain price discriminations, trade agreements, and other acts and practices. The provisions as to price discrimination and quantity discounts were amended in 1936 by the Price Discrimination Act, commonly known as the Robinson-Patman Act. This amendment includes exceptions to the general prohibition against discrimination in price between different purchasers of commodities of like grade and quality, one of which reads as follows:

"Provided, That nothing herein contained shall prevent differentials which make only due allowance for differences in the cost of manufacture, sale, or delivery resulting from the differing methods or quantities in which such commodities are to such purchasers sold or delivered: Provided, however, That the Federal Trade Commission may, after due investigation and hearing to all interested parties, fix and establish quantity limits, and revise the same as it finds necessary, as to particular commodities or classes of commodities, where it finds that available purchasers in greater quantities are so few as to render differentials on account thereof unjustly discriminatory or promotive of monopoly in any line of commerce; . . ."

This provision alone has resulted in much review and some extensions or revisions of cost accounting systems of corporations, by company personnel and study of the resulting cost data by government representatives. A number of opinions have been rendered by the Federal Trade Commission under this provision. References to several of these opinions will be given subsequently.

The Federal Trade Commission Act, which has been amended since 1914, but without changing its general purpose or methods, created the Federal Trade Commission, a body of five members, with power to employ "attorneys, special experts,

examiners, clerks and other employees . . . ." The Commission is empowered "to prevent persons, partnerships, or corporations" (with certain exceptions including banks, common carriers, and air carriers which are otherwise regulated) "from using unfair methods of competition in commerce and unfair or deceptive acts or practices in commerce." The Act also gives the Commission power "To gather and compile information concerning, and to investigate from time to time the organization, business, conduct, practices, and management of any corporation engaged in commerce, excepting banks and common carriers subject to the Act to regulate commerce, and its relation to other corporations and to individuals, associations and partnerships." The Commission is further empowered to require corporations to make reports, to investigate and act upon certain violations of statutes and noncompliance with orders, to publish information obtained by it, to classify corporations and to make rules and regulations for the purpose of making the Act effective.

Five case references are given in the annotations under the Clayton Act as it stood before amendment by the Robinson-Patman Act, in the Trade Regulation Service of Commerce Clearing House, Inc., in which decisions have been promulgated or investigations made with regard to selling goods below cost or setting discriminatory selling prices based on quantities, regardless of cost differences. Consideration of costs was necessary under all of these cases. It seems evident, however, that careful computation of cost differences did not assume such importance, under the Clayton Act as originally passed, as now may be held to attach to it since the amendments made by the Robinson-Patman Act have become effective. All except one of the five cases mentioned are shown to have been dismissed or decided in favor of the defendant companies. In the one case, in which a "cease and desist" order is reported to have been issued, sales were made below cost "in the one city in order to drive out competition there," and this purpose, rather than discriminatory prices or selling below cost, appears to have been a determining factor.

The Robinson-Patman Act can be discussed only with some reservations. Cases involving important interpretations are pending in courts and some fundamental questions have not yet been brought up formally for decision. Questions will probably continue to arise for many years regarding numerous provisions, including those relating to costs. There can be no question, however, but that the law has already affected the work of those engaged in cost accounting. It has placed a new emphasis on costs of "sale" (which presumably means what are ordinarily called "selling expenses") and on costs of "delivery." It has furnished another incentive, in addition to those provided by the usual motives of business, for making comparisons of "cost of manufacture, sale, or delivery resulting from the differing methods or quantities in which . . . commodities are . . . sold or delivered."

Notations from some of the cases under the Robinson-Patman Act may be helpful in understanding its effect on cost accounting. In H. C. Brill Company, Inc., Federal Trade Commission Docket 3299, an order was issued to cease paying cumulative discounts, except as indicated in the following quotation:

"A cumulative discount is sound only where savings have been achieved by the seller with respect to individual sales made to a particular buyer over a period of time, which savings were not reflected in the price at which the buyer purchased and which are reserved for the purpose of refunding at the end of a period of time. But any system of discounts based on the amount of annual sales is a price discrimination contrary to Section 2(a) of the Clayton Act, as amended, if it has any of the injurious effects on

competition enumerated in the statute, unless justified as by making only due allowance for differences in cost not previously allowed and resulting from the quantities sold or delivered."

In Master Lock Company, Docket 3386, the price discriminations effected by means of 5% discounts to purchasers in excess of $10,000.00 per year were ordered discontinued. There was no evidence that it cost the respondent less per dollar of sales to make shipments to such purchasers than to those who purchased lesser quantities.

On the contrary, it appears that individual orders from those not entitled to discounts were frequently larger and could be prepared and shipped at lower cost (presumably a lower cost per dollar of sales) than those to customers allowed the discount.

In other cases the Commission has closed its files on a number of complaints or investigations in which it has appeared that price differentials were justified by differences in cost. Several such cases are reported, beginning on page 12456 of the Congressional Record, Volume 81, August 25, 1937. In a case of extra discounts to purchasers of carload lots of candy bars, the summary states, "The carload price differential apparently can be justified in the particular circumstances on the basis of the lower cost of selling and shipping in carload lots." In another case, also involving chocolate bars, it is stated that "The file was closed because the 2-percent differential to carload or truckload buyers is justified by the difference in cost of selling, handling, and shipping carload and less-than-carload shipments." In connection with sales of laxative medicine, there is the statement that "The file was closed because the discount differentials did not result in injury to competition and apparently were justified by differences in cost." A fourth summary states, in part, "The record indicates the differentials were based upon differing costs in selling and handling, hence the file was closed."

The foregoing comments indicate something of what may be expected of the relation of the Clayton Act, as amended by the Robinson-Patman Act, to cost accounting. No prediction can be made, however, as to the effects of decisions in cases which are now pending and others which will develop later.

The Federal Trade Commission Act was intended to implement the Sherman and Clayton Acts. It created the Federal Trade Commission and gave it certain powers and duties. There has been litigation on the subject of the powers of the Commission. One of the cases which appears to be particularly interesting in connection with cost accounting is summarized as follows at ¶6126.11 of Commerce Clearing House Trade Regulation Service, Volume 2 (Ninth Edition):

"At the request of the Navy Department the Federal Trade Commission passed a resolution under Section 6(a) of the F.T.C. Act to investigate the Basic Products Co., the purpose of such investigation being to ascertain the cost of producing certain patented goods and thereby to reach a basis for fixing the price on the sale of such goods to the Navy Department. On a petition for mandamus to compel access to the books and records of the corporation, the U. S. District Court for the Western District of Pennsylvania held that the cost of production was a trade secret and the investigation was 'a contemplated search and seizure and a contemplated taking of private property for public use without due process of law, which are violative of the Fourth and Fifth Amendments of the Constitution.' U. S. v. Basic Products Co. (1919) 260 Fed. 472."

There have been other decisions tending to limit the powers of the Commission. Nevertheless, it has found lines along which it has functioned actively, for many years. Some of its acts which bear on cost accounting, principally uses of cost data, have already been mentioned. Others include orders to discontinue false representations that offers and sales of candy, groceries, staples and wearing apparel were being made below cost. The Commission has also held it to be improper to represent that the amount asked for products covers only the mailing, packaging, or handling costs, when in fact, the amount provides a profit above such costs, with respect to books, cameras, chicks, cosmetics, and jewelry.

The foregoing are examples of some of the reported acts of the Commission which have required or affected the use of cost data. They do not, by any means, represent a complete list of all of the activities of the Commission which bear upon cost accounting.

The Commission's influence upon cost accounting has not been limited to its official or informal acts. Individuals connected with the Commission have had a substantial influence, as a result of views held and expressed by them. In addition to the weight of such views which resulted from their respective degrees of inherent soundness and from their logical presentation, they have taken on additional force and effect due to the prestige resulting from connection of the speakers with the Commission.

Some testimony with regard to the attitude of the Federal Trade Commission toward cost accounting and toward improvement and extension of the use of cost accounting may be found beginning at page 176 of the Year Book of the National Association of Cost Accountants for the year 1921. The first paragraph of a statement by Dr. Francis Walker, Chief Economist of the Commission, reads as follows:

"Improved cost accounting has been advocated and encouraged by the Federal Trade Commission from the time it was organized and more uniform methods of cost accounting are among the particular improvements in accounting that it has stood for."

Dr. Walker continued with his statement, emphasizing the extensive work done by the Commission in examination of the accounts of many companies, the value to industry of more uniform methods of accounting, the efforts of the Commission to promote and develop greater uniformity in accounting, and something of the work of the Federal Trade Commission in obtaining cost of a great variety of basic commodities during World War I, and "for the use of the price fixing branches of the Government."

The following two paragraphs clarify somewhat farther the attitude of the Federal Trade Commission toward better accounting (and it seems clear that Dr. Walker had in mind principally cost accounting):

"To sum up, therefore, the Federal Trade Commission has always been strongly in favor of better accounting and of uniform methods of accounting. Probably it has had a greater influence in this direction than any other branch of the Government except possibly the Treasury department. The attitude of the Commission on this subject, however, has often been misunderstood and even misrepresented, but the things it has opposed have been incorrect methods of accounting, planned or undertaken for other purposes than showing for each company the truth about its own business.

"Sometimes trade associations or certain of their officials have submitted to the Federal Trade Commission plans of uniform cost accounting for approval, which were not

devised to show the correct costs of each individual concern, but instead to equalize as far as possible all the elements of cost. Thus, one of the first plans so submitted was that of a coal association that desired among other things to have its members report their depletion at a unifom average amount per ton instead of at the actual different rates depending on the cost of investment per ton in each case. The evident purpose of this plan was to make all costs substantially equal, with the expectation that it would tend to facilitate both higher and more equal prices."

Dr. Walker read a letter of July 25, 1921, from Nelson B. Gaskill, Acting Chairman of the Federal Trade Commission, to Mr. E. W. McCullough of the Chamber of Commerce of the United States. This letter, which is printed on pages 178 and 179 of the N.A.C.A. Year Book for 1921, sets forth certain attitudes of the Commission toward cost accounting, in accord with those stated by Dr. Walker.

In the same Year Book, beginning on page 75, there appears a statement by Dr. Walker as to the attitude of the Commission on a somewhat more specific, and then controversial, cost accounting matter, under the heading of "Attitude of the Federal Trade Commission Regarding Interest as an Element of Cost." The sentence, "For this reason I shall attempt to indicate very briefly what I believe have been the conditions and reasons that have led the Federal Trade Commission to reject interest as a part of production cost" gives us an indication of another way in which the Federal Trade Commission and its officials tended to influence cost accounting and the thought of cost accountants and businessmen in connection with its development. The first reason given by Dr. Walker for rejection by the Commission of interest as a part of production cost is, in effect, that a general opinion was found among economists and accountants in the Government service that interest should not be included in production cost. This attitude had been adopted by the Bureau of Corporations which, to some extent, was a predecessor of the Federal Trade Commission. Other reasons include "the general opinion and tradition of the accounting profession," the opinion of groups of professional accountants who came into governmental departments for service during the war, the opinion of a committee of the American Institute of Accountants and the fact that "many of the largest and best managed industrial corporations, including the Steel Corporation and the Standard Oil Companies, did not include interest in cost of production, and that their accounting officers were positively opposed to such a practice."

Further evidence of interest in costs is found in a statement by Colonel Nelson B. Gaskill, formerly Chairman, Federal Trade Commission, which is to be found in the Year Book of the National Association of Cost Accountants for the year 1926. Beginning on page 19 there is a paragraph in which Colonel Gaskill states:

"Consequently while some parts of the governmental field were filled with apprehension at the advance of the cost accounting movement, particularly as it appeared as an association activity, and because cost accounting information was sometimes misapplied and could be misapplied to level off differences in individual selling prices, as some of you may know, I applied all the support I could give to the development of the practice and use of cost accounting. In doing this, however, a very careful distinction had to be drawn between the proper use of this practice and the improper application of its results. The difficulty which was encountered here and the misunderstanding of the Commission's attitude and also the misuse of the results of associated activity in cost accounting, can all be attributed once more to the failure to comprehend the true significance of cost

in relation to price. If cost accounting had meant no more to me than a better system of bookkeeping or a method by which a man could, if he were interested, find out where his money went or tell him where he was losing money if he wanted to know or even tell him how much he had made or lost, I might well have taken the view that the dangers of misuse of this practice were too great for its tolerance, much less for its encouragement. But I have come to the point where almost every analysis of a phase of the so-called conflict between government and business as expressed in the anti-trust laws can be resolved in terms of a failure to apply continuously and generally the right relation of cost to price. It is just as big as that. And that is why I am interested in the advance of cost accounting. In your profession and its practice, if it is developed with a full appreciation of its significance, if it leads to a consideration of the principles whose results are the material in which you work, lies a great hope."

National Industrial Recovery Act

Although the National Industrial Recovery Act was generally in force for less than two years, some recognition should be given to it in any consideration of the impact of government on cost accounting. The Act took effect on June 16, 1933. Section 3 of the Act provided for "Codes of Fair Competition" and authorized the President of the United States to approve such codes upon application therefor by trade or industrial associations or groups. The Act provided against codes which would permit monopolies or monopolistic practices and also stated that—

"The President may, as a condition of his approval of any such code, impose such conditions (including requirements for the making of reports and the keeping of accounts) for the protection of consumers, competitors, employees, and others, and in furtherance of the public interest, and may provide such exceptions to and exemptions from the provisions of such code, as the President in his discretion deems necessary to effectuate the policy herein declared."

Under this Act a substantial number of codes were drafted and a great deal of cost accountants' ability, thought, and energy were devoted to the drafting of these codes. Because of the consideration given by business managers and others to the subject of cost accounting in connection with N.I.R.A. codes, the National Industrial Recovery Act had a very considerable influence on cost accounting despite its short span of life. For those interested in further study of this subject, reference is made to the 1934 and 1935 Year Books of the National Association of Cost Accountants. The 1934 Year Book includes a section on "The National Industrial Recovery Act," one on "Fundamental Accounting Problems Under the Recovery Administration," another on "Standard Costs and Statistics Under the Codes," and reports on "open forum" discussions which contain many pages of information and opinions regarding the Act, its codes, and their relation to cost accounting.

Under a decision of the United States Supreme Court in the Schecter case (295 U.S. 495), the National Industrial Recovery Act became substantially ineffective in May 1935.

Securities Act of 1933 and Securities Exchange Act of 1934

The Securities Act of 1933 became effective on May 27, 1933. The heading of the Act describes its purpose as "to provide full and fair disclosure of the character of securities sold in interstate and foreign commerce and through the mails, and to prevent frauds in the sale thereof, and for other purposes." As originally enacted the Securities Act of 1933 was to be administered and enforced by the Federal

Trade Commission. However, the Securities Exchange Act of 1934 established the Securities and Exchange Commission and provided for transfer of "all powers, duties, and functions of the Federal Trade Commission under the Securities Act of 1933" to the Securities and Exchange Commission. In addition, the Securities and Exchange Commission is required to administer and enforce the Securities Exchange Act of 1934, as well as other laws which have substantial effect upon accounting but not relatively great effect upon cost accounting.

The effect of these Acts on cost accounting comes principally through the requirements for financial statements, schedules, and notes thereon. To some extent the Acts themselves bear directly upon cost accounting but to a greater extent the regulations issued under these laws enter into matters which require specific cost accounting treatment or reports upon cost accounting treatment.

In Schedule A of the Securities Act of 1933, Item 25 requires a balance sheet and, among other things, requires that it show "all of the assets of the issuer, the nature and cost thereof, whenever determinable, in such detail and in such form as the Commission shall prescribe (with intangible items segregated)." Item 26 of Schedule A calls for a profit-and-loss statement and states "Such statement shall show what the practice of the issuer has been during the three years or lesser period . . . as to depreciation, depletion, and maintenance charges, in such detail and form as the Commission shall prescribe."

Section 13 of the Securities Exchange Act includes requirements as to periodical and other reports and subdivision (b) of that section authorizes the Commission to "prescribe, in regard to reports made pursuant to this title, the form or forms in which the required information shall be set forth, the items or details to be shown in the balance sheet and the earning statement, and the methods to be followed in the preparation of reports, in the appraisal or valuation of assets and liabilities, in the determination of depreciation and depletion. . . ."

The Securities and Exchange Commission has issued Regulations S-X under certain of the laws which are administered, including the Securities Act of 1933 and the Securities Exchange Act of 1934. This regulation is intended to cover the "Form and Content of Financial Statements." There are numerous provisions in the regulation which relate to and which affect cost accounting. For example, Rule 3-07, relating to consistency, would require investigation of and reporting upon any significant changes in cost accounting principle or practice from corresponding principles or practices of prior years. Rule 3-07 reads as follows:

> "If any significant change in accounting principle or practice, or any significant retroactive adjustment of the accounts of prior years, has been made at the beginning of or during any period covered by the profit and loss statements filed, a statement thereof shall be given in a note to the appropriate statement, and, if the change or adjustment substantially affects proper comparison with the preceding fiscal period, the necessary explanation."

Similarly, Rule 3-12 requires information as to the basis of determining amounts and indicates that information in addition to "book value" must be given generally. This would obviously require examination of cost accounts as to some items and, if a reasonably simple and clear statement is to be made, it would be necessary that the basic accounting methods for determining any given amount in the financial statements, such as inventories, be made in accordance with a consistent plan.

Subdivision (c) of Rule 3-19, which is given below, requires a policy to be determined, followed, and reported with respect to depreciation, depletion, obsolescence, and amortization.

> "(c) Depreciation, depletion, obsolescence, and amortization.—State the policy followed during the period for which profit and loss statements are filed with respect to—
> (1) The provision for depreciation, depletion, and obsolescence of physical properties, or reserves created in lieu thereof, including the methods and, if practicable, the rates used in computing the annual amounts;
> (2) The provision for depreciation and amortization of intangibles, or reserves created in lieu thereof, including the methods and if practicable, the rates used in computing the annual amounts;
> (3) The accounting treatment for maintenance, repairs, renewals, and betterments; and
> (4) The adjustment of the accumulated reserves for depreciation, depletion, obsolescence, amortization, or reserves in lieu thereof, at the time properties are retired or otherwise disposed of."

Rule 5-02, 6, of Regulations S-X relates to inventories and requires that there be stated the major classes of inventory, such as finished goods, work in process, raw materials and supplies. This rule also requires that the basis of determining the amounts shown in the balance sheet be stated. There is also the requirement that, if the basis is stated, for example, as "cost," "market" or "cost or market, whichever is lower," there shall also be given, so far as practicable, an indication of the method of determining the "cost," "market" or other basis such as "average cost" or "first-in, first-out."

Rule 5-02, 17, requires separate statement of any significant items of prepaid expenses and other deferred items.

Rule 5-03, 2A, requires that there be presented the amount of cost of goods sold as regularly computed under the system of accounting followed.

Rule 5-03, 15, requires separate statement of certain taxes and gives thereby a clear indication that (a) federal normal and excess profits taxes, (b) other federal income taxes, and (c) other income taxes are not to be included in reporting cost of goods sold.

The schedules provided also include instructions relating to cost. For example, the property, plant, and equipment schedule requires that additions during the period of the report be stated at cost and with respect to retirements or sales there is a requirement that if the amounts are stated at other than cost an explanation is to be given if practicable.

Rule 12-16 calls for a schedule of supplementary profit-and-loss information and requires a showing of the amount of each of five items charged to "costs or operating expenses." In preparing this schedule it is necessary to determine separate amounts for "maintenance and repairs." This requirement has developed some new lines of thinking among cost accountants in businesses in which "maintenance and repairs" have not been separately computed or stated prior to the issuance of regulations under the respective securities acts. It has also resulted in expression of questions as to whether the separate showing of this information is, in many cases, of sufficient value to warrant computing and showing it as required.

A total of 55 "Accounting Series Releases" had been issued by the Securities

and Exchange Commission, to and including May 22, 1946. Most of these releases have little relation to cost accounting. However, Release No. 54 dated March 30, 1946, requires "special disclosure of war costs, losses and expenses currently being recognized." The wording of the release shows that it is expected to be practically effective for only a short period of time, because the types of items to which it is applicable should be disposed of within a short time after the end of the war. While it is effective, however, it requires disclosure of amounts of certain war costs and this requirement obviously has an effect on some features of cost accounting.

Laws Regulating Special Industries

When we come to laws and the underlying regulations applicable to particular industries, we really get into numerous cost descriptions or "definitions," detailed requirements as to items to be entered in cost accounts and similar requirements as to reports to be made. The regulatory laws for special industries relate generally to service industries rather than to producers of commodities. Consequently, the cost requirements relate for the most part to capital asset costs and costs of functions, rather than costs of commodities. The cost methods are in some respects like those used in the "process" type of cost accounting for manufacturers.

The Interstate Commerce Act

The seal of the Interstate Commerce Commission shows the year "1887." It also shows an eagle carrying in its beak a streamer bearing the motto "E Pluribus Unum." Probably that motto was not used on the seal with the thought of expressing the intention of making a single, uniform accounting method take the place of many methods. However, it might have been so used. That is one line of work which the Commission has followed for a long period of years, by issuance of forms and instructions, by making investigations and otherwise.

Without attempting to go fully into the account classifications and regulations of this Commission we may take first, as examples, a few items from the "Classification of Investment in Road and Equipment of Steam Roads" which became effective July 1, 1914, and which superseded classifications of 1907, 1908, and 1910. The 1914 classification has, itself, now been superseded although in many respects the current classification is the same as that issued in 1914. A few items from the old classification are mentioned as indications of some of the effects of government on cost accounting, dating from approximately a third of a century ago.

The word "costs" is described as follows in the 1914 classification:

> "Costs shall be actual money costs to the carrier. Where a portion of the funds expended by the carrier has been obtained through donations by States, municipalities, individuals, or others, no deductions on account of such donations shall be made in stating the costs. Contributions for joint expenditures should not be considered as donations. The carrier's proportion only of the cost of joint projects, such as construction of jointly owned tracks and elimination of highway crossings at joint expense, shall be included in these accounts."

Charges to the accounts are not to be limited to "costs" as described in the foregoing quotation. A subsequent paragraph headed "Basis of Charges" provides for other items, in language as follows:

> "The charges to the accounts of this classification shall be based upon the cost of the property acquired. When the consideration given for the purchase or the improvement

of property the cost of which is chargeable to the accounts of this classification is other than money, the money value of the consideration at the time of the transaction shall be charged to these accounts, and the actual consideration shall be described in the record in sufficient detail to identify it. The carrier shall be prepared to furnish the Commission, upon demand, the particulars of its determination of the actual cash value of the consideration, of other than money."

The description of "cost" (formerly written "costs") in the currently effective classification is generally in accord with that in the 1914 classification, although it has been considerably expanded. The paragraph, "Basis of Charges" stands without change.

There follows a description of "Cost of Construction" and under that "Cost of labor," "Cost of materials and supplies," etc., through seven other items of cost, including finally "Cost of privileges."

Finally there are 25 pages (29 in the currently effective classification) of "Text pertaining to accounts for investment in road and equipment." There are three general groups of accounts, "Road," "Equipment," and "General Expenditures." The opening paragraphs under each of these general headings show clearly that the instructions are intended to be for computing and accounting for cost. The first paragraph under "Road," for example, is as follows:

"The several primary accounts included in this general account are designed to show the cost of land, fixed improvements, and roadway machines and tools owned by the carrier and devoted to transportation service."

With reference to accounts for depreciation, which are obviously important in cost accounting, the 1914 classification states, under "Depreciation of Fixed Improvements," that "Until further directed the use of depreciation accounts for fixed improvements is optional with the carrier." The same wording appears in special instructions regarding operating expenses as revised to January 1, 1941. Later, under date of May 1, 1943, the Commission ordered publication of the "Uniform System of Accounts for Steam Railroads, Issue of 1943." In this, the Commission has classified what it designates "Road property" into depreciable and nondepreciable groups. The engineering costs, land, grading, rails and ties, etc., are classed as nondepreciable and other items formerly called fixed improvements are treated as depreciable. Depreciation accounting with respect to these classes of property appears to be no longer optional with the carrier. Depreciation accounting with respect to the equipment classification appears to have been required at least since 1914.

The instructions for operating expense accounts are obviously intended to regulate the accounting for costs. We find, for example, in the 1943 classification, such expressions as "cost of repairs of telegraph outside plant and terminal equipment," "cost of repairing signals and interlockers," "cost of keeping track and roadway clear of snow, ice, and sand," "cost of advertising," "cost of water supplied to locomotives in switching service," and "cost of operating drawbridges." As a further indication of the extent to which the classification deals with cost accounts, it is of interest to note that, on the first page selected for counting the number of times the word "cost" appears (page 86), it was found printed 18 times, 10 times under "Track Laying and Surfacing" and 8 times under "Fences, Snowsheds, and Signs."

In some cases, estimates are to be used. For example, the 1943 classification, under account 268, "Deferred Maintenance—Way and Structures," includes a paragraph which reads as follows:

"This account shall include the estimated cost of repairs to way and structures which cannot be made during the current year due to priorities for materials and supplies or shortage of labor."

In some cases the accounts may be directly affected by other governmental regulations. An example is to be found in account 270½, "Road—Amortization of Defense Projects." The following sentence is included in the instructions regarding this account:

"The charges so included shall be in conformity with the allowances acceptable to the Bureau of Internal Revenue under the regulations prescribed by it."

Apportionment of charges is required, in some instances. There is a paragraph under account 301, "Superintendence," following the sub-heading "Office and other expenses," which reads as follows:

"Note B.—When officers designated above have supervision over more than one department, their salaries, the pay of their clerks and attendants and their office and other expenses shall be apportioned equitably among the departments over which they have jurisdiction."

Federal Power Act

The Federal Power Act, which dates from the year 1935, includes provisions as to cost accounting and very broad powers as to control of accounts and at the same time specifically denies intent to relieve the utilities from keeping accounts, etc., as required by State law, as shown by the following quotation from Section 301(a) of the Act:

"Every licensee and public utility shall make, keep, and preserve for such periods, such accounts, records of cost-accounting procedures, correspondence, memoranda, papers, books, and other records as the Commission may by rules and regulations prescribe as necessary or appropriate for purposes of the administration of this act, including accounts, records and memoranda of the generation, transmission, distribution, delivery, or sale of electric energy, the furnishing of services or facilities in connection therewith, and receipts and expenditures with respect to any of the foregoing: Provided, however, That nothing in this act shall relieve any public utility from keeping any accounts, memoranda, or records which such public utility may be required to keep by or under authority of the laws of any State. The Commission may prescribe a system of accounts to be kept by licensees and public utilities and may classify such licensees and public utilities and prescribe a system of accounts for each class. The Commission, after notice and opportunity for hearing, may determine by order the accounts in which particular outlays and receipts shall be entered, charged, or credited. The burden of proof to justify every accounting entry questioned by the Commission shall be on the person making, authorizing or requiring such entry, and the Commission may suspend a charge or credit pending submission of satisfactory proof in support thereof."

With reference to "cost," the Federal Power Act, in Section 3 (13), refers to the "classification of investment in road and equipment of steam roads, issue of 1914, Interstate Commerce Commission" and then states:

"The term 'cost' shall include, insofar as applicable, the elements thereof prescribed in said classification, but shall not include expenditures from funds obtained through donations by States, municipalities, individuals, or others, . . ."

In the Uniform System of Accounts promulgated by the Commission we find a section headed "Definitions" and under that several of the items relate to cost accounting, including "Book cost," "Construction cost, components of," "Cost," "Cost of removal," "Depreciation," "Net book cost," "Original cost," "Salvage value," "Service value," and "Units of property." The definition of "Original cost" reads:

" 'Original cost,' as applied to electric plant, means the cost of such property to the person first devoting it to public service."

Cost is defined as follows:

" 'Cost' means the amount of money actually paid for property or services or the cash value at the time of the transaction of any consideration other than money. (See, however, Electric plant, instruction 3.)"

Paragraph A of instruction 3 reads as follows:

"A. All amounts included in the accounts for tangible electric plant consisting of plant acquired as an operating unit or system shall be stated at the original cost incurred by the person who first devoted the property to utility service. All other tangible electric plant shall be included in the accounts at the cost incurred by the utility."

The instructions under Balance Sheet Accounts for the principal tangible capital asset accounts include requirements that "original cost" is to be included in these accounts. However, Account 100.5 Electric Plant Acquisition Adjustments, is followed by instructions which include the following:

"A. This account shall include the difference between (a) the cost to the accounting utility of electric plant acquired as an operating unit or system by purchase, merger, consolidation, liquidation, or otherwise, and (b) the original cost, estimated if not known, of such property, less the amount or amounts which may be credited to the depreciation and amortization reserves of the accounting utility at the time of acquisition with respect to such property.

. . . . .

"C. The amounts recorded in this account with respect to each property acquisition shall be depreciated, amortized, or otherwise disposed of, as the Commission may approve or direct."

With regard to depreciation or amortization of the amounts included in "Electric Plant Acquisition Adjustments," in instruction 252 under Balance Sheet Accounts appears the following:

"Reserve for Amortization of Electric Plant Acquisition Adjustments. This account shall be credited or debited with amounts which the Commission may approve or direct the utility to charge or credit to Account 505, Amortization of Electric Plant Acquisition Adjustments, to Account 537, Miscellaneous Amortization, or to Surplus, for the purpose of providing for the extinguishment of amounts in Account 100.5, Electric Plant Acquisition Adjustments."

The requirements with regard to Account 100.5 have developed substantial differences of opinion and some controversies. For example, in *The Journal of Accountancy* for June 1944 there is an article by Professor William A. Paton, entitled "Accounting Policies of the Federal Power Commission—A Critique," in which Professor Paton presents objections to the accounting requirements of the Commission. A reply by Mr. John Bauer under the heading "Accounting Principles of the Federal Power Commission" is presented in *The Journal of Accountancy* for October 1944.

No indications have been found that the "original cost" accounting methods of the Federal Power Commission are being adopted by businesses other than those required by law and regulations to follow them.

Federal Communications Act

The rules and regulations of the Federal Communications Commission include provisions with regard to "original cost" and with regard to accounts for plant acquisition adjustments which are generally similar to those of the Federal Power Commission.

Civil Aeronautics Act

The Civil Aeronautics Act of 1938, as amended, makes it unlawful for air carriers to keep any accounts, records, or memoranda other than those prescribed or approved by the Civil Aeronautics Board. The Act also authorizes the Board to prescribe systems of accounts for air carriers. The Board has signified its approval of keeping accounts, records, or memoranda in addition to those prescribed, provided that such additional accounts, etc., do not impair the integrity of those prescribed, do not constitute an undue financial burden, and meet certain other conditions.

In the "General Instructions" which precede the definite provisions of the "Uniform System of Accounts for International Air Carriers" the Board refers to inclusion of cost records, in language as follows:

> "The books and records referred to herein include not only accounting records but all other records such as minute books, reports, cost distribution and other accounting work sheets. . . ."

In the instructions as to individual items there is provision for including the cost of materials and supplies, costs of transportation, customs duties, etc.; for cost of aircraft, of aircraft engines, of aircraft propellors, of aircraft radio equipment, etc.; and for cost of light, heat, power, water and air conditioning, of operation of motorized vehicles, of cost of supplies and miscellaneous services used in cleaning and servicing aircraft and cleaning ground operations hangars.

A definition of "costs" is included, which reads as follows:

> "Costs are defined as the amount of money actually expended, the money value at the date of acquisition of any consideration other than money actually paid, or the liability incurred by the air carrier in the purchase, acquisition, and original installation of property, equipment, materials, and services, and in the construction of buildings, equipment, etc."

State Governments' Regulation

State laws as well as the laws of the Federal government affect cost accounting. The Trade Regulation Service of Commerce Clearing House, Volume 2, page 7503, lists 30 states and gives references to their statutes under the heading "Sales Below Cost Provisions." These provisions generally prohibit sales below cost for the purpose of lessening competition.

As an example picked at random, the State of California has its Unfair Practices Act. Section 17026 of that Act, under "Definitions" provides as follows regarding cost:

> "'Cost' as applied to production includes the cost of raw materials, labor and all overhead expenses of the producer.
>
> "'Cost' as applied to distribution means the invoice or replacement cost, whichever is lower, of the article or product to the distributor and vendor, plus the cost of doing business by the distributor and vendor."

There is a special provision as to the cost of an article purchased at a forced, bankrupt, or closeout sale and also a statement as to the meaning of "'Cost of doing business' or 'overhead expense.'" The latter provision is of interest because it is so much more inclusive than most statements of items included in what is described as "cost"; the purpose of the law, to prevent sales below cost, for certain purposes, may have served as an incentive toward the inclusion of all expenses. The law reads as follows, in connection with the items mentioned:

> "'Cost of doing business' or 'overhead expense' means all costs of doing business incurred in the conduct of the business and shall include without limitation the following items of expense: labor (including salaries of executives and officers), rent, interest on borrowed capital, depreciation, selling cost, maintenance of equipment, delivery costs, credit losses, all types of licenses, taxes, insurance and advertising."

The states also have laws and enforcement agencies for regulation of public utilities and other laws which bear upon cost accounting. The over-all influence of the state governments upon cost accounting has probably been somewhat less, however, than that of the Federal government.

The foregoing are examples from laws enacted and regulations issued by governments and governmental agencies for regulatory purposes, with comments and opinions by individuals connected with the government, which have influenced and are influencing cost accounting.

Another governmental activity whose laws, regulations, and opinions influence cost accounting is that of income taxation. The following paragraphs bring out some of the provisions of tax laws and regulations which bear particularly on cost accounting.

Income Taxation

Income tax requirements have a relation to cost accounting different from that of laws for purposes of business regulation. In many instances the regulatory laws directly require or prohibit certain accounting practices or methods, while the tax laws generally state what is includible in income and what is deductible, and methods of computing the related amounts, but often without requirement as to what

the accounts shall include. The effects of the tax laws are such, however, that they may be nearly as persuasive as the regulatory laws with regard to the accounts and financial statements, in numerous cases. This condition arises in a large measure because of the practical advantages of keeping to a minimum the differences between income tax returns and the accounts and financial statements.

Inventories

One of the subjects of the Internal Revenue Code and regulations which relates quite clearly to cost accounting, and which is by law given a special relationship to the taxpayer's financial reports or statements, is that of inventories under the last-in, first-out or "lifo" method, outlined in Section 22(d) of the Code.

The taxpayer is given an option to use this method, provided certain conditions are met. One of the conditions is to be found in Section 22(d)(2)(B), as follows:

> "(2) The method described in paragraph (1) may be used—
>
> . . . . .
>
> "(B) Only if the taxpayer establishes to the satisfaction of the Commissioner that the taxpayer has used no procedure other than that specified in subparagraphs (B) and (C) of paragraph (1) in inventorying such goods to ascertain the income, profit, or loss of the first taxable year for which the method described in paragraph (1) is to be used, for the purpose of a report or statement covering such taxable year (i) to shareholders, partners, or other proprietors, or to beneficiaries, or (ii) for credit purposes."

The "procedure . . . specified in subparagraphs (B) and (C) of paragraph (1)" is the "last-in, first-out" method of inventorying.

It will be noted that the foregoing quoted matter requires that the "lifo" method be followed in statements and reports if it is to be used for income tax purposes, for the first year only. But that is not the whole story. Section 22(d)(5) requires that, if the taxpayer uses this method for one taxable year, it is to be used in all subsequent taxable years unless (A) the Commissioner approves a change or (B) unless the Commissioner requires a change in a case where the taxpayer has used a different method, in a subsequent year, for purposes of a report or statement to shareholders, partners or other proprietors, or beneficiaries, or for credit purposes.

The Treasury Department has issued regulations, several pages long, on this matter. These tend in one respect to permit taxpayers some leeway in the issuance of statements in which there have been used an inventory method or methods other than the "elective" or "last-in, first-out" method. In Section 29.22(d)-2(5) of Regulations 111 we find the following:

> ". . . the taxpayer's . . . issuance of reports or credit statements covering a period of operations less than the whole of the taxable year not being considered at variance with this requirement. . . ."

The regulations do not, however, provide for full freedom of choice by the taxpayer as to methods and procedures. In this connection, it is of interest to read the following, from the regulations. The latter part of the final sentence of Section 29.22(d)-3 of Regulations 111 is as follows:

". . . the propriety of all computations incidental to the use of such method will be determined by the Commissioner in connection with the examination of the taxpayer's returns."

Subsection 29.22(d)-2(8) of Regulations 111 reads as follows:

"(8) The records and accounts employed by the taxpayer in keeping his books shall be maintained in conformity with the inventory method referred to in section 29.22(d)-1;" (the "elective" or "last-in, first-out" method) "and such supplemental and detailed inventory records shall be maintained as will enable the Commissioner readily to verify the taxpayer's inventory computations as well as his compliance with these several requirements."

Undoubtedly the provisions in Section 22(d) of the Internal Revenue Code and in the related regulations have influenced taxpayers to study their cost accounting methods relating to inventories and in some cases to change the methods. The provisions have also had a somewhat negative effect on other taxpayers. In those cases where taxpayers believed, before the enactment of Section 22(d), that it would be advisable to keep their accounts on the "last-in, first-out" basis, some were no doubt deterred from doing so by the thought that this method would not be accepted by the Treasury Department for purposes of computing taxable income. In such cases, the enactment of Section 22(d) removed a handicap which had previously caused taxpayers to refrain from changing to cost accounting procedures which they had already considered and believed they wanted to follow.

The law and regulations with reference to inventories generally are not as voluminous nor do they give as much detail as those for the special "last-in, first-out" or "lifo" method of inventorying. The general inventory regulations do, however, include a considerable number of paragraphs relating to cost accounting. Section 29.22(c)-2 provides two tests. The first of these would tend to bring income tax computations into accord with the taxpayer's accounts, and the second would tend (perhaps not quite as directly but often very effectively) to bring the books into accord with income tax computations. The two tests to which the inventory must conform are stated as:

"(1) It must conform as nearly as may be to the best accounting practice in the trade or business, and

"(2) It must clearly reflect the income."

Not infrequently problems have arisen as to which of the two tests out-ranks the other, in practice. One of the reasons for enacting provisions for the "last-in, first-out" method was that taxpayers in some lines of business considered that it represented the "best accounting practice in the trade or business" while the Treasury was disallowing that and similar methods in some cases, at least, on the ground that they did not "clearly reflect the income." There have been disagreements as to what is the "best accounting practice in the trade or business" reflected in decisions. Accordingly, one thing which is clear about these tests is that interpretation of them is necessary in order that a taxpayer may know whether he is or is not living up to them in his tax returns or in his cost accounting.

One of the rules expressed in Section 29.22(c)-2 of Regulations 111 is that:

". . . the inventory practice of a taxpayer should be consistent from year to year, and greater weight is to be given to consistency than to any particular method of inventory-

ing or basis of valuation so long as the method or basis used is substantially in accord with these regulations."

This rule may sometimes handicap taxpayers who keep their accounts in accord with their tax computations, when they are trying to make improvements in their cost and inventory accounting procedures. Aside from this point the rule is generally a sound one to be followed in cost accounting as well as for income tax purposes.

The statement of inventories on the basis of "(a) cost" or "(b) cost or market, whichever is lower" is one of the best-known and most generally accepted of accounting procedures. This procedure is provided in Section 29.22(c)-2 of Regulations 111 and similar provisions have been included in the Federal income tax regulations at least since the time of the old Regulations 45, under the Revenue Act of 1918. Probably no one would question that the statement of these alternative bases in the regulations over so long a period of time has been a substantial influence toward their acceptance in cost and general accounting. Questions still arise, however, as to the detailed application of these bases in practice, even though the general thought and intent is well understood and accepted.

Not only are there statements in the regulations as to results which should be produced in inventory accounts, but there are also included other occasional statements of acts to be performed to produce the results. An example of this is found in the two following sentences from Section 29.22(c)-2, and especially in the second sentence:

"Where the taxpayer maintains book inventories in accordance with a sound accounting system in which the respective inventory accounts are charged with the actual cost of the goods purchased or produced and credited with the value of goods used, transferred, or sold, calculated upon the basis of the actual cost of the goods acquired during the taxable year (including the inventory at the beginning of the year), the net value as shown by such inventory accounts will be deemed to be the cost of the goods on hand. The balances shown by such book inventories should be verified by physical inventories at reasonable intervals and adjusted to conform therewith."

The following sentence from Section 29.22(c)-2 of the Regulations would, with minor changes in wording, not seem inappropriate in a manual of inventory procedures of a corporation:

"Inventories should be recorded in a legible manner, properly computed and summarized, and should be preserved as a part of the accounting records of the taxpayer."

The foregoing are examples of acceptance and requirement of business and cost accounting practices. The effect of the regulations in such cases has been to confirm and probably to bring more generally into use the practices outlined.

When we come to Section 29.22(c)-3 we find that the first statement, a part of the outline of the meaning of "cost," is one to which cost accounting has not conformed and seems unlikely to accept fully. The section starts:

"Cost means:

"(1) In the case of merchandise on hand at the beginning of the taxable year, the inventory price of such goods."

In the general run of accounting statements, an inventory balance, which represented any substantial amount of materials stated at less than cost to purchase or

produce would not be characterized as "at cost" merely because the materials written down to less than cost had been in the opening inventory for the year.

In most cases the regulations and decisions call for allocation of cost in an equitable manner over the units to which total cost is applicable. For example, Section 29.22(c)-7 provides as follows:

> "A taxpayer engaged in mining or manufacturing who by a single process or uniform series of processes derives a product of two or more kinds, sizes, or grades, the unit cost of which is substantially alike, and who in conformity to a recognized trade practice allocates an amount of cost to each kind, size, or grade of product, which in the aggregate will absorb the total cost of production, may, with the consent of the Commissioner, use such allocated cost as a basis for pricing inventories, provided such allocation bears a reasonable relation to the respective selling values of the different kinds, sizes, or grades of product."

This is another case in which the regulations conform to business practice, as, for example, in connection with ceramics products and some kinds of lumber, and also a case in which one of the effects of the regulations has been to extend the use of the method outlined.

The reported decisions generally follow the thought of allocation of costs according to units, on a pro rata basis or a basis in which there is weighting of units according to sales prices. There are some cases, however, in which it has been held that the cost basis could not be allocated and that recoveries through sales or otherwise must be applied against the total cost. An example is the case of Orvilletta, Inc., 47 B.T.A. 10, in which it was held that no loss could be taken for tax purposes until all assets to which the lump-sum cost applied had been disposed of. This case relates to allocation of costs to different lots of securities, but presumably the same basis would apply in connection with other kinds of assets if similar conditions existed. Such cases are exceptional, however, and the general rule is one of allocating cost to each of the related units acquired.

In addition to the general statements of what "cost means," in the first three paragraphs of Section 29.22(c)-3 of the regulations, the fourth paragraph refers to certain special cases in which "costs may be approximated upon such basis as may be reasonable and in conformity with established trade practice in the particular industry." The cases mentioned are (a) farmers and raisers of livestock, (b) miners and manufacturers who by a single process or uniform series of processes derive a product of two or more kinds, sizes, or grades, the unit cost of which is substantially alike, and (c) retail merchants who use what is known as the "retail method" in ascertaining approximate cost. Statements of methods to be followed in computing inventories for such businesses are given in subsequent sections of the Regulations.

Depreciation, Amortization and Depletion

The foregoing paragraphs relate to a rather highly specialized feature of income tax requirements which is very closely connected with cost accounting. Other provisions of somewhat more general application are those having to do with depreciation and the related special "amortization" section which contains special rules for computing deductions for amortization of emergency facilities certified by the Secretary of War or the Secretary of the Navy as necessary in the national defense.

The basic provision for deductions for depreciation is stated in broad general terms in Section 23(l) of the Internal Revenue Code, as follows:

"In computing net income there shall be allowed as deductions:

. . . . . .

"(l) Depreciation.—A reasonable allowance for the exhaustion, wear and tear (including a reasonable allowance for obsolescence)—

(1) of property used in the trade or business, or

(2) of property held for the production of income."

The "basis" for computing depreciation is stated in Section 114, as follows:

"(a) Basis for Depreciation.—The basis upon which exhaustion, wear and tear, and obsolescence are to be allowed in respect of any property shall be the adjusted basis provided in section 113(b) for the purpose of determining the gain upon the sale or other disposition of such property."

Section 113(b) presents rules for computing the "adjusted basis" of property, starting with the "basis determined under subsection (a)"; that subsection starts as follows:

"(a) Basis (Unadjusted) of Property.—The basis of property shall be the cost of such property; except that . . ."

Then there follow 21 subsections of exceptions, in which are given principally statements of special procedures to be followed in cases of gifts, property transmitted at death, property acquired before March 1, 1913, etc. In most cases the "basis" of property is its cost; the "adjusted basis" is to be used for computing depreciation, however, and one of the adjustments to be made to the "basis" is for prior depreciation.

It will be seen from the foregoing that cost accounting may be required to determine the "basis" of assets for depreciation, that the amounts of current depreciation to be charged to costs of production, service, selling, construction, etc., will depend in part upon the cost of the depreciable assets, and the "adjusted basis" will be computed by using (possibly with other figures) the cost of the asset and adjustments equal to depreciation charges in prior periods.

Some idea of the relation to cost accounting of depreciation deductible on income tax returns may be obtained from considering how much more efficient and convenient it is to have the depreciation bases, charges, and reserves in the books of account the same as those used for Federal income tax purposes. It is sometimes impracticable to have such agreement, because of requirements of other laws, inadequate depreciation allowances by the Bureau of Internal Revenue, or for other reasons. The advantages of agreement are sufficiently great, however, so that the depreciation provisions of the Internal Revenue Code, as interpreted by regulations and in administration generally, have considerable influence upon the amounts charged to cost, on account of depreciation, in books of account.

Another influence in the direction of agreement between tax computations and the accounts, in connection with depreciation, is Section 29.23(1)-9 of Regulations 111, which is as follows:

"Records of Depreciable Property.—In order that the verification of depreciation allowances claimed by the taxpayer may be facilitated, depreciation shall be recorded

on the taxpayer's books, the amount measuring a reasonable allowance for depreciation either being deducted directly from the book value of the assets or preferably being credited to a depreciation reserve account, which should be reflected in the annual balance sheet. For the same reason the allowances shall be computed and recorded with express reference to specific items, units, or groups of property, each item or unit being considered separately or specifically included in a group with others to which the same factors apply. Also, the taxpayer's books shall show the basis of the depreciable property and any adjustments thereto, and, in cases where the basis of the property is other than cost, or value on March 1, 1913, or value at date of acquisition (as, for example, if the property was acquired by gift or transfer in trust after December 31, 1920), or through a reorganization or a tax-free exchange (see particularly section 113(a)), the books shall show the data used in ascertaining such basis and the adjustments thereto. If a taxpayer does not desire to have his regular books of account show all of the factors entering into the computation of depreciation allowances, such factors shall be recorded in permanent auxiliary records which shall be kept with and reconciled with the regular books of account."

The wording of parts of the regulations indicates that some attempt is made to provide a degree of adaptability with regard to depreciation. For example, Section 29.23(l)-5 of Regulations 111 starts as follows:

"The capital sum to be recovered shall be charged off over the useful life of the property, either in equal annual installments or in accordance with any other recognized trade practice, such as an apportionment of the capital sum over units of production."

The provision for relating depreciation computations to units of production is helpful in keeping the tax computations in accord with the books of account in those cases where it seems advisable to charge depreciation costs in the accounts in proportion to the extent of use of depreciable buildings, machinery, etc.

In September 1946, I.T. 3818 (Internal Revenue Bulletin 1946, No. 19) was issued, providing for the use of the "declining balance" method of computing depreciation, if certain conditions are met. One of the conditions which is of interest here, because of its effect on taxpayers' cost accounting, is expressed in the words, "provided it accords with the method of accounting regularly employed in keeping the books of the taxpayer. . . ."

Despite some flexibility in the regulations, if accounts and tax computations are to agree, it is necessary, generally, to do far more adapting of books to tax computations than can be done in adapting tax computations to the books, with regard to depreciation. In numerous cases it is found wholly impracticable to have the regular books carry the same "basis" for assets, the same depreciation charges, and the same depreciation reserves as are used in tax computations. Various types of ledgers, work sheets, etc., more or less formal, are used to record the tax "basis" of assets and depreciation balances and to reconcile these amounts with the taxpayer's regular cost accounting and other accounting data.

The amortization provisions (Section 124) do not appear to include specific provisions as to keeping books of account or other records, corresponding to those just quoted from Regulations 111. However, the advantages of having computations of taxable income and books of account in agreement are sufficient so that amortization deductions made in computing taxable income have influenced corresponding amounts charged in books of account and in financial statements. Whether such charges have or have not been included in production costs may have

depended upon company policy in some cases and in other cases upon other governmental regulations such as those relating to reimbursable costs under supplies contracts, those applicable with respect to renegotiation and those having to do with computing amounts to be paid in contract termination settlements.

In connection with depletion for purposes of income tax computations, probably the most important relation to cost accounting is in the costs of properties that are subject to depletion. There are some cases in which depletion charges are made to production costs in books of account on the basis of depletion allowable as a deduction under income tax requirements. There is no information available as to the number of cases or the proportion of all cases in which such procedure is followed. On the other hand, the regulations are quite positive in their requirements as to accounts to be kept for the "cost or other basis" of property, for depletion, and for the credits applicable against the "basis" or to reserve accounts showing the amounts of depletion computed. These provisions are in Section 29.23(m)-11 of Regulations 111.

Cost accounting may be required under Section 29.23(m)-1 of the same Regulations. In a paragraph dealing with the meaning and determining the amount of "gross income from the property," the following appears:

"If there is no such representative market or field price (as of the date of sale), then there shall be used in lieu thereof the representative market or field price of the first marketable product resulting from any process or processes (or, if the product in its crude mineral state is merely transported, the price for which sold) minus the costs and proportionate profits attributable to the transportation and the processes beyond the ordinary treatment processes."

Section 29.23(m)-6 is headed "Determination of cost of deposits." This section places upon the taxpayer the burden of showing that "the cost or price at which such interest was bought was fixed for the purpose of a bona fide purchase and sale. . . ." Such a requirement may be somewhat outside of the beaten path of cost accounting, but it is easy to understand that cost accounting adequate to meet this requirement might be very important.

Section 29.23(m)-12 specifies the required contents of a statement to be attached to a taxpayer's return when "valuation, depletion, or depreciation of mineral property is claimed." Certain of the sub-paragraphs in that Section require information as to costs, including the following:

"(4) The cost of the property, stating the amount paid to each vendor, with his name and address;

. . . . .

"(7) An allocation of the cost or value as between the mineral deposit and other assets. . . ."

Requirements as to accounting for costs of "Allowable capital additions" are to be found in Section 29.23(m)-15 of Regulations 111, which reads in part as follows:

"(a) All expenditures in excess of net receipts from minerals sold shall be charged to capital account recoverable through depletion while the mine is in the development stage. . . .

"(b) Expenditures for plant and equipment and for replacements, not including expenditures for maintenance and for ordinary and necessary repairs, shall ordinarily be charged to capital account recoverable through depreciation. . . ."

Section 29.23(m)-16 is headed "Charges to capital and to expense in case of oil and gas wells." It gives an option with respect to intangible drilling and development costs in general and a second option relating to cost of non-productive wells, both for taxable years beginning prior to January 1, 1943. It also gives differently worded options for taxable years beginning after December 31, 1942, with respect to costs of these items. Naturally, if such options are to be made effective, there must be accounting for the costs involved, in accordance with the requirements of the section.

The regulations with regard to "depletion of timber" start with Section 29.23(m)-21. That section provides an option to taxpayers who keep their books on a monthly basis to "keep their depletion accounts on a monthly basis." Section 29.23(m)-24 states items of information which must be presented in a statement attached to the return of a taxpayer "claiming a deduction for depletion or depreciation" (of timber). These include several items which require cost accounting, but the ninth item is especially interesting. It reads, simply and briefly, "(i) Unit production costs; . . ."

The heading and first paragraph of Section 29.23(m)-28 show a definite bearing upon cost accounting, as follows:

"Timber depletion and depreciation accounts on books.—Every taxpayer claiming or expecting to claim a deduction for depletion or depreciation of timber property (including plants, improvements, and equipment used in connection therewith) shall keep accurate ledger accounts in which shall be recorded the cost or other basis provided by section 113(a), as the case may be, of the property, and the plants, improvements, and equipment, together with subsequent allowable capital additions to each account and all of the other adjustments provided by section 113(b)" . . . (and other sections).

Cost of Goods Sold

Section 29.22(a)-5 of Regulations 111, in effect, gives us special requirements for determining "cost of goods sold," to be deducted in computing "gross income." The section first states that:

"In the case of a manufacturing, merchandising, or mining business, 'gross income' means the total sales, less the cost of goods sold, plus any income from investments and from incidental or outside operations or sources."

This is followed by the sentence:

"In determining the gross income subtractions should not be made for depreciation, depletion, selling expenses, or losses, or for items not ordinarily used in computing the cost of goods sold."

This section is one of those that produces problems for cost accountants when they are trying to develop a consistent pattern to follow in keeping their records in accord with the income tax regulations. For example, depreciation (of some classes) is ordinarily included in costs; selling expenses are not ordinarily so included. Both of these are specifically excluded in computing "gross income" by the foregoing quotations from Section 29.22(a)-5. Then what is to be the basis for determining, for example, whether the kinds of taxes which are ordinarily included in costs should or should not be included in "gross income" computations? Other uncertainties, from a logically consistent point of view, come up to puzzle one who is

attempting to outline the procedure intended to be followed. Practical expedients may be developed but they are less than fully satisfactory to one who looks for a clear, logical and consistent course to follow in complying with the regulations in preparing tax returns and in keeping accounts in accord with the returns.

Accounting Periods and Methods of Accounting

The above heading appears in the Internal Revenue Code as applicable to Sections 41 to 48, inclusive. The first part of Section 41 reads as though the taxpayer's regular annual accounting period and method would be determinative of the period and method to be used in computing the net income for tax purposes. The Section starts as follows:

"The net income shall be computed upon the basis of the taxpayer's annual accounting period (fiscal year or calendar year, as the case may be) in accordance with the method of accounting regularly employed in keeping the books of such taxpayer; . . ."

If there were no more of this Section, and if the Section were not overridden by others in the Code, then the Code might have considerably less effect on cost accounting than it now has. On this basis, computations of taxable income would be made in accordance with accounting methods established by each taxpayer. Admittedly, it might be inequitable to have such a provision in the law, without qualification. Our legislators have not considered it wise to experiment by using the above-quoted portion of the Section, alone. They have added limitations as follows:

". . . but if no such method of accounting has been so employed, or if the method employed does not clearly reflect the income, the computation shall be made in accordance with such method as in the opinion of the Commissioner does clearly reflect the income. If the taxpayer's annual accounting period is other than a fiscal year as defined in section 48 or if the taxpayer has no annual accounting period or does not keep books, the net income shall be computed on the basis of the calendar year."

The latter provisions clearly place at a disadvantage the taxpayer having no books of account or having books of account which do "not clearly reflect the income." There is uncertainty, in some cases, as to just how the latter phrase is to be interpreted. It may mean "not clearly reflect the income," in the opinion of the Commissioner, if his opinion is not proven to be at variance with the law. To a very considerable extent taxpayers act as if this were known to be the meaning of the expression and endeavor to keep their cost accounts and other accounts in such a manner that the Commissioner will find that they do "clearly reflect the income." These taxpayers receive their guidance in this respect, of course, principally from Sections 42 and 43 and other Sections of the Code, and from regulations, decisions of courts and from formal and informal rulings of the Treasury Department.

Following the guidance of some of these sources results in accounts which are perhaps better than they would otherwise be. On the other hand, if some decisions were followed in the accounts the results would be to overstate assets and profits.

Consider, for example, the South Tacoma Motor Company case, 3 T.C.411. It is accepted practice, in accounting, to credit income as soon as it has been earned, that is, when goods have been shipped or services have been rendered, but not before that time. Related costs and expenses are then applied in the same accounting period. In Stratton's Independence vs. Howbert, 231 U.S. 399, the Supreme Court

stated "Income may be defined as the gain derived from capital, from labor, or from both combined." In contrast, in the South Tacoma case the Tax Court chose to set aside sound accounting practice and to ignore the fact that neither capital nor labor had been given an opportunity to produce a "gain" with respect to the advances or deposits which were held to be income and held that the deposits received against services which might later be rendered constituted income when received. This was the decision, despite the fact that the deposits were refundable upon request of the customer before the rendering of services, or transferable if the customer moved to another city before the services had been performed.

The final paragraph of the Board's decision reads as follows:

> "Since petitioner's method of accounting did not treat the proceeds received from the sale of these coupon books as income in their entirety in the taxable year in which they were received, it follows that petitioner's method of accounting did not clearly reflect its income and that, therefore, the respondent's determination must be sustained."

Fortunately the lead toward inflated statements of profits and assets, which is presented in the foregoing sentence, is not being followed in accounting generally. If it were, it would create numerous dangers and difficulties. Among the difficulties would be those of cost accountants who would be faced with the problem of computing appropriate amounts of cost to be stated against deposits received (and treated as income) for services which might or might not be rendered in the future. The most serious feature would probably be the danger of misleading those using the accounts, or statements prepared from them, as a basis of decision or action.

The South Tacoma case is mentioned as an example. The case of Your Health Club, Inc., 4 T.C. 385 is, in some respects, more extreme. Reference is made in that case to the decision of the United States Supreme Court in Security Flour Mills Co. vs. Commissioner, 321 U.S. 281. Numerous other cases are also cited.

It seems clear that such decisions are beyond the limits within which cost accounting and general accounting can adapt themselves to income tax procedures, without destroying the reliability and usefulness of accounting.

Cost Accounting Under War Conditions

With widespread and highly specialized organizations, with highly-developed tools of war, and with the attempts to spread the costs and burdens of war as evenly as possible, it was found that cost accounting was required for many purposes, in World Wars I and II. No attempt will be made here to determine whether war conditions benefited or harmed cost accounting, on the whole. Some examples of related wartime requirements will be given, however, from which suggestions or conclusions may be developed.

Special uses were made of cost accounting in World War I. There were construction of plants and other facilities and production of ships and munitions of war on an unprecedented scale. The Federal Trade Commission conducted many investigations of production costs to obtain information for use in establishing prices of supplies and of their components. Contracts were entered into between the United States and business concerns and some of the contracts provided for reimbursement of contractors' costs, some provided for payment of cost plus percentages of cost, some provided for payment of cost plus fixed fees per unit with penalties and

bonuses for costs over or under estimated amounts (sometimes called "target" contracts in World War II), and others called for a basic price per unit of product but included provisions for adjustments in case of changes from estimated costs of specified types of materials to be used (called "escalator" clauses in World War II). The Bureau of Supplies and Accounts of the Navy did extensive work in cost accounting and in inspection or auditing of costs of ships, equipment, and supplies. The Army Ordnance Bureau had a Cost Accounting Section which included many hundreds of officers and civilians. They used pamphlets called "Definition of Cost" and "Instructions to Accountants" to coordinate their work. Other organizations of the government required cost accounting services. The resulting work in cost accounting naturally developed and spread information and understanding of the subject. It is interesting to note that the National Association of Cost Accountants was formed in October 1919, less than a year after the close of World War I. Conditions resulting from the war had a substantial influence in its formation.

The Vinson Act

Between World Wars I and II, laws were enacted which required cost accounting in connection with government contracts. The "Vinson Act," approved March 27, 1934, provided for repayment to the Treasury of all profits in excess of 10% of the contract price, on certain contracts made by the Secretary of the Navy. Obviously computation of costs was necessary in order to determine profits. In 1936 this Act was amended, but the indirect requirements for cost accounting continued. It was amended again in 1939 and, among other changes, the Act was made applicable to Army contracts for aircraft or any portion thereof as well as to Navy contracts, and other amendments were made in 1940. The profit-limiting provisions of the Vinson Act were suspended as to contracts entered into in any year to which the excess-profits tax, Subchapter E of Chapter 2 of the Internal Revenue Code, was applicable. The excess-profits tax was repealed, effective for taxable years beginning after December 31, 1945, and the profit-limiting provisions of the Vinson Act became effective again.

Section 3 of the Vinson Act provides in part as follows:

> "The method of ascertaining the amount of excess profit to be paid into the Treasury shall be determined by the Secretary of the Treasury in agreement with the Secretary of the Navy and made available to the public."

Accordingly, Treasury Decision 4434 (C.B. XIII-1, page 540) was promulgated on May 19, 1934. This Treasury Decision bears the words "Agreed to by" over the signature of William D. Leahy, Acting Secretary of the Navy.

Treasury Decision 4434 states that the profit on the contract shall be the difference between the total contract price and the cost of performing the contract (evidently assuming that a profit and not a loss would result). Then the following statement is made regarding cost:

> "The cost of performing the contract shall be the direct costs, such as material and labor, incurred by the contractor in performing the contract, plus a reasonable proportion of any indirect costs (including overhead or general expenses) appertaining to the contract which are not usually directly allocated to the cost of performing the contract. No general rule may be stated for ascertaining the reasonable proportion of the indirect costs to be allocated to the cost of performing a contract which would be applicable to all

cases. The proper proportion of the indirect costs to be applied to the costs of performing a particular contract depends upon all the facts and circumstances relating to the performance of the particular contract. The contractor shall include as a part of the report required to be made to the Secretary of the Navy upon the completion or other termination of the contract, a statement explaining the manner in which such indirect costs were determined and allocated to the cost of performing the contract."

Then follow provisions under which the Commissioner of Internal Revenue is to determine the profit and the excess profit, if any, and to collect any portion of the excess profit so determined which has not been paid to the appropriate collector of internal revenue on the basis of the report made by the contractor. Certain rulings were issued under T.D. 4434, including I.T. 2813 and I.T. 2821 (C.B. XIII-2, pages 579 and 580) which gave information as to acceptable methods of computing costs and as to items held includible or not includible in costs.

Then, as contracts for naval construction progressed, as war started in other countries and, finally, as the United States found it necessary to enter the conflict, there was a series of impacts on cost accounting in the form of revised and new rulings.

Treasury Decision 4434 was superseded by T.D. 4723 (1937-1 C.B. 519), filed with the Division of the Federal Register on January 8, 1937. This Decision includes approximately three pages in fine print under the general heading, "Cost of performing a contract or subcontract." Instructions are given as to numerous items of includible costs, a large number of items not includible are very briefly specified and there are three paragraphs on allocation of factory indirect expenses, engineering indirect expenses, and administrative expenses.

In T.D. 4723 there were some indications of the need for flexibility in the Regulations. There is a sentence (Article 8(b)) which reads, "No definitions of the elements of cost may be stated which are of invariable application to all contractors and subcontractors." Article 13 also contains some language, in the first sentence, which appears to provide for reasonable adaptation to conditions. Later, in the same article, a sentence is found which may indicate that one or more contractors had tried unsuccessfully to have the Treasury accept the results of a good industrial cost system which, however, was not specially designed to meet the requirements set up under the Vinson Act. The sentence reads as follows:

"Any cost accounting methods, however standard they may be and regardless of long-continued practice, shall be controlled by, and be in accord with, the objectives and purposes of the Act and of any regulations prescribed thereunder."

There may be some question as to the literal meaning of the sentence but it seems to reflect the intent of the Treasury to stand firm in refusing to accept costs unless they had been computed to the Treasury's satisfaction. The final paragraph in Article 13 states that no objection will be made to the use, temporarily, during the period of performance of the contract, of certain "normal" or "standard" costs, provided that the final determination must be such that "actual profit derived" is reflected in the books.

Similar provisions are found in T.D. 4906, T.D. 4909, and T.D. 5000 mentioned hereinafter.

T.D. 4723 was amended by T.D. 4741 (1937-1 C.B. 531) in June 1937. by T.D. 4861 (1938-2 C.B. 480) in September 1938, and by T.D. 4897 (1939-1-Part 1-

C.B. 404) in April 1939. The latter makes special provision for retention by contractors, available for inspection by internal revenue officers, of "All books, records, and original evidences of costs (including, among other things, production orders, bills of schedules of materials, purchase requisitions, purchase orders, vouchers, requisitions for materials, standing expense orders, inventories, labor time cards, pay rolls, cost distribution sheets). . . .". The foregoing related to Navy contracts and were applicable to income tax years ending before April 4, 1939.

Then came Treasury Decision 4906 (1939-2 C.B. 404), applicable to certain Navy contracts, and 4909 (1939-2 C.B. 422) applicable to certain Army contracts. Each of these included approximately five pages with regard to determination of costs. Both became effective in June 1939.

In August 1940, the well-known Treasury Decision 5000 (1940-2 C.B. 397) was issued. It superseded T.D. 4906 and T.D. 4909 with respect to contracts entered into after June 28, 1940, and before July 1, 1942.

As previously stated, the profit-limiting effects of the Vinson Act were suspended by Section 401 of the Second Revenue Act of 1940. This Revenue Act imposed an excess-profits tax. The Treasury Decisions, under the Vinson Act, which have been mentioned previously, were also suspended by T.D. 5034 (1941-1 C.B. 502), which became effective in January 1941.

In one sense, however, Treasury Decision 5000 continued in effect. In numerous contracts between the United States and business companies, under which it was necessary to compute costs, this Treasury Decision was "written into" the contracts by stating an agreement to the general effect that its terms were to be followed in related cost computations. Until such contracts were amended or finally settled T.D. 5000 presumably had effect in this connection.

The suspension of the profit-limiting provisions of the Vinson Act terminated with the repeal of the excess-profits tax, effective for taxable years beginning after December 31, 1945. Accordingly the Vinson Act is now effective again and I.T. 3822 states that the regulations in effect are T.D. 4906 relating to excess profits on contracts and subcontracts for naval vessels and aircraft, and T.D. 4909 relating to excess profits on contracts or subcontracts for Army aircraft. Mention has been made previously of the volume of instructions for determination of cost which is included in each of these Treasury Decisions.

Cost Under War Contracts, Generally

After war had been declared in December 1941, there was a great increase in contracts made for modern implements of warfare and for plants in which to produce them. Many of these contracts required cost computations, by their terms, in order to arrive at the amount to be paid by the United States to the contractor, for performance.

The cost-plus-a-percentage-of-cost system of contracting had been prohibited in certain cases in an act of May 2, 1941, relating to Merchant Marine construction contracts. The First War Powers Act, 1941, enacted December 18, 1941, contained a provision as follows:

> "That nothing herein shall be construed to authorize the use of the cost-plus-a-percentage-of-cost system of contracting."

In World War I the "cost-plus-percentage" contracts, without special features, had been found to offer an incentive which tended to increase costs and they had been found to entail heavy accounting and auditing expense. Accordingly they were not used in World War II.

There were, however, numerous other types of contracts which required cost determination, by their terms, and most of the other larger contracts involved cost accounting work because of laws enacted and administrative decisions relating to renegotiation, re-pricing and settlement.

Not only was cost accounting required to be done by contractors, to give a basis for their claims for reimbursement from the United States, but thousands of accountants and auditors were engaged by the government to test, examine, inspect, check, audit, or investigate such costs and to report thereon. Booklets and manuals on cost accounting were issued by the several governmental units for purposes of informing contractors of requirements and of informing those in government service as to their duties.

Some departmental instructions were issued soon after the declaration of war and some special instructions relating to defense contracts were issued before that time. The first general publication on cost accounting issued by the government in World War II, however, is believed to have been "The Green Book," so-called. This was prepared by two of the many professional accountants who served the government during the war. It was published bearing the date "April, 1942," and "War Department" and "Navy Department" were both imprinted on the cover. The booklet is entitled "Explanation of Principles for Determination of Costs under Government Contracts." It contains 19 pages of information as to admissible and inadmissible costs, basis of apportionment of items of cost, contractors' accounting systems, and inventory methods.

Accounting and auditing manuals were issued after the war started or pre-existing manuals were continued in use by the several bureaus, offices, etc., of the War Department and the Navy Department and by joint boards. Not only were the military services concerned with cost determination and amounts of payments to contractors but the Comptroller General had responsibilities for passing upon these matters. Under these conditions and in view of the fact that in some cases single companies were engaged in carrying out several contracts for several branches of the War and Navy Departments, at one time, cooperation of the governmental units and uniformity of cost standards were found to be highly important. Efforts were made in the direction of such uniformity and cooperation and substantial results were achieved. Some of the methods followed for purposes of such coordination, especially in connection with renegotiation and termination settlements, will be indicated in subsequent paragraphs.

Contract Renegotiation

"Renegotiation" of contracts, so-called, was authorized by Section 403 of the Sixth Supplemental National Defense Appropriation Act, approved April 28, 1942, as originally enacted and as subsequently amended. The procedure for renegotiation included obtaining and reviewing information as to contract costs, comparing these costs with proceeds received by contractors, determining amounts which should have been received and recovering the excess, if any, less appropriate tax adjustments.

For purposes of coordination, there was established a War Contracts Price Adjustment Board. It issued voluminous regulations, including a section headed "Costs Allocable and Allowable Against Renegotiable Business." The actual renegotiation proceedings were generally handled by a board in each of the contracting units or offices of the government. In the case of a contractor having contracts with two or more such units, arrangements were made to have the renegotiation handled by the appropriate board representing the unit having the principal contracts or by a board having knowledge of the business in which a particular contractor was engaged. Having common regulations and the following of other procedures mentioned tended, of course, toward uniformity in treatment of various kinds of costs as allowable or not allowable and toward some degree of uniformity in methods of allocation of costs under similiar conditions.

Section 403(a)(4)(B) of the statute relating to renegotiation contains several sentences which are of interest in connection with the effect of governmental acts upon cost accounting. The second sentence of this subsection reads as follows:

"Such costs shall be determined in accordance with the method of cost accounting regularly employed by the contractor in keeping his books, but if no such method of cost accounting has been employed, or if the method so employed does not, in the opinion of the Board or, upon redetermination, in the opinion of The Tax Court of the United States properly reflect such costs, such costs shall be determined in accordance with such method as in the opinion of the Board or, upon redetermination, in the opinion of The Tax Court of the United States does properly reflect such costs."

It may be of interest to note that the expression "properly reflect" is used in the foregoing while the corresponding expression in the Internal Revenue Code, which has been used for many years, appears to be "clearly reflect" with regard to income. The Regulations use "correctly reflect" and "clearly reflect," also with regard to income. Presumably these expressions are intended to have a single meaning.

Another sentence of Section 403(a)(4)(B) of the renegotiation statute which provides a basis for computing amounts of cost which, up to the time of writing this sentence, has not been commonly adopted for other purposes, is as follows:

"Notwithstanding any other provisions of this section, all items estimated to be allowable as deductions and exclusions under Chapters 1 and 2E of the Internal Revenue Code (excluding taxes measured by income) shall, to the extent allocable to such contracts and subcontracts (or, in the case of the recomputation of the amortization deduction, allocable to contracts with the Departments and subcontracts), be allowed as items of cost, but in determining the amount of excessive profits to be eliminated proper adjustment shall be made on account of the taxes so excluded, other than Federal taxes, which are attributable to the portion of the profits which are not excessive."

The indications are that the Congress and the advisers upon whom it relied found no more satisfactory comprehensive statement of what should be allowed as costs, for purposes of renegotiation, than the items "estimated" to be allowable under the stated parts of the Internal Revenue Code. For purposes of the required "estimate," use would presumably be made not only of the Code but also of pertinent Regulations, decisions, rulings, etc. The fact that the Congress considered it appropriate to use the word "estimated" is of interest but it will not come with any shock of surprise to those accustomed to the uncertainties inherent in the application of income tax law requirements to the tremendous number of varieties of

conditions under which different kinds of claims for deductions arise. The Regulations distinguish between amounts which a Revenue Agent or other representative of the Bureau of Internal Revenue has allowed or is expected to allow as deductions and amounts which the renegotiating agency estimates, on the basis of its independent judgment, are allowable under the Internal Revenue Code. The independent judgment of the agency is required to be followed.

The expression "to the extent allocable to such contracts and subcontracts," in the foregoing quotation obviously requires interpretation. The Regulations provided, in effect, that such costs would be those allocated to the contracts and subcontracts under the contractor's established cost accounting method; but if he had no such method or if, in the opinion of the War Contracts Board, the method did not properly reflect such costs, then allocation of costs should be made in accordance with such methods as the Board believed would properly reflect the related costs.

The Regulations include over 20 pages relating to specific items of cost, evidently intended for purposes of guidance of those responsible for making estimates of the items and amounts which would be allowable as deductions or exclusions under the Internal Revenue Code.

Since renegotiations of profits on war contracts continued only as to such profits derived up to December 31, 1945, the provisions as to cost determination do not continue in effect, after renegotiation has been completed with respect to such profits. The methods of determining cost for purposes of renegotiation will have some effect in the future on cost accounting methods, however, because of the large number of individuals who worked on cost accounting for renegotiation purposes during the war, some of whom will do cost accounting work in the postwar period. No prediction is offered as to whether their wartime experiences and impressions will tend to drive them from using the methods that were followed in renegotiation work or lead them to continue to use some or all the methods learned from such work. The only prophecy ventured is that the wartime experiences of these individuals will have some effect upon the cost accounting work which they do in the future.

Contract Termination

Plans were started for development of efficient methods of termination of war contracts, years before the surrender of the Germans or Japanese. Some contracts terminated, of course, prior to the dates of surrender, due to changes in requirements of the armed forces, changes of contractors producing certain articles, and due to other factors. But businessmen, lawmakers, and individuals in the procurement offices of the government were concerned with the effect of termination of contracts on a large scale at the end of the war, from the time when war started.

Under date of July 7, 1943, the War Department issued a "Termination Accounting Manual for Fixed Price Supply Contracts." Testimony was presented before the Committee on Military Affairs of the House of Representatives, on behalf of the United States Chamber of Commerce, in October 1943, with regard to termination of war contracts urging procedures, among others, which would keep to a minimum the delays and loss of time that would result if extensive and duplicated cost accounting and auditing of costs should be generally required. After other hearings and study the Contract Settlement Act of 1944 was approved on July 1, 1944. One of the features of this Act to which extended consideration was given was that

stating the powers and duties of the General Accounting Office and of the Comptroller General in the re-audit of settlements made by contracting agencies of the government and in changing the effect of such settlements. As enacted, the statute on that subject (Section 16(a) of the Contract Settlement Act) reads as follows:

"Any other provision of law notwithstanding, the function of the General Accounting Office with respect to any termination settlement made, authorized, ratified, or approved by a contracting agency shall be confined to determining, after final settlement, (1) whether the settlement payments to the war contractor were made in accordance with the settlement, and (2) whether the records transmitted to it, or other information, warrant a reasonable belief that the settlement was induced by fraud. For this purpose the General Accounting Office shall have the authority to examine any records maintained by any contracting agency or by any war contractor relating to any termination settlement."

This provision tends to limit the powers and responsibilities of the General Accounting Office in connection with war contracts. The purpose was to facilitate the completion of settlements at as early a date as practicable and to give finality to the settlements made by the contracting agencies, except where fraud was indicated to the General Accounting Office.

Another purpose of the Contract Settlement Act is that of coordination of the various agencies of the government on policies with regard to settlements under terminated contracts. Policies with regard to cost accounting are included. Section 6(b) of the Act reads as follows:

"Each contracting agency shall establish methods and standards, suitable to the conditions of various war contractors, for determining fair compensation for the termination of war contracts on the basis of actual, standard, average, or estimated costs, or of a percentage of the contract price based on the estimated percentage of completion of work under the terminated contract, or on any other equitable basis, as it deems appropriate. To the extent that such methods and standards require accounting, they shall be adapted, so far as practicable, to the accounting systems used by war contractors, if consistent with recognized commercial accounting practice."

Here there appears to be clear recognition of standard costs, in a Federal statute, and authorization to use such costs, where and to the extent that such use would be appropriate, in making settlements under terminated war contracts.

A review of the Act and of the reports of congressional committees regarding the bills which led to the Act, shows that it was recognized that accounting requires time. Since the making of expeditious settlements was a major objective, preference was clearly shown for settlement by a method which would not involve the time that full cost accounting would require. Although Section 6(d) of the Act sets forth costs for which the contractor should be compensated, when termination claims are not settled by agreement, and certain items which are not to be included as elements of cost, yet Section 6(e) directs that settlements be made by agreement, so far as practicable, in language as follows:

"In order to carry out the objectives of this Act, termination claims shall be settled by agreement to the maximum extent feasible and the methods and standards established under subsection (b) of this section shall be designed to facilitate such settlements. To the extent that he deems it practicable to do so without impeding expeditious settlements, the Director [the Director of Contract Settlement, appointed under the terms of

the Act] shall require the contracting agencies to take into account the factors enumerated in subsection (d) above in establishing methods and standards for determining fair compensation in the settlement of termination claims by agreement."

Here we have the same underlying thoughts that are found in business, that is, that if cost accounting is to provide the maximum net advantage to those who pay for it and use it, the results of the accounting must be available promptly; and that arrangements should be made to require only such cost information as is really necessary to arrive at substantially fair and sound decisions.

Under the Contract Settlement Act, regulations have been issued by the Office of Contract Settlement. Regulation No. 5 includes certain cost principles and under Regulation No. 14 a series of cost memoranda have been issued. Regulation No. 11 includes provisions for relaxation of requirements for preservation of records provided microphotographic copies are made, and other conditions are met.

There is probably no question but that the bulk of war contract termination claims were those against the Army and the Navy. For use in making settlements of those claims, the Army and Navy issued a Joint Termination Regulation. The document is voluminous. The same purpose is expressed in this Regulation as has been noted previously in the Act. For example, these two sentences are found in paragraph 531(3):

"Settlement by agreement should be facilitated to the maximum extent feasible. The amount of record keeping, reporting, and accounting, in connection with settlement of termination claims, will be reduced to the minimum compatible with the reasonable protection of the public interest."

These portions of the Regulations were quite evidently written by one who could see clearly the appropriate relationship of cost accounting to the ultimate essential objectives which it helps to attain, under the existing special conditions.

It is to be hoped and expected that the cost accounting provisions for use in war contract termination settlements will soon become of historical interest only and will have effect upon cost accounting only as they affect the thinking of those who have used them for war contract settlement purposes and those who refer to them for suggestions to be used in cost accounting for constructive purposes under conditions of peace.

Other Wartime Provisions Affecting Cost Accounting

Under the Emergency Price Control Act a great volume of reports was filed, much investigating of accounts, including cost accounts, was done, and long lists of orders and regulations were issued. Under some conditions increases in maximum prices were permitted if required reports were filed and if the facts presented showed that a price increase would be appropriate.

In some cases "high-cost" producers of strategic materials were granted bonuses for production in excess of established quantities. Production cost information was required by those government representatives authorized to decide whether bonus payments should be made and, if so, the amounts payable.

Contracting officers required cost information in some cases to be used in arriving at unit prices to be set for purposes of fixed-price supply contracts. They also required similar information for use in "re-pricing" where the prices originally established by them appeared later to be excessive. Special methods of cost alloca-

tion were devised to provide equitable sharing of the burdens of operating jointly used facilities.

These are mentioned only as examples to indicate the wide variety of uses of cost information and special types of cost data required and furnished under war conditions.

Indication has been given of a coordination of cost accounting efforts and activities by several governmental units, under war conditions. In some cases where cost accounting was used for substantially the same purposes by two or more organizations it has been possible to make considerable progress toward development of uniform standards and, at least within a given company, some cost accounting operations could be performed in the same manner for the Army, Navy and perhaps other governmental units.

Some progress was made in use of standards for deductions and exclusions under Federal income tax law as a basis for determining costs allowable under war contracts, as previously indicated. It should not be understood, however, that the standards set by income tax law and regulations furnish a complete basis or code for computations of cost under war contracts. Furthermore, there was at least one case in which use of deductions recognized by the Bureau of Internal Revenue for Federal income tax purposes was proposed as a part of the standard for computing costs, by an industry association, and this proposal was rejected on behalf of a governmental bureau. The following, taken from pages 75 and 76 of the 1945 Year Book of the National Association of Cost Accountants, outlines this situation and brings in other factors of importance and interest for consideration with respect to the impracticability of having general and complete uniformity of cost accounting for all purposes.

"Another situation involves applications to OPA for relief from ceiling prices. Here, fortunately, there is bureau recognition of the problem as evidenced by the following excerpt from a statement made by Paul M. Green, Deputy Administrator for Accounting of OPA, to the Senate Banking and Currency Committee. The National Coal Association had recommended that the accounting methods section of the Emergency Price Control Act be amended to the effect 'that determined costs for purposes of such regulations or orders shall include, but not be limited to, deductions from gross income recognized by the Bureau of Internal Revenue for federal income tax purposes.' Mr. Green's reply was as follows:

" 'This amendment would not require the use of established accounting methods in any sense of the term. For example, as we have shown, the method of computing depletion cost which we now follow and which the National Coal Association now attacks is the one followed by the coal companies themselves. The Association does not even propose that federal income tax accounting be the basis for OPA accounting. They propose that, in computing costs for pricing purposes, industry be permitted to include deductions from gross revenue recognized for federal income tax purposes. But they would not limit industry to such items. The proposed amendment would authorize the industry to take advantage of any specialized accounting methods developed by the Congress to meet the peculiar needs and problems of federal income taxation. However, it would not require the industry to observe any of the countervailing safeguards which the Congress may have provided since the determination of cost is specifically not to be limited to items deductible for tax purposes. Thus industry would be authorized to ignore the tax law whenever it would find an established accounting method more advantageous to it.

" 'The chief effect of such an amendment in many cases would be to inflate costs for price determinations far beyond those recognized by any system of accounting and out of all relationships to facts.

" 'So to relate the stabilization legislation to income tax law would embarrass the administration of both. Clearly the stability of the price structure would be threatened if effect had to be given to frequent changes in the statutory concepts and judicial interpretations of income for tax purposes.

" 'The two basic problems should not be confused. Tax laws have many objectives to achieve through the definition of gross and net income which are distinct from the objectives of the accountant in portraying as accurately as possible the actual cost incurred in the production and distribution of goods and services. I am confident that the leaders of the accounting profession would be unanimous in maintaining that cost accounting and its established methods should not be predicated upon income tax legislation.' "

The foregoing shows quite clearly that the quotation previously given from Section 403(a)(4)(B) of the renegotiation statute with regard to allowance as items of cost, for purposes of determining "excessive profits," of the deductions and exclusions under chapters 1 and 2(E) of the Internal Revenue Code, has not been considered an acceptable basis for government cost accounting for all wartime purposes.

No attempt will here be made to reconcile the different points of view and the different expressions with regard to costs and cost accounting under war conditions. It is clear that such differences have existed. They continue to exist.

Accordingly, it is clearly necessary to determine by what kind of an organization and for what purpose costs are to be prepared and used and to ascertain whether one or more laws or governmental regulations are applicable and, if so, which laws or regulations must be considered. This is true, of course, not only with respect to special wartime requirements but also with regard to the many requirements which must be considered under conditions of peace.

Possible Future Conditions

There seems reason to expect that government regulation of many businesses will continue as in the past, or at least without curtailing the extent of regulation and probably without reducing the requirements with regard to cost accounting. It may be that in some cases the extent of detailed accounting and reporting may be reduced. For example, a tendency is noticeable, over a period of years, for the Securities and Exchange Commission to simplify its requirements somewhat. As knowledge and understanding of cost accounting increase and become known to more individuals we may hope for more practical requirements and perhaps for somewhat less variations in requirements on the part of governmental organizations.

There seems no question that income taxes will continue, together with the related requirements regarding cost accounting. Probably we shall see some development in statements of requirements relating to cost accounting and it is to be hoped that such development may tend toward greater agreement with accepted practice in business. When and as income tax rates decline, some relatively fine distinctions should become less important and it may be possible to have the income tax law and regulations simplified. This may possibly include some simplification in connection with cost accounting requirements. It seems certain, however, that we

shall continue to have questions and contests with regard to income tax matters, that some of these will involve subjects closely related to cost accounting and that there will be a tendency toward increasing complexity as the number of rulings and decisions, issued under an almost infinite variety of factual situations, continues to grow.

There will be some continuing direct effect of laws and regulations from World War II for years to come. Undoubtedly the indirect effect of cost accounting under war conditions will continue for many years because of the large number of individuals who were engaged on cost accounting work during the recent war and whose minds have been influenced by their experiences in that work. The greatest hope in this connection is, of course, that any future war may be avoided and that the necessity of special cost accounting laws, regulations, etc., for wartime conditions will no longer be needed.

If war in the future is to be avoided, the present expectations are that the administration of the methods adopted for avoidance of war must be administered by one or more international organizations. This organization or the organizations will be in the nature of international government. We already have international treaties relating to international double taxation which relate rather closely to cost accounting problems. No doubt there will be international accounting codes for industries engaged in international business activities and these will presumably include requirements with regard to cost accounting. At least one such code is now being written. Accordingly, it is now not too early to begin thinking in terms of possible effects of international governments, treaties, etc., on cost accounting.

The strongest impression which consideration of the subject "Impact of Government on Cost Accounting" leaves on the mind of one who considers it is likely to be similar to that which one has after looking through a moving kaleidoscope. It has many aspects and many units, the conditions in each unit are changing frequently, and the relations of one unit to another are also in a state of change. The general tendency over the past fifty years has been for the effect of government on cost accounting to increase in scope of application as well as in complexity. There are indications that the effects, actual and potential, of governmental requirements, governmental acts, etc., on cost accounting are becoming appreciated and understood more fully and more widely by those engaged in business and those engaged in governmental activities. It is to be hoped that such appreciation, which appears to have reached new heights during the war period, will further develop in the postwar period. If such development continues, then we may hope for avoidance of the chaotic conditions in cost accounting which might result from increasing and noncoordinated requirements by the many departments, bureaus, and agencies of government which have to do with cost accounting and the consequent conflicting provisions with which individual businesses and their cost accountants would be confronted, in the absence of adequate cooperation to prevent such conditions. The need of such cooperation becomes increasingly obvious as we think of the possibility of adding international requirements with regard to cost accounting to those already in existence as a result of actions by our national and state governments.

COST ACCOUNTING IN THE AIRCRAFT INDUSTRY

By
ROY A. STARK *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Airplanes, to the general public, are means of transportation, mail service, and recreation. The aircraft industry classifies its products in three general classes—"light," "medium," and "heavy" planes. Light or small airplanes are advertised direct to the public in general and to individuals through distributors, as in the automobile industry. Medium and heavy planes are offered to the interlocking air passenger, mail and express lines, large corporations, army, navy, and a developing foreign market.

In general, the industry usually produces one type of each class of plane with its required spare parts and, of course, the experimental models for future designs and development. Like the automobile industry, profits depend mainly upon large-volume sales of a few products. Due to the great expansion of airports and aircraft facilities plus the world-wide demand for airplanes developed during the war and the broad expansion within the aircraft industries, mass production of airplanes will be possible in the future. Thus, originating large production, broad distribution, lower prices, higher wages, and continuous employment will enable the industry to operate at far greater efficiency.

Origin of the Products

Unlike most inventions, the desire to fly probably originated when man first observed the bird in its soaring flight. The first flight, made by the Wright brothers, occurred in December 1903. The plane, mechanically propelled by a four-cylinder car-type engine and carrying a man for the first time in the history of the world, remained in the air approximately sixty seconds.

In 1905 planes were able to remain in the air for half an hour. By about 1907, aviation had passed through its embryonic period. Flying had been achieved and was a fact.

Continuous effort was expended by the small manufacturers, inventors, and "dare-devil" pilots who were willing to risk their lives, finances, time, and energy in the development of aircraft.

During the period of hostilities in Europe (World War I), Congress appropriated more than one billion dollars for developing army aviation, combat planes, and observation ships, and for extensive development of suitable engines such as the Liberty 12, which proved to be one of the great engines produced during that war.

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Development continued with its ups and downs until the outbreak of World War II, when, through daring and intelligent planning of the government and all the aircraft industry, based on thorough knowledge gained through the research and development of the previous years, it was possible to produce such planes as the B-29 Super Fortress carrying many tons of bombs, ammunitions, and supplies; fast fighter planes traveling at the speed of sound; and army and navy trainer planes. This unprecedented development brought forth the airplane in its true value and opened the highways of the air to the new air-age. However, new designs, types, inventions, and the extensive research yet to be carried out to fill the broad highways of the air will require ingenuity, and the cooperation of the aircraft industry in standardization of aircraft.

Sources of Material

Flying machines have been made from almost every conceivable material available. A survey of all materials reveals that feathers, reed, fabric, paper, all the light woods, and light metals have been used. The materials to be used are usually determined by the availability of the raw materials, and the ease and cost of fabrication. Materials may be distinguished in two broad classes. (1) *Special materials and parts* made to definite specifications, such as radios, technical instruments, plastic compositions, standard bolts and nuts, castings, and forgings. This class of material is usually contracted for some time in advance and is not susceptible to rapid price changes. Material of this type requires a minimum amount of processing by the manufacturer. (2) *Material which can be purchased in the open market,* such as magnesium, aluminum, steel, bronze and lumber. Materials of this type are purchased in all forms: sheet, extrusion, bar, tubing, blocks, tooled, etc., and require extensive and elaborate processing to form and machine into parts necessary to complete the airplane. Class (1) materials are usually purchased from mass producers. Class (2) materials are purchased in large quantities in order to secure the quantity price decreases.

Organization of Plant

The description of cost accounting for manufacturing airplanes pertains particularly to plants that purchase special equipment and items requiring little or no processing and standard raw materials that require forming, shaping, heat treatment, machining, and welding to fit the specific type of airplane; in other words, the assembly-type industry.

A tabulation of the departments in a typical plant and their operations are grouped as follows:

Service Departments

- Engineering Department
- Experimental Department
  - Test Laboratories
  - Functional Analysis
  - Research
- Tooling Department
- Purchasing Department
- Production Departments
  - Production Planning

These have the usual duties and functions of industrial plants and present no problems peculiar to this industry.

Production Control
Production Scheduling
Material Control
Receiving and Shipping Dept.
Inspection Department

Outside Production Department — Serves the Production Department in many ways. It is the additional source of securing tooling, fabrication of parts where shop overloads occur and facilities and equipment are not available within the manufacturer's plant.

Manufacturing Departments are divided into four main classes as follows:

Manufacturing Departments	*Operations*	*Equipment and Facilities*
I. Fabrication Departments		
1. Machine Shop 2. Sheet Metal 3. Wood Mill	Milling, boring, cutting, shaping, grinding, form, drilling, punching of all types of material, metal, wood, and plastics.	Using automatic lathes, screw machines, punch presses, saws, hydro presses, and other machines for fabrication of parts to the close tolerances required in the manufacture of parts and with the minimum of direct labor hours.
II. Minor Assembly Department		
1. Upholstering 2. Welding Departments Torch Weld Spot Weld Arc Weld 3. Electrical Department 4. Bench Assemblies 5. Cable and Tube Assemblies 6. Riveting (Erco and Hand)	Sewing, glueing, welding, swaging, riveting, and the many operations of setups, checking, fitting of component parts to their proper places in the assemblies.	Assemblies requiring extensive jigs, fixtures, Erco rivet machines, spot weld equipment, and an enormous amount of floor space. As these assemblies are completed, they are expedited to the positions and major assembly lines to complete the airplane.
III. Major Assembly and Assembly Line		
1. Jig Assemblies (Large) 2. Assembly Position Line	Consists mostly of riveting, cutting, and fitting. Installation of special equipment and assembly of parts and assemblies as the plane moves through its positions, finally to be rolled to the flight department.	Very little equipment is required; only large jigs, dollies, and floor space.

IV. Flight

Consists mostly of trained mechanics and pilots. Here the plane is thoroughly inspected and test flown. Any inferior work or parts are repaired and replaced for final completion of the planes. Finished planes are usually stored on the adjoining field, anchored down, and heavily insured against damage.

Storerooms and warehouses, under control of the Production Department, are established for raw material and work in process. Whenever practical, raw materials, detail parts, assemblies, and installations are moved to their assembly lines by conveyor systems and overhead loading and moving devices.

Further segregation and additions can be made in a large organization with facilities to produce their special equipment, such as instruments, castings, forgings, and to produce the particular raw material for production of airplanes.

Production Order System

Production orders are assigned by the management and released to the factory through their controls set up by the Production Department.

One of the most important single functions in any manufacturing concern for cost accounting and cost control is the planning and control of production. Production Planning's purpose is to centralize all manufacturing data for each work order into a single function and parcel it to the shop for fabrication in a concentrated form, that is: *"The shop order"*—Exhibits 1 and 2.

FORM P. 1000 — SHOP ORDER-BEECH AIRCRAFT

CONT. CHARGE	SECT.	MODEL	SHIP NOS.	PART NUMBER	DRWG. CHG.	SEQ.
702-A 1	31	D18S		18.6084 LH & -1 RH		B-8

UNITS	PARTS	NEXT ASSEMBLY	DESCRIPTION
16	16L 16R	18.6052 LH & -1 RH	BRKT - RUDDER TAB 90 DRIVE CONT 567

FOR SPLITS						QUAN. PER UNIT		P	C	F
DEPT.	NO. PCS	DATE	DEPT.	NO. PCS.	DATE	4	(MAKES 1 LH & 1 RH)			
		2-506	034	$.278 per lb.		1	.064 x 10-1/4W x 3-1/2L	R		
	.1008	2.2960	.2314	.2661	15%		24SO AL ALCLAD SHEET			
							3-1/2L - EACH ADDITIONAL PART			

DATE NO.	SECT.	DESCRIPTION OF OPERATION	TOOL CODE	MACH CODE	SHIFT	WORKMAN	NO. OF PARTS	TIME START	TIME STOP	CREW CHIEF
75	9	FURNISH MATERIAL								
2··· 77	4									.0741 ··8
4	SH	SHEAR STRIP FOR P PRESS		.0008						
4	PP	BLANK PROFILE & PIERCE TEN #40, THREE #18, TWO #30 & ONE 15/16 HOLES	346B	0221						
3··· 4	SB	BURR		.0061						
4	BR	FORM JOGGLE	318	.0293 .0583						
5	HP	PARTIAL FORM FLANGES	213	.0411						
5	QF	FINISH FORM FLANGES	213	.0210						
5	HT	HEAT TREAT		.0096						
5	AL	ALIGN		.0366 .1083						
78	6	INSP								
77	6	STORE								
		9···Total Hours								
		NOTE: FINISH DRILL ON ASSEM								

ENG. NEXT ASSEMBLY | PLANNER KALB | TYPIST NCS

Exhibit 1—Shop Order, Detail Part. 1: Work Order No. and Release. 2: Service Department. 3: Production Department and Operations. 4: Material Requirements for one Left Hand Part. 5: Purchased Parts and Raw Material. 6: Manufactured Parts or Component Parts. 7: Government or Customer Furnished Parts. 8: Material Cost for one Left Hand Part. 9: Total Standard Hours.

Exhibit 1 is for manufacture of single items or detail parts.

Exhibit 2 is for assembly of fabricated parts and purchased items.

There are basically two types of production—mass production and job-lot production. The aircraft industry operates under the job-lot production basis. The Shop Order and its controlling work order are the basis for requirements of all materials, direct labor, tooling requirements, and control of production.

II. How to Design the Cost System

What Information Is Required

The cost system must be designed in such a manner that it will fulfill the needs and requirements of the management. It usually is essential to determine:

1. Costs that will comply with federal laws and government regulations
2. Total cost of contracts and work orders
3. Cost and efficiency of each department

FORM P-103A — SHOP-ORDER-BEECH AIRCRAFT

CONT. CHARGE	SECT.	MODEL	SHIP NOS.	PART NUMBER	DWG. CHG.	REQ.
702-A 1	31	D18S		18.6052 LH & -1 RH		C-2

UNITS	PARTS	NEXT ASSEMBLY	DESCRIPTION
16	16L 16R	407-18.6060 SA#9	BRKT - RUDDER TAB DRIVE CONT

FOR SPLITS

DEPT.	NO. PCS.	DATE	DEPT.	NO.PCS.	DATE	DEPT.	NO.PCS.	DATE	DEPT.	NO.PCS.	DATE
										5-6-7	

DATE RELEASED

DEPT. NO.	OP'R NO.	DESCRIPTION	TOOL NO.	AMT. COMP.	CO. INSP.	CUST. INSP.	QUAN. PER UNIT	MATERIAL INVOLVED	R	C	E	LOCA.
2							(11)					
77	6	FURNISH PARTS						(MAKES 1L & 1R ASSEM)				
6	1	INSTALL 18.6084	.1011				1LH	18.6084 BRKT		C		
		BRKT 18.6086					1	18.6085 REINF		C		8
		REINF & 18.6085					1	18.6086 REINF		C		
		BRKT					1RH	18.6084-1 BRKT		C		
6	2	DRILL TEN HOLES	.1583				1	18.7713-2 GUARD		C		
3		1/8 " THREE #18		1-232-139	.0007ea.	2	AN515-6-6 SCREW	.0015	R			
		HOLES		1-214-029	.0007ea.	2	AAF366-632 NUT	.0147	R			9
6	3	DISASSEMBLE & BURR	.1061	1-143-024	.0003ea.	2	AN960-6 WASHER	.0006	R			
6	4	ASSEMBLE & RIVET	.1000					Total	.0168			
78	6	INSP						(10)				
77	10	STORE										
		Total Hours	.5000	4								

ENG. NEXT ASSEMBLY	PLANNER	TYPIST

Exhibit 2—Shop Order, Assembly or Installation. 1: Work Order No. and Release. 2: Service Department. 3: Production Department and Operations. 4: Standard Hours Detail Operations and Total. 5: Purchased Parts and Raw Material. 6: Manufactured Parts or Component Parts. 7: Government or Custom Furnished Parts. 8: Requirements of Component Parts for Left Hand Assembly. 9: Requirements for One Assembly. 10: Cost of Raw Material and Purchased Parts. 11: Material Required for Left Hand and Right Hand.

4. Cost of each type of plane and spare parts
5. Data for costing year end physical inventories
6. Cost for insurance settlements
7. Records for accurate costing of sales
8. Records for preparation of profit-and-loss statements and balance sheets
9. Basis for establishment of sales prices

The reports of the cost accounting department serve as the principal source of information used by the management in the formation of its future plans and policies and in securing efficient and profitable control of operations. Therefore, they should be submitted to the top management in an intelligible summarized form.

Consideration in Designing the Cost System

First to be considered is the type of industry. The aircraft industry is of the assembly type industry. Their products consist of an enormous amount of fabricated and purchased parts assembled to complete their product. Their production system is of the job-lot type involving numerous work orders for planes with special equipment, optional equipment, and spare parts.

The general principles and systems of cost accounting are governed somewhat by the Federal laws and regulations, such as working conditions, hours, wages, rates of profit, allowable and unallowable cost, and other factors that enter into designing the cost system. In designing the cost system, considerations were given to the type of industry, type of production, Federal laws and regulations, the data to be furnished to the management for their future plans and policies, price establishment, and securing efficient and profitable control of operations. This requires what might be termed a combination *"Standard Cost System"* and a basic *"Job-Lot Cost System."*

"Standard Cost System" Combined with a Basic "Job-Lot System" is Favored

The "Job-Lot Cost System" is well adapted for use in this type of industry with the job-lot production system of manufacture. The heart of the system is the production work order and shop order, which are used to accumulate records of direct material, direct labor, factory overhead, variances, and direct expense for the entire course of production. If there are a number of units comprising the work order, the average cost per unit can be obtained through the media of production work orders when each job is completed by dividing the total cost of the work order by the number of units involved.

The job-lot cost system is very adequate in giving the over-all total manufacturing cost and data to compute the profit-and-loss Statement, balance sheet, and some of the managerial control data, but is inadequate in supplying the breakdown of the cost involved in the manufacture of each detail part, assembly and installation, without extensive and expensive timekeeping procedures, material distribution, distribution of overhead with an extravagant amount of personnel and clerical work.

The standard cost system used in conjunction with the job-lot cost system has proven very satisfactory in the aircraft industry with respect to efficiency, speed, usability and accuracy. It is inexpensive in comparison to a complete "Standard Cost System" or a "Job-Lot Cost System" where detail costs are concerned and the type of industry and type of production are considered.

III. Description of the Cost System

The most important steps in establishing the *"Standard Cost System"* in this industry are as follows:

1. How to create the standards
2. Material pricing
3. Method of securing direct labor
4. Computing direct labor rate
5. Computing overhead rates
6. Outside production cost
7. Standard cost forms
8. Computing the standards, variances, and keeping the Standards current

It has been proved that the value of this type system increases as more costs are standardized.

Material Pricing

Material prices used in computing standards are taken from average prices maintained by the Material Accounting Division.

Standard Labor Hours

Standard labor hours are secured from the Scheduling Section of the Production Department. Time Study Hours are preferred as a basis for the labor cost and should be used in all cases where they are available. In case time studies are not available, manufacturing time from the factory copy of the Shop Order is used. The workmen in the shop record the actual time expended on the back side of the factory or traveling copy of the shop order. As orders are completed or "closed out," they are routed to the Standard Cost Section and filed by Part Number. Due to human errors or machine trouble, the recorded time will vary considerably with the different orders and good judgment is necessary in arriving at the correct time to use in computing the costs. In some cases time will not be available on the part from either the Time Study Department or the shop orders. In such cases the labor hours are estimated and stamped "Estimated" to allow for any necessary changes when time studies are completed.

Outside Production Costs

Due to shop overloads and shortages of equipment and facilities, it is necessary to "farm out" some fabrication to other manfacturers. In these cases it is necessary to set up controls showing the vendor's costs to the manufacturer and the manufacturer's cost. It seems that the most logical way of handling this situation in regard to standard cost is to compute the standards as follows:

> Compute the standards on the basis of the cost invoiced to the manufacturer from the Outside Production vendors.

This method will give the data to properly allocate the variances to be applied to the standard costs.

If fabrication is to be secured by the outside producers, the reference copy of the shop order will route the parts to the Outside Production Department. They in turn secure contracts with the outside producers to manufacture the parts. In most cases the manufacturer sells the material to the vendors.

An estimated cost is furnished to the Outside Production Department for each item to be subcontracted and is used to establish and control the contract price. A copy of the contract is maintained by the Standard Cost Section for computing the standard cost.

Direct Labor Rates

The average department hourly rates are used in computing direct labor costs.

Overhead Rates

The hourly overhead rate is kept on both a monthly and a yearly moving average basis. The last method is used to eliminate monthly fluctuations in overhead and is accomplished by using a twelve-month moving average—always dropping the earliest month in the computations and adding the current month. This method gives the current overhead picture and is used as the overhead rate in special estimated costs and as the basis for arriving at the hourly overhead rate to be used in setting up new standards.

How Standards are Created

Standard cost forms are the heart of any standard cost system. Standards for the cost of material, direct labor, and overhead expense on each item are posted on the cost form which then becomes the basis of cost information in regard to the item throughout the life of the part. The cost form should be designed to give the cost correctly and efficiently at a minimum of expense in clerical work and personnel. *The Cost Form* (Exhibits 3 and 4) *is standard in relation to the shop order* (Exhibits 1 and 2) *and is printed on the reverse side of the shop order,* thereby giving all necessary information in regard to material, labor requirements by operations and department, next assembly, quantity required per assembly, work order, etc., on the face of the cost form.

A copy of all shop orders on each work order is secured from the Production Planning Department and from these the standards are created.

Detail Parts—Exhibits 1 and 3

Cost forms for detailed parts are routed to the Material Accounting Inventory Section where the proper material codes and prices are entered on the face of the form (Exhibit 1). The proper allowances for waste and conversion factors are posted. With this, the cost is computed, showing the standard cost of material which is extended to the reverse side of the form under the heading "Material Cost" (Exhibit 3).

Direct labor hours are posted to the face of the cost form by operations and totaled by department. The total hours by departments are then posted to the reverse side of the cost form and extended at the departmental direct labor rates to the labor column, as shown on "Exhibit 3." The direct labor hours are then extended by the over-all overhead rate entered under the heading "Overhead." The addition below gives a cross check showing the standard cost of material, labor, overhead, and total.

In case the reference cost form routes the part to be manufactured to the Outside Production Department and is "Vendor Furnished" material, the cost is posted,

from a maintained file of prices, to the cost form under the heading "Outside Production Cost."

If the manufacturer "Furnished" material, the cost of material is computed as shown in "Exhibit 1" and entered under the heading "Material Cost" and the contract price for labor is extended to the column for Outside Production Cost.

Exhibit 3. COST FORM
DETAIL PART

No. Reg.	Part Number	Rate	Man Hr.	Overhead	Out. Prod.	Material	Labor	Overhead	Out. Prod.	Total
		Material	Labor							
(1)	Matl. & Pur. Parts					07				07
(2)	Dept. 4	132	.058 3	250			08	15		23
	Dept. 5	139	.108 3	250			15	27		42
(3)						07		23	42	72

660 C. 1. Material Cost from Face of Cost Form or Shop Order (Ex. 1). 2. Labor Hours from Exhibit 1 extended by Labor and Overhead Rate. 3. Total Standard Cost.

Assembly Costs (Exhibits 3 and 4)

Cost of the raw material and purchased parts are computed in the same manner as detail parts with the exception that there are a number of items per each assembly which are totaled and extended to the reverse side of the Cost Form.

COST FORM - EXHIBIT 4
ASSEMBLIES AND INSTALLATIONS

	No. Reg.	Part Number	Rate	Man Hr.	Overhead	Out. Prod.	Matl.	Labor	Overhead	Out. Prod.	Total
			Matl.	Labor							
(1)		Matl. and Pur. Parts					02				02
	1	18.6084					04	23	42		69
(4)	1	18.6085					03	08	16		27
	1	18.6086					03	08	15		26
	1	18.7713-2					01	04	08		13
(2)		Dept. 6	136	500	0			68	125		193
(3)							13	111	206		330

1-2-3. Same as Detail Part (Exhibit 3). 4. Part Numbers (Exhibit 2) Posted from Cost Form (Exhibit 3).

Detail components and assemblies are called out on the Assembly Cost Forms, (Exhibit 2), and are extended to the reverse side of the Cost Form (Exhibit 4) by part number and quantity required per assembly. The costs are obtained from the Detail and Assembly Cost Forms and posted for extension to arrive at the total cost of the quantity required.

Labor costs, overhead, and outside production costs are computed for the assemblies in the same manner as detail parts.

Position and Installation Cost (Exhibit 5)

Position planning orders are issued to the assembly line, calling out all the required parts, assemblies and installations, and purchased parts to complete the airplane for flight. These are costed and totaled, showing the total material, labor, overhead, outside production and total, giving the total standard cost of the airplane.

DATE RELEASED	BEECH AIRCRAFT CORPORATION	POSITION
JULY 16, 1946	POSITION SHEET	10

CONTRACT	SEC.	MODEL	SHIP NOS.	PART NUMBER	CHG.	SEQ.
702-A	31	D18S			A	E-1

UNITS	SHEET	NEXT ASSEMBLY	DESCRIPTION
1	10 of 15	FLIGHT	

QUAN.	OP'R NO.	MATERIAL	R	C	GF	1	2	3	4	5	6	7	8	9	10
		(2) (404-18.9663 INSTAL. ANTI-ICER PIPING)													
1		118.9690 FLANGE (84-18.9646)		C											
1		84-18.9664 TUBE ASSEMBLY		C											
1		814-18.9663 TUBE ASSEMBLY		C											
1		AC811-HT-4D UNION	3												
1		84-18.9692 BRACKET		C											
2		84-18.9693 BRACKET		C											
3		AN3-7 BOLT	3												
3		AN310-3 NUT	3												
3		AN380-2-2 PIN	3												
3		10.5933-4 CLIP	3												
3		AN515-8-10 SCREW	3												
3		AN960-8 WASHER	3												
3		AC365-832 NUT	3												
2		AN742-D4 CLAMP	3												
		(C) (407-18.6000 INSTALLATION TAIL SURFACES)													
1		407-18.6000 SA #2 FIN & STAB. ASSEMBLY		C											
1R		18.6052 BRACKET		C											
1L		18.6052-1 BRACKET		C											
4		AN502-10-12 SCREW	3												
10		AN960-10 WASHER	3												
10		AN365-F632 ANCHOR NUT	3												
1		404-18.6002-6 FAIRING		C											

Exhibit 5—Position Sheet. Costs are computed on the reverse side of the Position Forms in the same manner as "Assembly Cost," giving total Standard Cost of each airplane.

Keeping Standards Current

Standards are currently checked with the changes in production as to material requirements, prices, engineering changes, etc., by checking the standard cost forms with the new releases as issued to the shop for fabrication. On any changes that are found, costs are computed on a new shop order or cost form and stapled to the front of the old cost form. This is done to accumulate a part history; also, in this industry, once a part number is assigned it never is to be changed. With these changes in production costed, it is easy to notify all interested parties of the change and any change they deem necessary to make can be made by authority of the notification. Hence, the cost data are current and if any irregularities and inefficiencies are found, they can be corrected and favorable happenings will be brought to light.

Variances Used

I will state again that the heart of the "Joint Cost System" are the Production Work Order and Shop Order which accumulate the manufacturing cost of the industry's products and by addition of the administrative cost, the total costs are obtained.

Variances are calculated and distributed to the accounts entirely within the Job-Lot Cost System; therefore, a variance is accumulated between actual or job-lot cost and standard cost.

Name of Variance			*For Accumulating the Difference Between*			
Material	—	Price	Actual	or	Job-Lot Cost	Standard Cost
Material	—	Usage	Actual	or	Job-Lot Cost	Standard Cost
Labor	—	Rate	Actual	or	Job-Lot Cost	Standard Cost
Labor	—	Efficiency	Actual	or	Job-Lot Cost	Standard Cost
Overhead	—	Budget	Actual	or	Job-Lot Cost	Standard Cost
Overhead	—	Volume	Actual	or	Job-Lot Cost	Standard Cost
Outside Production	—	Price	Actual	or	Job-Lot Cost	Standard Cost
Outside Production	—	Usage	Actual	or	Job-Lot Cost	Standard Cost

It might be well to point out at this time that the difference between actual and standard cost is a very small percentage, as has been proved over the years that this system has been in use at the Beech Aircraft Corporation.

How Variances are Allocated

On products where actual costs are known, variances are allocated by the percentage method of the difference between standard and actual cost. When it is necessary to bring standard to actual for a definite purpose, a percentage is applied to each item of the cost, material, labor, outside production, and overhead. With these percentages applied to all the detail cost, the total of all the components, assemblies, and installations will give the manufacturing cost.

On products where actual costs are unknown, variances are computed in the following manner: In conjunction with our job-lot cost system, direct labor hours are accumulated against each work order and charts plotted for the total direct labor hours charged to each release. From experience it is found that, when a new product is started, there is bound to be a high ratio of labor variance, but as the

contract progresses, the ratio drops in the same proportion that efficiency increases. Standards are computed on an ideal or best performance basis; therefore, the hours will not be subject to constant change and costs can be adjusted easily by applying back the variance.

To put these costs on a comparable basis, the actual hours, current labor, and overhead rates are substituted for the standard hours, labor, and overhead rates. A basis for estimating the variances between Standard and Actual Material Price and Usage and Outside Production Price and Usage has been established by the completed work orders on other products. These revised figures, when added to the material cost and outside production cost with estimated variances applied, will tie in with the manufacturing cost if proper allowance for waste has been made.

Calculating the Variance

Variances are computed by two methods:

(1) When actual costs are known.

(2) When actual costs are unknown.

(1)

COMPUTATION OF VARIANCE
WHEN ACTUAL COSTS ARE KNOWN

Elements of Cost	(1) *Actual Cost*	(2) *Standard Cost*	(3) %	(4) %
Material	$ 6243.48	$ 5834.06	——	7.0177
Outside Production	5700.14	5499.53	——	3.6477
Direct Labor	4144.66	3989.82	——	3.8808
Overhead	7188.43	6982.44	——	2.9501
Total	$23,276.71	$22,305.85	4.3525	

(1) Taken from completed cost report.

(2) Cost taken from total of Position Sheets (Exhibit 5).

(3) Over-all variance to be added to Standard Cost to bring them to manufacturing cost.

(4) Individual variance to be added to elements of cost to bring them to manufacturing cost.

(2)

COMPUTATION OF VARIANCE
WHEN ACTUAL COSTS ARE UNKNOWN

Elements of Cost		*Standard Cost*		*Actual Cost*
Material	(a)	$ 5834.06	(A)	$ 6359.13
Outside Production	(b)	5499.53	(B)	5664.52
Direct Labor		3989.82	(C)	4564.48
Overhead	(c)	6982.44	(D)	8237.46
Total		$22,305.85	(E)	$24,825.59

(1) Standard Labor Hours	(3,173)	Computed by Division of Std. O.H. (c) Cost by Std. O.H. Rate (3)
(2) Actual Hours	(3,566)	From Direct Labor Chart of Actual Hours
(3) Standard Hourly O.H. Rate	($2.20)	As established for computing Standards
(4) Current Overhead Rate	($2.31)	From O.H. Analysis "12 month average"
(5) Standard Hourly Labor Rate	($1.25)	As established for computing Standards
(6) Current Hourly Labor Rate	($1.28)	From current Direct Labor Analysis
(7) Estimated Material Variance	(9%)	Average Variances from Analysis of Completed Cost (Actual Cost Known)
(8) Estimated Outside Purchase Variance	(3%)	Average Variance from Analysis of Completed Cost (Actual Cost Known)

(A) Standard Material (a) plus Variance (7)
(B) Standard Outside Production (b) plus Variance (8)
(C) Actual Hours (2) by current Labor Rate (6)
(D) Actual Hours (2) by current Overhead Rate (4)
(E) Actual Manufacturing Cost, Variances can be computed on each item of cost and total on same basis as shown in item (1) Actual Cost Known, by adding administrative cost, total costs are secured for setting sales prices.

The above computation is an example as to how manufacturing cost can be obtained when the actual cost is unknown.

The variances as accumulated between job-lot cost and standard cost, when standards are kept current with production, are mostly due to the starting load costs and inefficiencies that are inevitable when new products are put into production. Variances between standard and actual can be handled, when computed in the manner outlined, to fit any situation that may arise.

COST ACCOUNTING IN AIRPLANE ENGINE MANUFACTURING

By
ROGER A. SEEBE *

I. DESCRIPTION OF THE INDUSTRY

Airplane engines, the sources of power used to drive an airplane, are produced in several distinctive basic types. The most common type is the radial engine in which the cylinders project from a central crankcase, like the spokes of a wheel. Such engines may have from five to eighteen cylinders, and are usually air-cooled. Another type is the in-line engine, such as is generally used in automobiles. These engines may have from two to thirty cylinders, and are made both air-cooled and fluid-cooled. Other types of engines are jet turbine and rocket engines. The latter two may still be considered to be in experimental state, although both have actually been used in flight.

Before the war, airplane engines were mostly produced as individual units. During the war it was necessary to introduce the mass production line system, so widely used by the automotive industry. In the postwar period, the mass production line method will probably not be needed, although for certain operations this method will no doubt be retained.

The principal source of the engine design is the engineering department. The final finished product never remains fixed in design details for an extended time. The engineers must continually experiment and devise means of improving the engine. Engineering changes are numerous even after a given model has been started in production. This will be particularly true for the new jet turbine and rocket engines.

One of the particular requirements of an airplane engine is that it must be light in weight and be compact in space requirements. Reciprocating engines are now built to weigh about one pound per horsepower of output. In order to attain light weight, aluminum and magnesium are used extensively.

Since human life depends on the proper functioning of airplane engines, they must be produced subject to the most rigid tests and inspections. Every piece of metal or part must be inspected and tested for the highest standards of perfection. After assembly, each engine must be tested by actual runs of a specified number of hours. And after the first test run, each engine must be completely disassembled and every individual part again inspected. If any part shows flaws, it must be replaced. After reassembly, each engine must again be run under a carefully scrutinized test. Upon passing the final test, the engine must be carefully packed so that no portion can be damaged by handling or through atmospheric conditions. As a protection against the latter, the engines are usually sealed in pliofilm containers,

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which also contain humidity indicators, so placed as to be visible through the packing case.

Other than engines for the manufacturer's own experimenting, airplane engines are usually produced only on order, not for stock. An important factor in the airplane engine industry is the long period of servicing required for the customers. During the war, when the Federal government was the chief customer, airplane engine manufacturers had service men and equipment stationed in far away and remote corners of the globe.

Materials needed in engine production include steel, magnesium, aluminum, bronze, castings, silver for plating, and gasoline and oil for testing. Many specialized parts, such as spark plugs, magnetos, carburetors, etc., are usually purchased finished. As many as 16,000 parts may be needed in engine manufacturing. Often, a large proportion of these parts are manufactured by outside vendors. Many of the parts, or processes for making parts, are covered by patents, requiring license agreements, the considerations of which are variously based on price per part, or per engine produced, or a percentage of engine sales price.

A typical airplane engine plant would comprise departments as follows:

Service Departments:

Research and Development	To study improvements in design and processes.
Engineering Design	To design and draft engines and parts.
Production Control	To control procurement, scheduling, and manufacture of parts.
Purchasing	To procure materials to cover scheduled requirements.
Receiving	To receive and report incoming materials.
Vendors' Inspection	To inspect all incoming material.
Master Mechanic	To provide the machine tools and maintain them in efficient condition.
Plant Engineer	To maintain the physical plant.
Laboratory	For chemical analysis and X-ray of production materials.
Rough Stores	For storage and responsibility over raw materials.
Maintenance Stores	For storage and responsibility over materials and equipment to maintain the plant and machinery.
Tool Room	For storage and protection of small tools and maintaining them in good condition.
Labor Measurement	To make time studies of the various production operations.
Timekeepers	To keep time records of jobs and count of quantities produced.
Finished Stores	For storage and responsibility over finished parts and subassemblies.
Shipping	To ship finished product to customer.
Personnel	To procure employees and maintain records and promote employee relations.
Plant Safety	To promote safety and care for injuries to employees.
Cafeteria	To provide meals.
Training	To instruct and train personnel.

Productive Departments:

Category	*Process*	*Principal Equipment and Facilities*
Pattern Shop	Making patterns for foundry operations	Lathes, sanders, etc.
Foundry	Making castings of steel, aluminum, or magnesium	Furnaces, ladles, moulds, cleaning equipment, etc.

Category	*Process*	*Principal Equipment and Facilities*
Heat Treat	Annealing or hardening materials and parts	Ovens and conveyers
Plating	Silver, indium, chromium and copper plating of parts	Plating vats and conveyers
Cylinder Heads	Machining the rough castings	Drills, milling machines, and grinders
Cylinder Sleeves	Machining the rough castings	Drills, lathes, milling machines, and grinders
Cylinder Assembly	Assembling cylinder heads and sleeves	Heating ovens and presses
Crankcase	Machining the rough castings	Drills, lathes, milling machines, and grinders
Crankshaft	Machining the rough steel forgings	Drills, lathes, milling machines, torque machines, and grinders
Pistons	Machining the rough castings	Lathes, drills, milling machines, grinders, and polishers
Precision Parts	Machining gears, cams, pins, etc., from bar stock or other materials	Lathes, drills, milling machines, gear cutters, gear lappers, shapers, honers, grinders, etc.
Rods and Rockers	Machining the rough forgings and castings	Drills, milling machines, and grinders
Machine Shop Inspection	Inspection of parts at various stages of completion for workmanship and for allowable size tolerances	Inspection benches, gauges, etc.
Engine Assembly	All subassemblies and parts needed for each engine are withdrawn from Finished Stores and segregated to be accessible for assembly. After assembly, engines are sent to test and then are returned to assembly for tear-down, detailed inspection and reassembly.	Assembly rigs, derricks, hoists, etc.
Engine Test	Engines are placed in test blocks in test cells, oiled, connected to fuel supply and run under observed and carefully recorded tests. After tear-down and reassembly, engines are again similarly tested.	Test cells (built with noise absorbing baffles), test blocks, derricks, test propellers, gasoline and oil, and special testing controls, meters, etc.
Packing	After final accepted test, engines are encased in pliofilm and packed securely in fully enclosed shipping boxes. Spare parts sold are withdrawn from Finished Stores and suitably packed.	Derricks, hoists, etc.

II. How to Design the Cost System

The cost system in an airplane engine plant must be designed to give the actual cost of each engine produced; along with sufficient intermediate data of costs of the various major productive operations, and the corresponding departmental efficiencies, to afford managerial control over the successive steps of manufacture. The intermediate cost data must be made available currently in order that increased efficiency may be effected through continuous studies of costs and possible reductions thereof. In this respect, variable costs should be reported to the supervisors who exercise control thereof.

The finished product changes continually, even for a standardized engine, because there are always improvements in details, which will affect the over-all cost. Therefore, it must be realized that variations in over-all cost of a given model will be due both to changes in design and in manufacturing efficiencies.

Consideration must be given to the method of distributing overhead and whether service department costs should be successively distributed, or whether, in order to expedite closing the books, all overhead costs should be distributed directly to the producing departments. These policies will depend upon individual conditions and also upon individual personal preferences. Although the simplest and quickest way of distributing overhead would be a plant-wide uniform rate on direct labor cost, distribution by departments on the basis of direct labor hours or machine hours would give more accurate cost results. Consideration must also be given to the various labor categories that might be classified either direct or indirect. Among such would be:

Receiving	— Indirect
Receiving Inspection	— Although each part received must be inspected, such labor would probably be classified indirect, for to treat it as direct might entail excessive bookkeeping.
Rough Stores	— Indirect
Pattern Shop	— Direct
Heat Treat	— Direct
Plating	— Direct
Tool Room	— Indirect
Machine Shop and Assembly Inspection	— Direct; during manufacturing and assembling, regular inspections become specific operations in the product.
Finished Stores	— Indirect
Testing	— Direct
Packing	— Direct

The "standard" cost system is preferred for an airplane engine industry. The material element of each part manufactured should be expressed at a standard cost, as near as possible to market value. The labor element of each part manufactured should be expressed at a standard, based on time studies of each operation, converted at an average rate for the labor classification for the particular operation.

MANUFACTURING ORDER	CLERK	DATE ISSUED	PART NUMBER	WORK ORDER OR SUB
PART NAME				QUANTITY
WORK TO BE DONE				
			SALES ORDER NO.	
MATERIAL REQUIRED				

REMARKS	MATERIAL TO STORES		
	DATE	QUANTITY	AUTHORIZED SIGNATURE

PRODUCTION CONTROL COPY

Fig. 2.

The overhead element of each part manufactured should be expressed at a standard, preferably on the basis of standard direct labor minutes, individually determined for each major producing department. Each purchased part that goes into assembly should be expressed at a standard cost, as near as possible to actual cost. Subassembly standards should gather separately the material standards, labor standards, and overhead standards, augmented by assembly labor standards, also based on time studies, and corresponding assembly overhead standards.

The testing operation, which is a significant factor in the cost, requires extensive quantities of gasoline and oil. Although these items are direct expenses they are not logically direct materials in the product, and hence can be considered a part of testing overhead, distributed on the basis of direct testing labor hours.

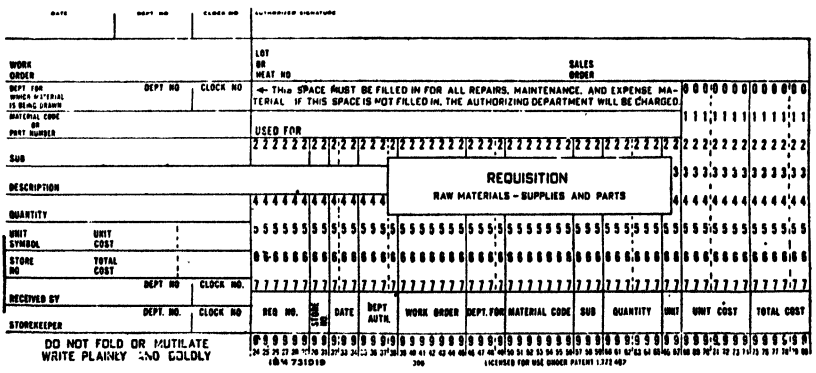

Fig. 3.

ISSUED REC'D

MOVE ORDER

PART NO.	ORDER NO.	SALES ORDER NO.
NAME OF PART		

PCS. ON ORDER	PCS. FINISHED	PCS. REJ.	BAL. DUE
LAST OPERATION COMPLETED			

FROM DEPARTMENT	TO DEPARTMENT

O. K. For Quantity Issued	C. K. For Quantity	O. K. For Quantity Received	O. K. For Quantity
Checker	Inspector	Checker	Fin Stores

REMARKS:

TO REMAIN WITH MOVE ORDER CLERK ORIGINAL

Fig. 4.

III. Description of the Cost System

A standard cost system for an airplane engine industry does not involve any exclusive problems not met in any similar industry which requires the production and assembly of large numbers of precision parts. As in all similiar industries, the heart and pulse of planning and action lie in the activities of its production control. It is here that orders originate and records accumulate which ultimately reflect in the cost accounting records.

Production Control

The purchase requisitions and manufacturing orders are based on a master schedule of shipping requirements (in turn based on sales contracts and commit-

Date_____ Part No._____ Order No._____

Part Name _____ Quantity_____

SHOP ROUTE CARD

Dept.		Oper. No.	Operation Name	Dept. Performing Operation	1st Pc. Insp.

Fig. 5.

PART NUMBER		WORK ORDER OR SUB	QUANTITY ISSUED
SPECIFICATION	LOT NUMBER	STOREKEEPER	DATE

HOLD TICKET AND SPLIT RECORD

DATE	OPER.	HOLD TICKET NO.	QUAN. HELD	SPLIT LETTER	QUAN. SPLIT	SIGNATURE AND BADGE NO.	BALANCE DUE
		ASSIGNMENT CRIB ACKNOWLEDGMENT →					

CLEARANCE TO STORES

DATE	INSPECTOR'S NAME	BADGE NO.	TOTAL CLEARED	BALANCE DUE

STORES ACKNOWLEDGMENT

DATE	QUANTITY	RECEIVED BY	STOREKEEPER

Fig. 6

ments), which is used by production control department in its activities of procurement and issuance of shop orders for engine building. The engineering department supplies a bill of material for each model, listing subassemblies and details by part numbers, giving specifications, drawing numbers, etc. From this, production con-

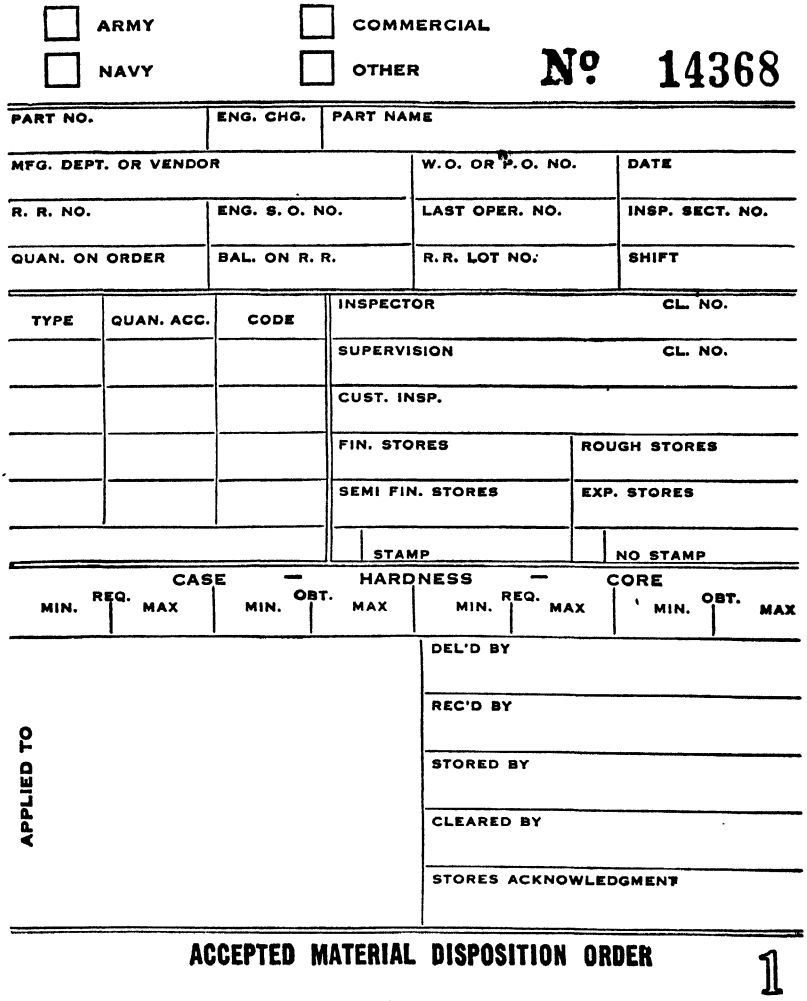

Fig. 7.

trol prepares a model analysis, listing each individual part, quantities needed, specifications, whether to be manufactured or purchased, etc. Next, individual *production control record cards* (Figure 1) must be set up for each individual part, showing over-all requirements and requirements by months, as adjusted by lag in procurement and manufacturing cycle. From the requirements thus set up, purchase requisitions are prepared, and upon fulfillment of the latter, raw materials, rough castings, and purchased finished parts are procured.

Manufacturing orders (Figure 2) are issued for production of parts to be manufactured and delivered to finished stores. Assembly orders are issued for assembling the individual parts and building and testing the engine. The withdrawal of parts from finished stores for building the engine is authorized by an engine pull list, which lists all parts, quantities needed for a specified period, units per engine, and place

REQUEST FOR MATERIALS REVIEW DECISION

PART NO. AND ENG. CHG.	QTY. ON ORDER	QTY. DEVIATING	DATE	446367

PART NAME	MFG. GROUP NO. OR VENDOR NAME

W. O. OR P. O. NUMBER	REC. REPORT NO. AND LOT	REC. REPORT DATE	I. D. R. NO.

CASTING OR FORGING NO.	SPECIFICATION NO.	HEAT NO.	LAST OPERATION

QUANTITY	DESCRIPTION OF DEVIATION	DISPOSITION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

INSPECTED %	INSPECTOR'S SIGNATURE	CLOCK NO.	AREA NO.	CHARGE TO

INSPECTION LEADMAN	HARDNESS TEST LEADMAN
DEVIATION NOTED GOV'T INSPECTOR	GOV'T HARDNESS TEST INSPECTOR

MATLS. REV. INSPECTOR	CLOCK NO.	UNIT NO.	ENGINEER

MATLS. REV. LEADMAN	REFER TO	GOVT. INSPECTOR

FINISHED STORES ☐	SEMI-FINISHED STORES ☐	ROUGH STORES ☐

PUNCH 1	ACCEPTED QUANTITY	TO BE CORRECTED QUANTITY	SCRAP QUANTITY	RETURN TO VENDOR QUANTITY

APPLIED TO

REC'D BY

DEL'D BY

STOCKED BY

PARTS CLEARED BY

Fig. 8.

in assembly line where parts are to be sent. This pull list is prepared from the underlying model analysis. The parts called for by the pull list are placed in segregation racks duly labeled and identified, until ready for assembly.

Material

From a cost accounting standpoint, it is important that all movements of material, and all physical changes of material being processed, be recorded in some manner.

The cycle of material movements for manufactured parts would start with a *requisition* (Figure 3) issued by production control, authorizing stores to issue ma-

REQUEST FOR REWORK No. 636806

PART NO.	ORIGINATING DEPT. STATION	QUANTITY	DATE
PART NAME		LAST OPERATION COMPLETED	ENGINEERING CHANGE
ORDER NO.	CASTING OR FORGING NO.	SPECIFICATION NO.	HEAT NO.

QUANTITY	REASON FOR REWORK

1	REFER TO	DEPT. CHARGED	FOREMAN
	INSPECTOR	DEPT. CREDITED	FOREMAN

Fig. 9.

terial. A *move order* (Figure 4) issued by stock clerk would authorize handlers to move material, would accompany material to floor, and also serve as notification to production control and accounting of the move. The machine shop would perform the prescribed operations as designated on a *shop route card* (Figure 5). As the group of parts travels through the various operational divisions or departments, a hold ticket record or *traveler* (Figure 6) would always accompany, together with *shop route card,* which would show the operation number completed at all times. Upon completion of all operations, and sometimes at various stages prior to completion, the group of parts is sent to Inspection. Upon acceptance (allowable tolerances are very small in this industry) an *accepted material disposition order* (Figure 7) is prepared, authorizing move of parts to finished stores. If parts are not accepted, Inspection would issue either a *request for materials review decision* (Figure 8) or a *request for rework* (Figure 9), if parts are to be reworked. If Material Review inspectors determine that parts are to be scrapped, they would issue a *material rejection order* (Figure 10). Copies of all above orders are distributed to the various affected departments (such as production control, quality control, finished stores,

accounting) for entry on the various records. Cost accounting entries are made on cost copy of *manufacturing order* (Figure 11).

If, as is usual in an airplane engine industry, engines are built only on order, and no finished engines are carried in stock, it is not necessary to maintain a finished

MATERIAL REJECTION ORDER

No 16399

DATE

PART NO.	ENG. CH. L.	ASSEMBLY NO.	L .O. COMPL.	QTY. REJECT.

PART NAME	MFG. GROUP NO. OR VENDOR NAME

ORDER NO.	REC. REPORT NO. & LOT NO.	REC. REPORT DATE	ENGRG. S. O. NO.

CAST. OR FORG. NO.	SPEC. NO.	HEAT NO.	SHIPPING ORD. NO.	REFERENCE

MFG. GROUP OR VENDOR RESPONSIBLE	INSPECTOR'S SIGNATURE	QUANTITY	
		SCRAP	RET. TO VENDOR

QUANTITY	REASON FOR REJECTION

DETAILS INCLUDED IN ASSEMBLIES

PART NUMBER	QUANTITY	PART NUMBER	QUANTITY	PART NUMBER	QUANTITY

1

Fig. 10.

MFG. ORDER	CLERK	DATE ENT.	DATE DUE	PART OR ASSEM NO	WORK ORDER or SUB.
COST COPY					

PART OR ASSEMBLY NAME

QUANTITY

WORK TO BE DONE

INVENTORY	
PART CLEARED	
SCRAP	
PHYSICAL INVENTORY	
TOTAL	

SALES ORDER NO.

MATERIAL REQUIRED

HEAT NO. OR LOT NO.	

CHECKED BY

MODEL NO

DELIVER TO DEPT.	STARTED		COMPLETED		SCRAP or SEMI-FINISHED
	DATE	QUANTITY	DATE	QUANTITY	

SHEET NO 1

NO OF SHEETS

ORDER COST RECORD

DATE	ACC'T. NO.	MATERIAL							DIRECT LABOR	OVERHEAD	TOTAL
		PART NO.	QUANT.	PURCHASED FINISHED	MATERIAL	LABOR	OVERHEAD	TOTAL			
FOW'D											

Fig. 11.

goods inventory account. Without a finished goods account, parts being processed, finished parts, and manufactured parts being assembled would all remain in work in process accounts until shipment of the finished engine or of spare parts. Under such a system, the following productive material inventory accounts would be needed:

Raw Materials—foundry
Raw Materials—bar stock

Raw Materials—rough parts
Purchased Finished Parts
Foundry Work in Process—material
Foundry work in Process—labor
Foundry Work in Process—overhead
Machine Shop Work in Process—material
Machine Shop Work in Process—labor
Machine Shop Work in Process—overhead

All are stated at standard unit costs, preferably to the nearest thousandths of a dollar.

The differences in standard costs and actual purchase prices of foundry materials, bar stock, rough parts, and purchased finished parts are charged or credited to applicable material cost variation accounts. Since the standard unit costs should include freight, such forwarding charges should be charged to the material cost variation accounts.

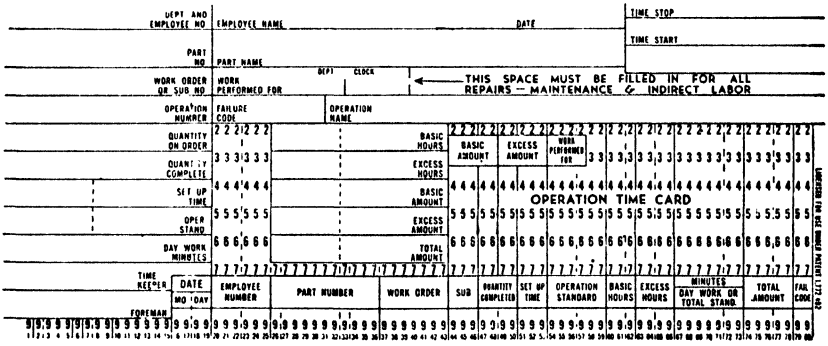

Fig. 12.

It is desirable that bar stock standard costs be expressed in value per length rather than per pound. As the bar stock is cut into short pieces, the unit material cost for each piece remains at the same price per unit of length. Remaining pieces too short to use should be immediately charged to scrap, as the value of an accumulation of such useless pieces should not remain in the inventory account.

On the basis of requisitions, foundry raw materials are charged to foundry work in process—material. Upon completion of castings, foundry work orders (comprising material, labor, and overhead) are charged to raw materials—rough parts. Likewise, bar stock and rough parts are charged to machine shop work in process—material. Upon completion of parts manufactured, no entry will be needed in the inventory accounts, but the manufacturing work orders will be closed out, and entries of quantities only will be made in production control records and finished parts stock ledgers.

Upon completion and shipment of the finished engine, the assembly and test work orders are closed, the machine shop work in process accounts and purchased finished parts account are credited, and cost of sales is debited. The basis of such entry is a tabulation of all parts and assembly cost expressed in unit standards as shown on the model analysis.

Labor

The labor cost of each manufactured part or assembly is based on time studies expressed in standard minutes required to perform each operation. Such standard minutes are multiplied by the standard minute rate for each department, which is the average of the actual rates paid direct labor in such department, to convert to dollars. All direct labor is charged to work in process—labor on basis of payroll distributions. The *actual elapsed* minutes are the total minutes for which the direct labor employees are paid. *Operation time cards* (Figure 12) would be used for each employee to indicate elapsed time and number of pieces completed.

The *earned minutes* are the standard minutes per part or assembly, times the number of parts or assemblies completed. The difference between the standard cost of earned minutes (labor at standard cost) and the actual direct labor is the Rate Variation.

The labor work in process account would be credited with the following factors and charged to the appropriate expense accounts, as based on time lost thereby:

Spoiled Work
Corrective Work
Idle Time (machine breakdown)
Learners Allowance
Set-up Time

The departmental efficiency is the ratio of earned minutes (adjusted by allowances for factors not caused by direct labor) to elapsed minutes. The earned minutes over a period of time, such as a week, may be computed by taking a weekly physical inventory of work in process, expressed in standard minutes up through the last completed operation. The earned minutes during the week would be the cumulated minutes in process at end of week, plus total standard minutes of parts completed during week, minus cumulated minutes in process at beginning of week. Such a physical inventory, if taken by leadmen of each department, can usually be taken in a relatively short period of time. The earned minutes may also be computed from compilations of all job cards, where individually completed operations and quantities are shown. The earned minutes for each department, plus allowances for idle time, set-up time, extra time needed by learners, and spoiled and corrective work if not fault of workers; divided by the actual elapsed minutes, gives the departmental efficiency. The difference between the earned minutes and the elapsed minutes multiplied by the departmental standard minute rate gives the efficiency variation for that department.

Overhead

We will assume that overhead is to be applied on the basis of direct labor minutes, separately for each department.

The standard, or budgeted expense must be predetermined for each department, at normal capacity. The total normal direct labor minutes (based on a normal staff of direct employees, with allowances for idle time, etc.) divided into the standard departmental expense, will give the standard overhead rate per direct labor minute, more practically expressed in dollars for 1000 minutes. The standard departmental expense must also include provision for a portion of service department costs, based upon the use of such services by the producing departments, and for plant-wide

general expenses. The standard overhead rate may be a composite one including services and general expense; or it may be dually expressed as a direct departmental standard rate and a general standard rate, the latter uniform for all departments.

Overhead is charged to work in process—overhead, at standard, on the basis of *earned minutes* of direct labor.

The difference between *actual* overhead expense and *applied* overhead makes up the overhead variances. The portion of such difference which is that difference between *actual* expense and *budgeted* expense represents the overhead *cost* variance. The balance of such difference represents the overhead *capacity* or *volume* variance.

It is in the overhead that most of the factory cost can be controlled. The budgeted expenses should always be segregated as to *fixed* and *variable* expenses. The latter are usually controllable by the departmental supervisors. Therefore the responsible supervisors or foremen should be given detailed statements each month, showing the controllable expenses compared with the budgeted expenses, and the application to overhead on basis of production.

Spoiled work is a large factor of overhead and merits careful study. Sometimes spoiled work is due to inherent defects in the material and should be charged back to the vendor.

A representative list of expense accounts would comprise the following:

Variable:

Idle time
Excess time
Night differential
Spoiled work (scrap)
Corrective work
Set-up cost
New help allowance
Operating supplies
Miscellaneous supplies
Perishable tools
Fuel oil and coal
Utilities service
Royalty and license expense
Repairs—machinery and equipment
Compensation insurance
Payroll taxes

Semi-variable:

Supervision
Indirect labor
Repairs—building
Plant rearrangement
Service departments

Fixed:

Rents
Fire insurance
Property taxes
Depreciation

The subsidiary ledger would carry similar accounts as above for each department, when applicable; direct, service, or general.

Application of Variance Accounts

A representative list of variance accounts would comprise the following:

Material Cost—raw
Material Cost—purchased finished
Inventory Adjustments
Labor Rate
Labor Efficiency
Overhead Cost
Overhead Capacity

The ultimate objective of the cost accounting system is to determine the cost of sales of each type of engine and of spare parts. Hence the variance accounts must be distributed into those categories.

Upon shipment of engines or spare parts the following entry is made, based on unit standards:

Dr. Cost of Sales (segregated by types or spare parts)
  Cr. Purchased Finished Parts
    Machine Shop Work in Process—material
    Machine Shop Work in Process—labor
    Machine Shop Work in Process—overhead

Since there is always a substantial amount of raw material, purchased finished parts and work in process on hand, the variance accounts should not be entirely charged off monthly. The variance accounts (except inventory adjustments) may be distributed to profit and loss in the ratio of applicable inventory credits for cost of sales to the total of such inventory accounts, before credits were applied. The remaining balances in the variance accounts are reflected on the balance sheet as inventory valuation items. The inventory adjustment variation should be entirely charged to profit and loss. Its distribution into categories of sales may require an analysis of its nature and origin, if substantial.

In order to provide for guaranteed servicing costs subsequent to sale, it is customary to set up reserves based on experience and estimates. The expense charges for such reserves are not a part of engine costs, but are a substantial factor that must be recognized in setting selling prices.

COST ACCOUNTING FOR AUTOMOBILE REPAIR SHOPS

By

JOHN BURNIS ALLRED *

I. DESCRIPTION OF THE INDUSTRY

Classification of Services

Automobile repairs to the layman are very simple operations. Indeed in some shops they are simple operations, and the products of such deserve no better recognition. But it is the purpose of this article to outline and describe the worth-while service that one would naturally expect when he patronizes a repair shop worthy of the name.

Services may be classified broadly as major repairs and minor repairs. Major repairs would embody complete overhaul or similar operations while minor repairs would be such as fixing small broken or worn parts, timing, adjusting brakes, etc. Major repairs are generally done only by first-class mechanics. Minor repairs may be done by those who have had much less experience. But no job is worthily done unless the party employed knows the anatomy of the automobile and, consequently, the effect that anything he may do on it will have on it.

Origin of the Service

The repair shop obtains its patronage by holding itself out as capable to do the service which comes its way, and to continuation of such patronage by rendering good service at a reasonable price.

The customer brings his car to the shop because it does not function the way he feels it should. He knows little or nothing about automobile mechanism and, consequently, looks for some relief by using the services of one who does. He expects to be told what the trouble is and is usually glad to hear in advance, if possible, what the cost is going to be.

Source of Materials and Labor

Materials may be considered as parts, supplies, etc., usually carried in stock. If not carried in stock the shop usually has ready access to wholesale depots close by where parts can be supplied on reasonably short notice. Labor is usually done by regular employees, but sometimes in small shops this may be had from others on call where the need is in excess of the regular personnel's ability to function. If the shop sells gasoline, oil, and grease, these will be purchased as required usually on a day-to-day basis.

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Organization of Plant

The organization of the small automobile repair shop involves the arrangement of benches, machines, cranes, pulleys, blocks, etc., so that the expense of operation is lessened by shortening steps and bringing parts to be repaired or replaced more readily and easily accessible to the mechanic. Ample floor space should be allotted to each mechanic for a sufficient length of time to finish the job without being moved or changed about.

Parts should be accessible to the mechanic as needed so that he will lose no time in waiting.

Helpers should be kept available for the job in process if needed. No time should ever be lost while the high-priced mechanic waits for some low-priced helper to finish working at some other job.

Facilities should be available for checking and testing finished jobs so that the work can be done without serious delay. The customer should not be called upon to pay for delays caused by the poor coordination of plant organization or arrangement.

Production Order System

Orders for services should originate in some special department or individual. They should recite exactly the service required, the material to be furnished, if possible, and should be signed by the one responsible for the order, and one who has authority to bind the customer for payment of the bill.

Every space should be filled in on the repair order so that there can be no misunderstanding as to what is expected to be done. All entries should be in plain legible handwriting so that the mechanic will make no mistake in selecting the parts or in doing other required services.

II. How to Design the Cost System

What Information is Required

The cost system for the automobile repair shop must be designed to give the management a good working program at a cost it can afford to pay. The following essential factors of costs must be determined with reasonable certainty:

1. Each operation should have its cost and efficiency known.
2. The greatest effectiveness should be employed in utilizing labor, materials and plant equipment.
3. The cost of service and the income-cost relationship of each operation should be known.
4. Information for analysis of operations and profit-and-loss statements and balance sheets should be preserved.

All data for use of the management should be furnished in form readily understood and dependable enough to be acted upon. The basic material from which management statements are prepared should be kept available for use of supervisors and others, if desired, for comparative or other purposes.

Consideration in Designing the System

The cost system in the automobile repair industry is designed for the purpose of cost finding for services it renders. Competition is keen and he who knows what the service he renders costs is far ahead of his competitor who pays no attention to costs, merely thinking he is operating profitably.

The cost system once established should be tested frequently, especially in times when prices of parts, materials, and labor vary to any great extent.

Standard Cost System is Favored

There is no particular objection to use of one's own "actual" system of costs, but even then frequent comparison with the industry's "standard" for the same or similar services should be made. The standard is favored because of the control data it provides, not only for individual operations, but for determining profits from periodical operations of similiar kinds.

By use of the standard type, variances are clearly outlined in past operations. Budgets for future operations can, by its use, be more easily estimated.

Variance between one's actual and the standard costs should be kept constantly under scrutiny for the following reasons:

1. Small variances where many operations are had could result in loss instead of profit on operations as a whole.
2. Any large variance indicates wrong accumulation of cost data which should not be depended upon.
3. Inability of comparison is seriously detrimental.
4. Rigid comparisons aid in reaching and keeping control of costs at, or near, a level maintained by the industry as a whole.

III. Description of the Cost System

The important points to be considered in a standard cost system for automobile repair shops are as follows:

1. Design an operating profit-and-loss control report that can be used monthly or other period (see Exhibit A).
2. Design labor and overhead reports for supervisors and others, as follows: Individual Worker's Time; Monthly Overhead Report.
3. Find and preserve own standards for cost of labor, materials, and general overhead.
4. Set up necessary procedures for continuing cost system and producing desired result.
5. Chart all accounts and preserve same for permanent use.

Profit and Loss Statement

All cost methods point toward producing needed data for profit-and-loss statements which are important to control by the management.

Comparison of the actual profit-and-loss statement by the suggested standard shows the operation variance, or that on individual services rendered, if desired, by further analysis.

It provides comparison of budgeted and actual figures.

It also reveals variances between the actual and standard costs of operations. By the above comparisons the management is able to know:

What and why his profits, or losses are.

What to do to correct that which caused the variance.

Variances Used

The following general accounting variances are applicable to this industry.

Name of Variance	*For Accumulating Difference Between*
Materials—Price	Standard and actual costs of materials, parts, etc.
Labor—Rate	Standard and actual rates of pay for productive work plus overtime premiums, bonuses, vacation allowance, etc.
Labor—Efficiency	Standard and actual direct labor cost due to inefficiencies of personnel not originating in rates of pay.
Inventory—Adjustments	Ledger and audited values of inventories.

Variances, How Allocated

Variances are cleared to the proper variance accounts in proportion to the amount for which each is responsible. This is true if it is known which operation is responsible. If this cannot be ascertained, then it is apportioned to all operations which could have been involved.

Labor efficiency variance could be caused by breakdown of machines, waiting on material, supplies, etc. Since these are indefinite, individual case application of such variances is required.

Costing of Individual Services

A means of assembling of individual job costs is very necessary. Much of this information is shown herein as Exhibit B, repair order. The costs of labor, materials, parts, and supplies are shown at actual or estimated amounts.

Revisions of Standard Costs

Where it becomes necessary, because of local conditions or otherwise, to revise the standard cost system, it may be done at any time. This, however, should be studied carefully and then, revisions should be relatively infrequent, and based upon more or less permanent changes in the cost structure.

Analysis for Benefit of Supervisors

Some kind of daily, weekly, or monthly reports showing effectiveness of productive operations should be provided for the owner, manager, and supervisor of services. These statements should detail the differences between operating and expected results by cause and circumstance. These variances, shown to management in such manner, show trends which the management can correct in future operations.

Creation of Standards

All standards should anticipate efficient activities. The development of such standards might be as follows:

Labor—Efficiency.—Standard productions rates should be established by a time study. This should be what could be expected to be attained by every worker assigned to a like operation.

Labor—Rates.—A rate should be established for every type of service and a standard wage rate established for performance of clock-like operation.

Materials, Parts, Etc.—Quantities.—These should be provided as needed so that unnecessary delays may be avoided.

Materials, Parts, Etc.—Prices.—The management should be informed as to unit prices of each commodity needed. Such things as cash discount and delivery charges should not be overlooked.

Overhead Rates.—Expenses classified as overhead appear in every business. These should be budgeted as to different departments based on normal operations.

This could be applied to hourly or daily rates, or by any other standard which will prorate the total overhead cost to all operations for the period.

How Cost Summary Data are Obtained

Finding Cost of Sales

Since the cost of a repair job is composed of labor, materials, parts, supplies, and overhead, the cost of each classification must be known on a unit basis. When this is known and these factors accumulated, the cost is apparent. While it might be difficult to place a standard cost on a job, there is no good reason for not being able to accumulate the component costs that are known.

Material and Labor Variances

Material costs variances are seen immediately when prices are compared with standard costs for the same article. Labor variances, likewise, are revealed when the recording on the workers' time cards shows that excess time has been used for a given operation. This excess might be explained by outside causes, such as waiting for materials, parts, etc., but if this is not so there is reason for adjustment if the variance cannot be overcome by subsequent tests.

Overhead Varances

Every productive service is an accumulator of overhead. Variances between standard and actual calculations, consequently, become apparent and must be apportioned to respective bases. They are distributed monthly or on other time bases as necessary.

Inventory Variance

This is very prevalent in this industry, chiefly because running records are not religiously kept, and by reason of price variation. The amount is to be cleared to adjustments to inventory accounts, regardless of what caused the variance.

EXHIBIT A

DEPARTMENTAL PROFIT AND LOSS STATEMENT
JOHN DOE REPAIR SERVICE
MONTH OF MAY, 1946

	Grand Total	Labor	Material and Parts	Accessories	Misc. Supplies
Gross Sales					
Less:					
Return Sales and Allowance					
Cash Discounts					
Total Sales Deductions					
Actual Net Sales					
Less:					
Cost Based on Standard					
Profit, Based on Standard					
Actual Costs					
Labor					
Material and Parts					
Accessories					
Miscellaneous Supplies					
Shop Overhead Applied					
Inventory Adjustments					
Total Actual Cost of Sales					
Gross Profit—Actual					
Less:					
Selling Expense					
Administrative Expense					
Total Selling and Administrative Expense					
Net Actual Profit					
Profit Variance:					
Over or (Under) Standard					

Explanation:

The total column, of course, includes all items of both income and deductions from income. Distributions are made to the various departments depending upon their nature. By this means a profit or loss can be shown in each department and thereby give the operator a means of locating weak places in his program.

If the operator desires to show comparative results with the standard for the industry, parallel columns could be used in which the standard is entered, with another column, using parentheses for decreases, or two columns, one for increases and the other for decreases. Great care should be used in preparing this kind of statement to see that the same account in both the actual and the standard is on the same line. No proper comparison is possible unless this is done.

EXHIBIT B

PRODUCTION ORDER

Name _____ Ticket No. _____

Address _____ Job No. _____

Mechanic _____ Date _____ 19__

Starting Time _____ M. Finishing Time _____ M. Time Used ____Hrs.____Min.

List: Services Required: Signature of Customer_____

_____

_____

_____

_____

COSTS APPLIED

Parts Used	Actual Cost	Standard Cost	Variance Over or (Under)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
Labor Costs			
_____Hours____Rate	_____	_____	_____
_____ ____	_____	_____	_____
_____ ____	_____	_____	_____
Overhead			
_____	_____	_____	_____
_____	_____	_____	_____

(Check)

Efficient Worker _____ Fair Worker _____ Poor Worker _____ Other _____

Posting Record: Date _____ Posting Reference _____ Bookkeeper _____

This is the order given by the customer for the service. It must be used on each and every job. The numbered job order must be accounted for. If this blank form is spoiled it must, never-the-less, be preserved in the numerical order in which it falls. Every space must be filled in by the proper authority.

The first (original) copy is for use in posting and filing in office. The second copy is for the customer with "sales price" instead of "actual cost" for use as an invoice. The third copy is a hard copy for use of mechanic and others as the car goes through the shop. No extensions are made in the shop. Only the descriptions of the services are to

be placed in the blanks there. The original and the hard copy should have identical entries when the operation is finished. The customer's copy will be identical except the pricing at selling—instead of cost price.

EXHIBIT C

_____ 19____

Date

DAILY LABOR REPORT

(To be filled in by each mechanic daily)

Job Ticket No.	Amount	Starting Time	Finishing Time	Lost Time	Reason for lost time

Mechanic: Sign here

COMPARISON WITH STANDARD

(To be filled in by Superintendent, Manager or Bookkeeper)

Job Ticket No.	Actual Amount	Standard Cost	Variance Over or (Under)	Remarks

Signature Title

Description of Exhibit C: This report or form is to be filled in each day by each mechanic to show the services rendered on that day by him. It is from this form that the information for filling in labor costs on Exhibit B are transferred. The lower part of the form is more technical and can hardly be trusted to the mechanic. But if good costs are to be maintained it should be followed every day by a competent authority by completely filling in all information required. This also serves as a check on the mechanic to eliminate the possibility of padding of time.

There will be some duplication of job ticket numbers when the lower form is filled in, but the value gained by having the number, the actual cost, and the standard cost on the same line readily overcomes this.

EXHIBIT D

CHART OF ACCOUNTS FOR AUTOMOBILE REPAIR SHOPS

DEPARTMENT	HOW CLASSIFIED
General Office	
Owner—Manager	Generally as Overhead
Office Personnel	
Service Department	
Parts Manager	Overhead or Cost of Parts if this service had been added to invoice price
Mechanical Department	
Foreman	Overhead and job units
Mechanical Staff	Direct cost of jobs
Storage Department	
Storage Manager	Storage Costs
Cashier	Ticket unit base
Intake and Delivery Men	

This chart is necessarily limited because of need for it in the small repair business. A larger operation would necessitate a purchasing department, an office manager, stock keepers in the parts department, floor manager, cranemen and hoisters in the mechanical department. These features are present in the small business, but they are performed by others.

RETAIL BEVERAGE COST ACCOUNTING AND BAR CONTROL

By
S. A. TESORIERE *

I. DESCRIPTION OF THE BUSINESS

General

Since the repeal of the Eighteenth Amendment, the nation has witnessed a great growth of drinking establishments commonly called "bars." The distinguishing attribute of these bars, sometimes christened tap rooms, cafes, cocktail lounges, and other appealing appellations, is that they serve alcoholic beverages.

The operation of a bar business usually necessitates the maintenance of a restaurant or an eating place for the guests, for in the eyes of the law the bar is only auxiliary to the food business. Many bars, in addition to food, provide some manner of entertainment and music as exemplified by the modern night club and hotel club lounge. With railroads and vessels licensed to sell liquor, wine, and beer, it is indeed a difficult task today to locate an inhabited area where one cannot have his favorite drink served to him.

The financial requirements for a bar business are sufficiently flexible to admit into its fold the businessman of modest capital as well as the large entrepreneur. Because of that it was possible to develop one of the largest industries in the country over the brief span of the dozen years since repeal of the Eighteenth Amendment.

Government Control

For the sale of liquor, wine, and beer to be consumed on the premises, a retail liquor license must be obtained from the state. The establishment becomes subject to the rules and regulations of the state liquor authorities.

The salient features of these regulations pertain to the following:

1. The maintenance of certain moral standards for the welfare of the state.
2. The keeping of an adequate set of accounting records wherein purchases and sales are properly segregated as between alcoholic beverages and food and miscellaneous items. Such books and records are to be available for inspection by the liquor authorities.
3. Prompt payment must be made for purchases of liquor, usually by the tenth day of the following month.

Any violation of the Alcoholic Beverage Control Laws shall be subject to various penalties, fines, and possible revocation of his license to operate a bar business.

Organization of the Business

This description of cost accounting for beverages relates primarily to those retail establishments that serve alcoholic drinks by the glass in more than one place on the same premises.

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Although the organizational setup varies with the type and size of the bar business, be it in a hotel, restaurant, or night club, generally the following operating categories are maintained:

1. Purchasing department charged with the responsibility of supplying an adequate liquor stock suitable to the needs of the location and clientele of the business.
2. Storeroom or bin to maintain and account for the bottled liquor received from vendors and issued upon request to the bartenders through the medium of requisitions.
3. Stand-up bar—where beverages are sold to customers who drink their beverages standing up. For practical purposes no record is made of the type of beverage sale and the proceeds are rung up in the cash register.
4. Cocktail lounge or grill room usually adjoining the stand-up bar where table drinks are served to the customers by waiters who write the order down on a bar check. These orders are brought to the bartender who prepares the drink. Usually these orders are filled by designated bartenders at the service end of the stand-up bar.
5. Dining room—where the customer desiring an alcoholic beverage with his meal orders it from the waiter. This order is recorded on a bar check and is presented by the waiter to the dining room service bar, which prepares drinks only for the use of the dining-room trade.

A greater or lesser amount of segregation of activities based upon business requirements may be made without losing the effectiveness of the beverage controls hereinafter discussed.

II. How to Design the Cost System

Basic Principle

The cost system to be effective must control liquor from the moment an order is placed with the vendor to the time it reaches the consumers' hands and the sale is properly recorded either on a bar check or on the cash register tape. Liquor has often been referred to as liquid cash and to many it is as tempting as cash itself. Care must be taken therefore to avoid or detect quickly any pilferage. However, in planning the cost system we must guard that it in no way hampers the selling of beverages. It is for this reason primarily that bar checks are dispensed with at the stand-up bar where volume during certain hours makes such a practice undesirable. Therefore to summarize, the cost system must be designed to furnish at a minimum cost the maximum of managerial control without hampering operations.

Information Desired of the System

Because the bar is considered a department of the entire business, managements' prime interest in accounting for liquor is twofold—volume of sales and the material cost of those sales. In that connection they are interested in the following essential data:

1. That the cost of liquor purchased is reasonable in price.
2. That the bottles of liquor consumed are bringing the expected amount of revenue.

The above information should be presented at periodic intervals in a concise and intelligent fashion. Also, deviations from the established norms should be immediately brought to the management's attention that the remedial action required in the situation may be taken promptly.

Standard Cost and Sales System Preferred

For an intelligently operated beverage business a system of standards is preferred over an actual cost system or no cost system at all, which surprisingly enough exists in this advanced epoch. The trend, however, is to the use of standards because, through cost standards, management can measure the efficiency of the purchasing department; and through the use of selling standards the performance of bartenders and waiters can also be measured.

Standards are particularly useful in the operation of a chain of bars where direct managerial supervision is either lacking entirely or necessarily kept at a minimum and for the more expensive establishment, as characterized by cabarets and night clubs where the selling price of drinks is unusually high and the material cost of those beverages may be as low as 25% of the wine list. Unless guards are established against pilferage, dishonesty, and nonadherence to the prescribed standards of the business, expected profits may be materially reduced.

How the Standards are Established

A cost standard means a setting of a price as a norm for all bottled liquor to be purchased by the business. A study of past prices, current prices, quantities purchased, and a forecast of market conditions in the near future should be considered in setting the cost standard of bottled liquor.

A sales or selling price standard means that for each bottle of liquor consumed a certain amount of revenue or potential sales is expected. For example, a bottle of "Calvert's Reserve" measuring a fifth of a gallon is expected to bring so many dollars and cents of sales.

In order to set up such a standard the following data must be obtained:

1. Liquid content of the bottle.
2. Liquid content of the glassware used for the drinks served.
3. Liquid measurement of the ingredients entering the drink. This will be influenced by the location and clientele of the bar.
4. Average amount of waste produced by bartenders in preparing drinks. Adherence to the use of "jiggers" is the best cure for waste.

The formula in arriving at sales standards is that each bottle of a certain type liquor must realize at retail the sum equal to total ounces divided by the ounce size of the serving glass multiplied by the selling price of a straight drink. Since usually higher prices are paid for mixed and fancy drinks, differentials must be arrived at for all such drinks served based upon tests. The differential thus determined is applied to the converted retail selling price as determined above.

Since a glass of rye from the service bar may be sold at a higher price in the dining room or cocktail lounge than at the stand-up bar, it is customary to have a different set of selling standards for liquor consumed at the different bars.

III. Description of the Cost System

General

In setting up a cost system for beverages the following salient procedures and records must be given ample attention.

1. Preparing the chart of accounts.
2. Establishing standard cost and potential sales value of the bottled liquor carried in stock.
3. Setting up the procedures that will assure the successful operation of the system.
4. Designing the reports that will high light for management and supervisors all deviations from standards—
   a. Schedule of purchase variations from standards (Figure 1)
   b. Inventory and beverage control record (Figure 2)
   c. Statement of gross beverage operating results by location (Figure 3)
5. Designing the profit-and-loss statement for top management (Figure 4).

Having outlined the basic steps and procedures, it would be advantageous at this point to comment briefly on the operation of the system from its inception in the purchasing department through to sales and reporting the results thereof on the final profit-and-loss statement.

Purchasing

As the employees and store managers determine their stock requirements, requisitions are prepared usually in duplicate. The original is sent to a central purchasing department and the duplicate retained on the premises. The purchasing department consolidates the requirements and places orders and instructs vendors as to deliveries.

When the goods are received the vendors' invoices are checked to related requisitions and receipt of delivery forms. The vendor's invoice is then processed for prices and the standard cost value of the items thereon is written in. With this information the accounting entry is prepared:

(Dr.) Liquor Purchases (or store current account, if merchandise was received direct by the store)	At actual cost
(Cr.) Vendors Payable	
(Dr. or Cr.) Purchase Variation Memorandum Account	Variation from standard cost

Weekly or as desired the purchase variation memo account is used as the means of preparing the schedule of purchase variations from standard (Figure 1). Through this report management is immediately made aware of all deviations from standard and may, if the matter warrants it, institute remedial action at once.

Storing in Wine Bin

The liquor stock having been received direct from vendors or from a central company warehouse is controlled in quantities only, through the use of perpetual inventory bin cards. A bin card is made out for each type of liquor and contains the following information:

Type of liquor and liquid content of bottle
Opening balance
Purchases
Total
Deduct: Issues (to the bars)
Balance on hand

At all times and subject to periodic spot checks, the balance on hand as shown by the individual bin cards must be supported by actual goods.

Requisitions from Wine Bin

As the bars in the establishment require liquor to replenish their stock, requisitions in duplicate are prepared. One of the copies is sent down to the wine bin and is the authority for releasing goods from the bin and as the medium for posting to the bin cards. The second copy, together with the daily store report, is submitted to the central office. Because dining room and cocktail lounge liquor prices are customarily higher than those at the stand-up bar, the requisitions for the latter bar should be of a different color. Accordingly, it will simplify the process of valuing these requisitions at the selling standards applicable to the liquor sold at the different places on the same location.

In this manner daily control on liquor sales may be maintained in a satisfactory manner.

Base or Par Stock

Where it is not practical to take daily inventories it is pertinent that the liquor stock at the various bars be kept at a certain set quantity, commonly called a base stock or a par stock. To maintain a par stock it is necessary that at the end of each day the bartenders requisition the required bottles of liquor to bring their stock to par. Through this medium daily requisitions represent sales for the day. The results, of course, will be only approximate for it is a difficult matter to replace the stock at the bars each day exactly to the established par.

The maintenance of a base stock inventory supplemented with weekly actual inventories will be found to be an effective means of controlling beverage sales. Of course, if circumstances require it inventories should be taken more frequently.

Liquor Sales

Liquor having been controlled up to this point is now available at the various bars for consumer consumption. Sales at these bars are recorded as follows:

Cocktail Lounge and Dining Room.—The bar check is generally prepared in duplicate by the waiter, one for the customer, the other for the bartender at the service bar representing his receipt for the order made up by him. It is advisable in the dining room to indicate in some manner on the food check that a bar check has also been prepared for the customer. This will prevent the client from leaving the premises paying only for the food check without the accompanying bar check.

Stand-up Bar.—The only record of the sale made at the stand-up bar is on the cash register tape when the sale is "rung up." As previously mentioned the issuance of checks at the bar has generally been dispensed with for practical reasons.

Beverage Control

Undoubtedly the ideal system of control is that based upon written checks for all liquor sales. Through the use of checks the total sales value can be determined more accurately. It would also be possible to ascertain potential sales by certain groups such as straight drinks, mixed drinks, wines, etc. These potential group sales totals being known would then be compared with actual sales for the same group. However, lacking such a variety of sales analyses the over-all comparison of ex-

pected sales with the total actual sales affords as effective a control of bar operations as is practicable.

Through frequent inventories the exact consumption by type of liquor can be determined for any period. Valuing this consumption at predetermined retail values it can readily be compared with actual sales. When such comparison reveals large differences, the cause may be investigated and immediately corrected. Without this control discrepancies would not come to light until some time after the end of the month when the month-end report is submitted.

A combined inventory and beverage control record (Figure 2) is suggested. Several pages should be used to cover every liquor item carried in stock. Once the form is properly set up it is a relatively simple task to arrange a loose-leaf system wherein the side headings may be used constantly without rewriting. One such report should be prepared for the stand-up bar and another for the service bar as the selling standard per consumed bottle will vary with the type of bar.

Of course, if it is practicable to cost out bar checks, only the stand-up bar would prepare the beverage control record.

These store beverage control reports are then summarized weekly or semi-monthly for ready review by top management (Figure 3).

Application of Differentials

In addition to the standard minimum retail value of liquor sold, a table of differentials is also used to reconcile potential with actual sales. The underlying theory is that each bottle of liquor should bring in at retail a sum higher than the minimum computed on straight drinks on account of highballs and fancy drinks. Accordingly, the applicable differential for all such drinks sold (based upon tests) is applied to the converted retail sales price of the bottles consumed.

Differentials are also used to take into account the featuring of special cocktails from time to time at reduced prices. The bar then is credited with the total amount of such reduction.

If the comparison of potential and actual sales then reveals substantial differences, they can generally be attributed to:

1. Failure to credit sales for all sales.
2. Errors in taking inventories.
3. Excessive wastage, spoilage, or breakage.
4. Pilferage.

Profit-and-Loss Statement

The final results from operations for the bar and the other divisions of the business for the month are summarized for management in the profit-and-loss statement (Figure 4). Briefly, the statement is designed to show the gross profit (actual sales less the material cost thereof) for beverages, food, and miscellaneous items. Variations between standards and actual sales and purchases of beverages are also shown on the statement.

Expenses other than material costs are not allocated to the various types of sales. However, an interesting and informative distribution of expense can be had by dividing them into controllable and noncontrollable expenses. For the type of expense shown under each category, refer to Figure 4. Of course, some confusion may arise in determining the distribution of certain expenses as between these two

THE F. L. BROWN COMPANY

SCHEDULE OF PURCHASE VARIATIONS FROM STANDARDS

FOR THE WEEK ENDED JUNE 15, 1946

Purchasing Agent	Date of Purchase	Vendor	Liquor Bought	Quan.	Purchase Price		Standard Price		Total Variation	% of Variation
					Unit	Total	Unit	Total		
R. M. Jones	June 12	A Liquor Co.	Calvert's Reserve 1/5	48	x	x	x	x	(x)	
T. C. Smith	June 13	B Liquor Co.	Mount Vernon 1/4	24	x	x	x	x	x	
*832 X Street Store	June 13	C Liquor Co.	Teachers Scotch 1/5	6	x	x	x	x	x	

Note:

Schedule is devised to render control by:

1. Purchasing agent
2. Vendor
3. Quantity lot purchases
4. Price

(x) Indicates unfavorable variation.
* Used only where the stores would have authority to make some local purchases.

Fig. 1. Schedule of Purchase Variations from Standard.

THE F. L. BROWN COMPANY

INVENTORY AND BEVERAGE CONTROL RECORD

104 Y STREET, BOSTON

FOR THE WEEK ENDED JUNE 15, 1946

Size	Description	Opening Inventory	Issues from Wine Bin	Total	Closing Inventory	Bottle Consumption	Retail Sales Value per Bottle	Total Standard Sales Value	Cost per Bottle	Total Cost
1/5	Teachers Scotch	4	2	6	1	5	$10.00	$50.00*	$6.00	$30.00

* After arriving at the total standard sales value of liquor consumed for the period, that amount is adjusted by the differentials applicable to the period. Having then obtained the adjusted total standard value of sales for the period, the actual sales are shown directly thereunder and the difference represents the variation from sales standards.

Fig. 2. Inventory and Beverage Control Record.

THE F. L. BROWN COMPANY

GROSS BEVERAGE OPERATING RESULTS BY LOCATION

FOR THE WEEK ENDED JUNE 15, 1946

Location		Sales at Standard	Variation	%	Actual Sales	Cost at Standard	Variation	%	Actual Cost	Expected Gross Profit	%	Actual Gross Profit	%
Street	City												
1040 Y St.	N. Y. C.	x	(x)	(x)	x	x	x	x	x	x	x	x	x
832 X St.	Boston	x	(x)	(x)	x	x	(x)	(x)	x	x	x	x	x
15 W St.	Hartford	x	x	x	x	x	x	x	x	x	x	x	x
186 Z St.	Newark	x	(x)	(x)	x	x	x	x	x	x	x	x	x
— etc —													
Total													

Note:

The information contained herein is taken from the individual store inventory and beverage control record—Figure 2.

(x) Indicates unfavorable variation.

Fig. 3. Statement of Gross Beverage Operating Results by Location.

categories. However it is decided to treat these questionable expenses, depending upon individual circumstances, they should be maintained in the same category consistently for comparative purposes.

With this form of profit-and-loss statement, noncontrollable expenses are readily dispensed with by a comparison with previous month's figures. There is little value in looking at depreciation, license costs, and rent each month.

Attention, therefore, is mainly focused on controllable expenses—expenses which management can concentrate upon and follow up for constant improvement.

THE F. L. BROWN COMPANY
PROFIT AND LOSS STATEMENT
FOR THE MONTH OF JUNE 1946

		Bar	Restaurant	Miscellaneous	Total	%
Sales		x	x	x	x	x
Sales Variations—Bar	x					
Per Cent of Variation—Bar	x					
Cost of Sales		x	x	x	x	x
Purchase Variations—Bar	x					
Per Cent of Variation—Bar	x					
Gross Profit		x	x	x	x	x
Departmental Gross Profit %		x	x	x		
Deduct Operating Expenses						
Controllable Expenses:						
Payroll					x	x
Electric					x	x
Gas					x	x
Telephone					x	x
Advertising					x	x
Music					x	x
Silver, China, and Glassware					x	x
Payroll Taxes					x	x
Etc.					x	x
Total					x	x
Noncontrollable Expenses:						
Rent					x	x
Insurance					x	x
Depreciation					x	x
License Expense					x	x
Amortization of Leasehold					x	x
Etc.					x	x
Total					x	x
Total Operating Expenses					x	x
Net Operating Profit					x	x
Other Income (List)					x	x
Other Deductions (List)					x	x
Net Profit					x	x

Fig. 4. Profit-and-Loss Statement.

COST ACCOUNTING IN BITUMINOUS COAL INDUSTRY

By
HAROLD G. AVERY *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Coal, one of the most important of all minerals, is used chiefly as fuel for domestic and manufacturing purposes, and is divided into two main groups: Anthracite or "hard" coal, which contains roughly 80% or more of fixed carbon; and bituminous or "soft" coal, in which the carbon content falls below 80%. Bituminous coal in turn is classified into an almost endless number of varieties, depending upon the carbon content and other chemical properties. It is graded for shipping and marketing purposes usually according to size as determined by the various screenings. A typical classification is given below:

Lump	6" and over
Furnace	6" by 3"
Small Egg	3" by 2"
Stove or No. 2 Nut	2" by 1¼"
Chestnut or No. 3 Nut	1¼" by ¾"
Pea or No. 4 Nut	¾" by ⅜"
Carbon or No. 5 Nut	⅜" and less
2" Screenings	2" and less
1¼" Screenings	1¼" and less

Furnace coal is sometimes referred to as Egg, 6" by 3"; then there are other designations such as washed screenings, mine run, stoker nut, briquets (manufactured from low-volatile coal screenings and fines), and slack.

Origin of the Product

Coal is a natural resource and, from an accounting point of view, it is considered a wasting asset. Although coal in its natural state does not deteriorate with the passage of time, its supply is exhaustible through use. A coal mine is subject to depletion since the coal in the ground—a natural resource—is converted into inventory, then marketed and consumed.

Several theories have been developed relative to the origin of coal, but the one that is generally accepted is that a layer of rank and luxuriant growth of vegetation during the Carboniferous Period decayed and slowly sank below the surface of the earth; this layer was gradually covered with sand, silt, and other mineral sediment; then this process was repeated again and again until many layers of vegetable matter subsided into the earth. Great pressure resulting from the stratification of the earth's surface, together with chemical changes taking place within the soil and

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the vegetation, finally caused these layers to mineralize into coal. As a result, coal is discovered in many seams and layers extending at various intervals from the earth's surface to a thousand feet or more below.

Sources of Raw Materials

The main area of anthracite coal in the United States is in Pennsylvania, although there are small areas in other states, particularly New England. The bituminous coal area, however, extends widely over the United States from Virginia, through the Appalachian Chain from New York to Alabama, Northern, Central, Western, Southern, and Rocky Mountain States, into the Pacific area. The production of bituminous coal in the United States amounts to approximately 620,000,000 tons annually at the present time, or about ten times the amount produced in the anthracite mines. West Virginia, Pennsylvania, Illinois, and Kentucky in the order named are the four highest ranking states in bituminous coal production in the United States.

The chief production of bituminous coal in Illinois comes from seven seams. Coal Seam No. 1 is dicovered more than 1000 feet below the surface, whereas Coal Seam No. 6 ranges from surface outcroppings to a depth of 60 to 100 feet in the central area of the state. There are many other seams, but a number of them are not of sufficient thickness to assure profitable mining operations. The most productive beds of bituminous coal are found in the Pittsburgh and West Virginia areas.

Organization of Plant

This description of cost accounting pertains only to the bituminous coal industry, and covers only the processes extending from the time the coal is discovered, extracted, and shipped or distributed from the plant. Coal is delivered from the mine to local distributors or truckers in truck lots, but the majority is sold through coal brokers or agents in carload lots. Railroad, steel, utility, and manufacturing companies sometimes own and operate their own mines to assure themselves of an adequate source of fuel supply.

A tabulation of the processes in a bituminous coal mine will be established generally along the following lines:

Service Departments

Engineering and Development.—The function of this department is to determine the location and to estimate the quantity of coal to be mined. Many years may be spent in prospecting work, such as making surveys and maps, drilling test holes, analyzing cores, and studying and revising previously made geological surveys. Coal mining involves the installation of expensive capital structures and equipment, and the venture ordinarily does not prove profitable unless a great many years' coal supply exists. A sufficient amount of coal must therefore be discovered, and titles or leases to mining property legally acquired, before structures and equipment will be installed. Some local mines deplete within a few years, whereas the larger companies usually acquire from twenty-five to fifty years' supply before starting capital construction. The Engineering Department guides the installation of capital equipment and supervises current maintenance and mining operation. The original engineering development and construction costs are capitalized; but once mining operations have commenced, the labor and supply costs of this department are

included in the production costs unless further additions and betterments are made to the capital structure of the plant.

Sales Department.—When coal is sold directly from the tipple bins in carload lots to the railroads or distributed through brokers or agents, the sales organization need not be very extensive; on the other hand, the sales department would be of utmost importance in recording sales and accounts receivable if the coal were sold locally or distributed directly from the mine in truck loads or in carload lots to hundreds of individual buyers.

Personnel Department.—Some of the smaller mines are beginning to realize the importance of an efficient personnel department. This department will take on more significance as the veterans of World War II return to the mines, and as the increased mechanization of coal mines continues.

Purchasing Department.—Supplies, including power, make up from 30% of coal production costs in the strip mines to 10% in hand-loaded mines; therefore, the continued and efficient operation of the mine depends to a large extent on the timely acquisition and quality of supplies.

Realty and Mercantile Department.—Mining companies provide living quarters for their employees; also they maintain company stores where food and clothing may be procured. These services should be maintained separately from the mining operations. Records must be provided for the rental and upkeep of company homes, for the lease and operation of agricultural land, and for the maintenance of recreational facilities of the employees. The books of the company store are maintained similar to other trading concerns.

Productive Operations

Operation	*Processes*	*Equipment and Facilities*
Hand Loading	Cutting, picking, and loading coal into cars or conveyers.	Loading is done by hand in the longwall or room-and-pillar systems of shaft or slope mines.
Machine Loading	Loading coal into cars or conveyers by machine.	Mobile loading machines.
Conveyer Loading	Conveying coal from room-and-pillar to shaft opening; coal transferred to cars for conveyance to tipple.	Conveyer machinery.
Stripping	Removal of top soil covering coal seam.	Stripping shovels capable of removing from 22 to 27 cubic yards of earth in one operation.
Coal Shovel	Drilling and shooting coal seam in a strip mine, and loading coal mechanically into cars or trucks.	Tractors, scrapers, and shovels for cleaning and loading purposes.

Tracks, timbering, locomotives, explosives, ventilation, and tools are needed for equipment and facilities in shaft and slope mines; whereas no timbering and ventilation equipment are needed in stripping operations.

Operation	*Processes*	*Equipment and Facilities*
Haulage	Transporting coal from mine to preparation plant.	Locomotives, cars, trackage, grading, and tools.
Power	Light and power provision.	Mines may either purchase power from local utility or provide their own power plant.
Drainage	Water control in shafts or strips.	Pumps and piping, construction of drainage ditches and sumps.
Ventilation	Purify air in shafts and slopes.	Fans, brattices, and doors.
Timbering	Support of shaft or slope from cave-ins.	Timbers.
Preparation (Tipple)	Coal is hauled to preparation plant and processed for the market.	Cost and construction of tipple, containing conveyers, screens, washery, driers, and bins.

Suitable tools and other miscellaneous equipment are needed for the maintenance of these productive services. In addition to the above, an efficient shop and storage room should be provided. Engineering and mine office expenses attributable to mining production should be properly allocated, together with miscellaneous general expenses.

Production Orders

Although the quality of the coal in the seam is a natural factor, after coal has been prepared, screened, washed, and dried, certain mixtures can be delivered to meet buyers' specifications. Nevertheless, some particular coal from a certain mine or seam makes better furnace, stove, stoker, coke, or steam coal than others. Coal is provided for the market in the preparation plant. Its first operation is to crush the raw coal, after which the coal is conveyed to the primary shaker screens in the tipple. After the coal, four to six inches and larger, has been picked—usually by hand—the coal is conveyed to the washery where the foreign material is removed by the specific-gravity washing process or by the pneumatic method. The product is then dried, if necessary, and subjected to the various screenings determined by the market classification, and finally conveyed to tipple bins where it can be further classified according to mixtures, depending upon the specifications received from the various buyers. Railroad cars or trucks are loaded at the tipple bins for primary distribution.

II. How to Design the Cost System

What Information is Required

Mining operations of any kind are based upon fortuitous events, thus making it necessary for management to allow a wide margin for conjecture before large sums of capital equipment are invested in a mining venture. The mining plant is located at the site of the coal discovery and, in many instances, this involves the development of an entire community in order to provide for an adequate labor supply. Transportation facilities in the form of improved roads, state highways, and railroad spurs leading to the mine plant are also required.

Mine accounting is divided into two phases: The development and opening of the coal seam, and the extraction and marketing of the product. All expenditures made for the development and construction of the mine plant are capital items; after operations once begin, it becomes necessary to distinguish properly between capital and revenue items. Therefore, an adequate control of fixed assets on unit cards, ledger sheets, or machine punch cards must be established in order to substantiate the proper depreciation and depletion deductions for federal income tax purposes.

All expenditures on account of fixed assets, after operations have begun, can be classified under the following headings: (a) additions and extensions; (b) replacements; (c) improvements and betterments; (d) repairs; (e) maintenance; (f) renewals of royalties and leases; and (g) deferred charges.

Labor and supply costs, including power, make up the largest share of operating expenses. Each cost must be allocated in such a manner that management can determine the efficiency of each operation. Semimonthly operating statements on a per ton basis and classified according to operation are a part of the routine records furnished by the cost accounting department.

Considerations in Designing the System

Productive, administrative, and selling costs are accumulated on a cost per tonnage basis. The cost accounting system for a bituminous coal mine will depend generally upon the following factors:

1. Whether the mine is an underground mine or a strip mine.
2. Whether mine is a shipping or local mine. (A local mine is defined as one that does not ship coal by rail, but confines its sales to the distribution of coal by truck in the local area.)
3. Whether underground mines are reached by vertical shafts or slopes.
4. Whether the mining is done by the longwall or room-and-pillar system, once the coal is reached in an underground mine by shaft or slope.

The "Process" Cost System Is Favored

The characteristics of coal mining favor the introduction of the process cost system. This system has proved satisfactory in the past as a method of measuring the efficiency of bituminous coal mining operations, and process costing appears to be universally practiced. Since the costs of each mining operation can be measured, cost accounting has proved an effective guide in the introduction of mechanized equipment in the mines. Slopes have been substituted for shafts, conveying equipment has been introduced, and machine loading has replaced hand loading. Fur-

thermore, the method of strip mining has proved profitable in the mining of coal seams near the surface of the earth.

III. Description of the Cost System

The major steps in designing a cost system for a bituminous coal mining plant are as follows:

1. Design the profit-and-loss control report for top management.
   a. Monthly comparative profit and loss statement (Figure 1).
   b. Profit-and-loss statement for the year (Figure 2).
2. Design the semimonthly cost statement (Figure 3).
3. Establish control of materials and supplies.
4. Establish control for payroll distribution.
   a. Semimonthly time report (Figure 4).
   b. Summary of payroll.
   c. Semimonthly individual payroll.

Profit and Loss Statement Formats

The comparative monthly profit-and-loss statement (Figure 1) accumulated on a sales per ton basis shows the comparison of current month's production with the same month a year ago. In addition to this statement each month, it is also possible to show the cumulative tons, costs, and sales per ton to date in comparison with the cumulative figures of the preceding year. Additional columns can be provided in the single statement to combine this dual information. Another variation that can be adopted in this statement is to figure the cost per ton on the number of tons produced instead of on the number of tons sold. Supply and labor costs are based on the cost per ton mined; and in the figure given, $2.00 is the amount of supply and labor costs on a production basis, but it becomes $2.133 on a sales per ton basis.

The profit-and-loss statement (Figure 2) shows the result of the mining operations for the entire year. This report includes the year's summary of other income and expenses which are not a part of the productive operations. This division of the profit-and-loss statement could be included in the monthly comparative (or cumulative) statement if the books of these subsidiary operations are closed on a monthly basis, such as rentals of farm lands, company residences, company stores, and recreational and service activities. This statement indicates the final result of net profit for the year carried to earned surplus.

Semimonthly Cost Statement

Labor and materials and supplies costs are accumulated on a semimonthly basis from the payroll summaries and materials and supplies expense sheet. Figure 3 illustrates the information contained in the Semimonthly cost statement of a slope or shaft mine. The number of tons mined is based on the tonnage of clean coal that has been processed at the preparation plant. The shrinkage in coal tonnage because of foreign materials, such as clay and rock, is considered a natural one, and the amount of the shrinkage does not enter into the accounting records, although an estimated record is maintained to determine the quality of the coal seam.

The semimonthly cost statement is also a part of the cost accounting records of

a strip mine. An example of its cost sheet measures 16½ inches by 26 inches and contains three major vertical divisions: Labor cost from the time the raw coal leaves the pit until it is processed for sale, and classified by processes similar to the shaft or slope mine with the exception of hand loading, machine loading, conveyer loading, ventilation, safety, timbering, and underground; labor cost of stripping the overburden soil; and materials and supplies cost classified by processes. The cost of stripping overburden removal is divided into three shifts, and each shift of eight hours each is sub-classified into the following accounts:

a. Pit Boss
b. Engineers
c. Oilers
d. Ground Men
e. Drillers
f. Helpers
g. Shooting
h. Electricians & Helpers
i. Water Boy
j. Miscellaneous

The total tonnage of coal mined, summary of production cost, statistics on the amount of stripping accomplished by depth, width, etc., delays and cause, weather, and remarks are also a part of the statement.

Control of Loading Performance

A performance record is kept on a weekly basis for mechanized loading equipment in the mine. It is a statistical record used for the purpose of determining the cause of delays and decreases in tonnage output. Since the record is maintained on a machine basis, the superintendent can analyze the number of tons handled by each machine during the regular shift. If production diminishes or there are too many delays, the cause can easily be traced and the necessary action taken to remedy the situation. Each line on the sheet represents a Machine Number. Vertical columns are constructed for date, machine number, places cut, places drilled, places to load, cars—coal loaded, cars—dirt loaded, tons—coal hoisted, number men in crew, tons coal per man shift; then suitable space for delays and remarks; followed by columns listed under Specified Delays for loading machine, shuttle car, cutting machine, and miscellaneous delays; and a final column for total shutdown delays. A grand total for the weekly summary is listed on the last line of the sheet.

How the Data for the Cost Summary is Obtained

Control of Materials and Supplies Expense

A materials and supplies expense sheet is compiled on a monthly basis and serves as a subsidiary of the general ledger Materials and Supplies account, and also as a control of the materials and supplies division of the semimonthly cost statement. The left side of the sheet contains information relative to the requisition number, invoice number, vendor, and amount debited. The right side con-

tains a classification similar to the materials and supplies division of the semimonthly cost statement, and a column for amount credited.

Inventory of materials and supplies at the beginning of the month, plus purchases debited during the month, minus the total amount credited during the month, will give the amount of materials and supplies inventory on hand at the end of the month. This balance agrees with the amount appearing as the balance in the general ledger Materials and Supplies account. The cumulative monthly totals of the credit side, classified by processes and subclasses, will agree with the cumulative monthly totals in the semimonthly cost statement.

Payroll Distribution

Time cards are maintained daily by the timekeepers and approved by the foreman for each individual. This information is posted daily to the Time Report (Figure 4) where it is classified according to individual workman, date, rate of pay, and type of work. Columns are provided for the amount of time devoted to each process and machine, and the amount chargeable thereto. This information is summarized semimonthly on the Summary of Payroll for cost distribution purposes and also on the payroll sheet for payment to the employees.

The Summary of Payroll is a three-column sheet on which the labor costs are classified by process and machine in the same manner as found on the semimonthly cost statement. Thus, the total amount chargeable to the subclassifications of Yardage, Face Loading, Cutting, etc., and to Machine Nos. agrees with the same amount as found in the cost statement. The third column of the Summary of Payroll contains the following information:

Gross Amount of Payroll
DEDUCTIONS
Overdrafts
Rent—Company House
Rent—Company Land
Other Rent
Store Orders
Wash House Locks
Coal for Employees
Power—Company House
Total Mine Local No._____
Check Weighman
Dues
Assessments
Assessments—Special
Initiation
Burial Fund
Collections for
Total Mine Local No._____
Federal O.A.B.
Withholding Tax
Series "E" Bonds

Other Collections
Cash Advanced
Total
TOTAL ALL DEDUCTIONS
BALANCE DUE

An example of the payroll sheet for payment to the individual employees is a 17-inch by 34-inch sheet containing the name and occupation of each employee and columns for the respective earnings and deductions, showing finally the net amount due and the check number. The earning columns include information relative to the number of hours employed, rate, and amount. A section for government deductions contains columns for state unemployment compensation, Federal old-age benefit, and bond deductions. The deductions section has individual columns for miscellaneous deductions, cash advanced, coal, rent, insurance, check off, and total. The difference between the total deductions of government and company sections and the gross earnings is shown in the column "Net Amount Due."

Thus, a complete control of labor cost is established. The totals shown on the Summary of Payroll agree with the totals found on the payroll sheet for individual earnings. The same classification appears on the Summary Payroll as the Semimonthly Cost Statement. This information is gathered from daily work reports and classified on the individual Time Report, from which it is posted semimonthly to the other three payroll controls.

Depletion and Depreciation

Depletion and depreciation are figured on the basis of tonnage of coal mined during the accounting period. Mining companies should adopt a depletion and depreciation policy which will meet the requirements of the Internal Revenue Department. Each taxpayer claiming a deduction for depletion and depreciation of mining property must keep accurate records of the cost or "adjusted cost" of the mineral deposit, plant, and equipment, together with subsequent capital additions and retirements. Therefore, all expenditures must be properly classified as to revenue or capital expenditures in the coal mining industry in order that revenue items can be recovered during the fiscal operations, and capital expenditures recovered through depreciation charges.

The current depletion charge is established by the engineering department. Estimates are made as to the amount of coal recoverable over a period of time or during the mining operation of a particular piece of property. The cost of this coal supply is divided by the number of tons that can be extracted, giving the depletion cost on each ton of coal mined. This rate of depletion per ton may vary from year to year depending upon the estimates of the quantity available in the particular coal seam which is being mined.

The depreciation rate is calculated on per ton of coal mined in the same manner as depletion, except that the capital investment in the plant and equipment is spread over the total supply of all coal to be recovered. On the other hand, the plant and equipment may be depreciated by the straight-line method depending upon the service life of each asset, in which case the depreciation rate would be the same for each period regardless of the amount of coal tonnage mined.

BITUMINOUS MINING COMPANY

Comparative (or Cumulative) Profit and Loss Statement
January 1946 and January 1945

	January 1946				January 1945				Inc. or Dec.* in Amount
Sales	Tons	Amount	Total	Sales Per Ton	Tons	Amount	Total	Sales Per Ton	
Shipments:									
Lump	1,500	$ 6,750		$4.500					
Furnace	7.000	28.000		4.000					
Egg	12,000	51,000		4.250					
Nut	30.000	105.000		3.500					
Mine Run	1,000	3.000		3.000					
Slack	21.500	53,750		2.500					
Total Shipments	73,000	$247.500		$3.390					
Local Sales	2,000	7,000		3.500					
Total Sales	75,000		$254.500	$3.393					
Less Allowances			500	.006					
Net Sales			$254,000	$3.387					
Cost of Sales									
Inventory 1/1/46	5,000	$ 16.500		.220					
Materials and Labor	80.000	160.000	(2.000)	2.133					
		$176.500		$2.353					
Less Inv. 1/31/46	6,000	12,000		.160					
		$164,500		$2.193					

Fixed Expenses			
Taxes	2,250		.030
Federal and State Payroll Tax	4,500		.060
Compensation Insurance	9,000		.120
Property Insurance	500		.007
Royalties and Lease	5,250		.070
Depreciation	8,250		.110
Depletion	2,750		.037
Total Production Cost		$197,000	$2.627
Administrative Expenses			
Officers' Salaries and Expenses	xxxxx		
Office Salaries	xxxxx		
Bad Debts	xxxxx		
Other Taxes	xxxxx		
Legal Expenses	xxxxx		
Miscellaneous	xxxxx		
Total Administrative Expenses		7,500	.100
Selling Expenses			
Salesmen's Salaries	xxxxx		
Commissions	xxxxx		
Advertising	xxxxx		
Miscellaneous	xxxxx		
Total Selling Expenses		3,750	.050
Total Production, Administrative and Selling Cost		$208,250	$2.777
Net Income from Sales		$ 45,750	$ .610

Fig. 1. Comparative Profit-and-Loss Statement (Monthly).

BITUMINOUS MINING COMPANY

Profit-and-Loss Statement
For the Year 1946

Sales, less Allowances		$2,554,000
Cost of Sales:		
Inventory, Jan. 1, 1946	$ 16,500	
Mine Costs—Materials and Labor	1,768,000	
	$1,784,500	
Less Inventory Dec. 31, 1946	20,000	
		$1,764,500
Gross Income from Sales		$ 789,500
Operating Expenses:		
Taxes	$ 30,000	
Compensation Insurance	42,000	
Federal and State Payroll Tax	50,000	
Insurance	4,500	
Royalties and Lease	54,000	
Depreciation	99,000	
Depletion	36,000	
Administrative Expenses	91,000	
Selling Expenses	96,000	
Total Operating Expenses		502,500
Net Income from Sales		$ 287,000
Other Income and Expenses:		
Rentals—Net	$ 5,600	
Merchandise Operations—Net	3,250	
Purchase Discounts	3,500	
Interest Income	1,200	
Miscellaneous Income	1,000	
	$ 14,550	
Less:		
Interest and Discount	1,200	
Total Other Income—Net		13,350
		$ 300,350
Less Provision for Federal Income Tax		72,084
Net Profit to Surplus		$ 228,266

Fig. 2. Annual Profit-and-Loss Statement.

BITUMINOUS MINING COMPANY

Mine No. 1 Semimonthly Cost Statement Date _____

Width of Sheet: 20″
Length of Sheet: 32″

Vertical columns are provided for the following information:

Process
Example: 1 Yardage and Deadwork
Subclassification
Example: 01 Yardage
Labor Classification—8 Columns
Materials and Supplies—8 Columns
The heading of each of these 8 columns is similar with the exception of the account number. Example:

Under Labor:
100 Fixed Charges (Money Columns for PERIOD and TO DATE)
200 Operating Cost (Same as Above)
300 Non-recurring Expenses (Same as Above)
Total (Same as Above)

Under Materials and Supplies
400 Fixed Charges (Money Columns for PERIOD and TO DATE)
500 Operating Costs (Same as Above)
600 Non-recurring Expenses (Same as Above)
Total (Same as Above)

Section for Machine Data—3 Columns
Column for Machine No.
Column for Period
Column for Month to Date

Omitting columns for Fixed Charges, Operating Cost, and Non-recurring Expenses, the following information is found: (The Machine Data section follows the Labor and Materials Supplies Sections).

Classification	*Labor* TOTAL			*Material and Supplies* TOTAL	
	Period	To Date		Period	To Date
1. *Yardage and Deadwork:*					
01 Yardage			01		
02 Deadwork			02		
03 Man Trips			03		
Total	151.20	286.72		4.13	4.13
Cost per Ton					
2. *Face Loading:*					
05 Hand Loading Undercut Coal			05		
06 Hand Loading Solid Coal			06		
07 Conveyer Loading			07		
08 Operating Loading Machine			08		
09 Maintenance Loading Machine			09		

Classification	*Labor* TOTAL			*Material and Supplies* TOTAL	
	Period	To Date		Period	To Date
10 Clean Up			10		
Total	5,480.33	10,138.58		1,602.88	2,044.84
Cost per Ton					
3. *Cutting:*					
13 Operating Undercutting Machine			13		
14 Maintenance Undercutting Machine			14		
15 Sharpening and Delivering Bits			15		
Total	3,650 47	6,652.95		1,179.85	2,622.07
Cost per Ton					
4. *Drilling and Shooting:*					
17 Drilling			17		
18 Loading and Shooting			18		
19 Delivery of Powder or Cardox			19		
20 Airdox			20		
21 Repair Drills			21		
Total	3,131.71	5,693.57		1,161.00	2,257.05
Cost per Ton					
5. *Haulage:*					
22 Operating Main Line Loco.			22		
23 Operating Swing Locos			23		
24 Operating Gathering Locos.			24		
25 Maintenance Main Line Loco.			25		
26 Maintenance S. and G. Locos.			26		
27 Maintenance of Mine Cars			27		
28 Trappers and Switchers			28		
Total	3,900.22	7,046.74		982.37	1,520.90
Cost per Ton					
6. *Underground Power:*					
30 Operating Generating Sets			30		
31 Trolley Wiring			31		
32 Feeder Wiring			32		
33 Banding			33		
34 Underground Lighting			34		
Total	393.62	580.15		79.51	145.12
Cost per Ton					
7. *Tracklaying:*					
36 Main Line and Partings			36		
37 Panels and Rooms			37		
38 Recovering Rails and Ties			38		
39 Grading			39		
Total	2,541.97	4,793.00		435.60	788.19
Cost per Ton					
8. *Timbering:*					
40 Main Line			40		
41 Panels and Rooms			41		
42 Recovering Timbers			42		
Total	1,339.28	2,427.37		391.30	908.69
Cost per Ton					
9. *Ventilation:*					
44 Batticing			44		
45 Maintenance of Air Courses			45		
46 Sealing and Overcasting			46		

Classification	*Labor* TOTAL Period	To Date		*Material and Supplies* TOTAL Period	To Date
47 Fans and Air Shafts			47		
Total	158.28	383.02		208.17	314.96
Cost per Ton					
10. *Hoisting:*					
49 Top			49		
50 Bottom			50		
51 Shaft			51		
Total	259.37	476.65			
Cost per Ton					
11. *General Underground:*					
53 Cleaning Roads			53		
54 Telephone System			54		
55 Drainage			55		
56 Materials Handling and Delivery			56		
57 Shop—Tool Repairs			57		
Total	567.02	978.97		337.74	654.60
Cost per Ton					
12. *Power Generation:*					
58 Operating Engines, Gens. and Turbs.			58		
59 Maintenance Engines, Gens. and Turbs.			59		
60 Operating Boiler and Equipment			60		
61 Maintenance Boiler and Equipment			61		
Total					
Cost per Ton					
13. *Preparation:*					
64 Operating Machinery			64		
65 Maintenance Machinery			65		
66 Hand Picker			66		
67 Handling R. R. Cars			67		
68 Refuse Disposal			68		
69 Car Cleaning			69		
70 Inspection			70		
Total	910.45	1,752.70		185.83	189.69
Cost per Ton					
14. *General Top:*					
73 Automobiles			73		
74 Trucks			74		
75 Handling Material			75		
76 Top Telephones			76		
77 Top Power Lines			77		
78 Pump Station			78		
79 Filter Plants			79		
80 Wash House			80		
81 Maintenance Mine Bldgs. and Structures			81		
82 Machine Shop			82		
83 Motor Sand			83		
Total	278.24	433.71		75.06	186.88
Cost per Ton					
15. *General Safety:*					
86 Examining			86		
87 Sprinkling			87		
88 Rock Dusting			88		
89 Inspection			89		

Classification	*Labor* TOTAL Period	To Date		*Material and Supplies* TOTAL Period	To Date
90 Mine Rescue and F. A. Training			90		
91 Underground Fire Fighting			91		
92 Top Fire Fighting			92		
93 Trip Lamps			93		
94 Watchmen			94		
95 Life Checks			95		
Total	286.70	527.93			12.06
Cost per Ton					
16. *Railroad Tracks, Cars and Engines:*					
96 Prorate			96		
97 Direct			97		
Total		12.23			
Cost per Ton					
17. *Storage Coal:*					
99 Prorate			99		
100 Direct			100		
Total					
Cost per Ton					
18. *Electric Cap Lamps:*					
102 Attendants			102		
103 Issuing and Receiving			103		
Total					
Cost per Ton					
19. *Supervision:*					
105 Prorate			105		
106 Direct			106		
Total	2,794.10	5,215.60			
Cost per Ton					
20. *Engineering:*					
108 Prorate			108		
109 Direct			109		
Total					
Cost per Ton					
21. *Office and Clerical:*					
111 Prorate			111		
112 Direct			112		
Total	423.48	942.22			
Cost per Ton					
TOTAL AMOUNT	26,266.44	48,342.11		6,643.44	11,649.18
COST PER TON	1.234	1.242		.31	.30

SUMMARY	
LABOR	48,342.11
MATERIALS AND SUPPLIES	11,649.18
TOTAL	59,991.29
COST PER TON	1.542

SUMMARY OF TONNAGE	PERIOD	TO DATE
Tons, Hand		
Tons, Conveyer		
Tons, Loading Machines	21,279	38,914
TOTAL	21,279	38,914

MACHINE DATA SECTION—3 columns

Machine No. 1	Period	Month to Date
Total Tons	1709	3089
Labor	1757.44	3193.84
Supplies		
Total Amount	1757.44	3193.84
Cost per Ton		
Machine No. 2		
Etc.		
TOTAL AMOUNT—All Machines		
COST PER TON		

Date April 30, 1946

Fig. 3. Semimonthly Cost Statement.

Bituminous Mining Company

TIME REPORT

RATE													DAILY WAGE	HRS. WEEKLY ST.	O.T.	AMT.
FWD. DATA																FWD.
DATE	HRS.															
1-16																
2-17																
3-18																
4-19																
5-20																
6-21																
7-22																
8-23																
9-24																
10-25																
11-26																
12-27																
13-28																
14-29																
15-30																
31																
TOTAL																

SUMMARY

HRS.	RATE	AMOUNT	

TOTAL AMOUNT		
TOTAL DEDUCTIONS		
NET DUE		

DEDUCTIONS

FEDERAL O.A.B.		
WITH-HOLDING TAX		
BONDS		
CASH ADVANCE		
COAL RENT		
EMPLOYES INS.		
U.M.W.A. DUES		
U.M.W.A. ASSESSMENT		
TOTAL DEDUCTIONS		

NAME _____

FROM _____ TO _____ 19 ____, INCL.

Fig. 4. Time Report.

COST ACCOUNTING FOR A BRASS MILL

By
WILLIAM F. BURKE *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Although the products are commonly classified as copper base alloys, they comprise brasses, bronzes, nickel silvers, and phosphor bronzes in the form of sheet, rod, wire, and tube, each form in a variety of sizes and tempers. The brasses are alloys of copper and zinc, the copper content varying from 60% to 95%, each alloy having measurable differences in corrosion resistance, strength, color, and fabrication properties. Yellow or high brasses range up to 75% copper content, while red or low brasses have 80% to 95% copper content. The addition of a small percentage of lead gives added machinability. Bronze alloys contain tin, the tin content ranging from 1% to 3%, the balance being copper and zinc. These alloys have improved mechanical properties and corrosion resistance. They are used in the manufacture of jewelry, springs, welding rod, and many other articles.

Adding nickel to the brasses results in alloys known as nickel silvers. The most common, perhaps, is an alloy consisting of about 18% nickel, 17% zinc, and 65% copper. This alloy is used in sheet form for the manufacture of table flatware and jewelry, in rod form for watch parts, and in wire form for optical bows and slide fasteners, just to mention a few of the uses. Phosphor bronzes are copper tin alloys with a small amount of phosphor included. Each alloy is identified by a number that is used for production control and accounting purposes.

Raw Materials

Raw materials are of two general classes—base metals and scrap. The chief base metals are copper, zinc, lead, tin, and nickel, and they are purchased from refineries. The chief source of scrap is customers of the brass mills who sell their trimmings, turnings, rod ends, and skeleton scrap to the mills from whom they purchased the brass. There is also a considerable amount of scrap made by the mills themselves that is returned to the furnaces for remelting.

Organization of Plant

This description of cost accounting pertains particularly to mills that cast base metals and scrap and process the resulting bars and billets into finished brass that is ready for fabrication by other manufacturers in specialized industries. There are a considerable number of smaller mills that have neither casting furnaces nor the heavy machinery for the first operations on bars and billets. They are known as rerollers and redrawers. Some buy sheet from the larger mills and roll it down to

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thin gauges, some buy rod and draw it down to very fine wire, while others take tube and draw it to very small dimensions. However, the cost methods herein described, with adaptations to particular conditions, are applicable to the smaller mills.

Each mill has the usual service departments that are similar to those found in most industrial plants. Prominent among these is the laboratory which performs routine chemical analyses of alloys and many forms of metallurgical testing, as rigid laboratory control must be maintained to assure high quality of product.

The principal production departments and processes in a complete mill are as follows:

Casting Shop
Rolling Mill
Rod Mill
Wire Mill
Tube Mill

The casting shop controls the base metal and scrap stores from which it requisitions copper, zinc, etc., and scrap, and carefully proportions and weighs the quantity of each constituent metal that is put into a container known as a "charge," which when melted will give the desired alloy. A charge is a furnace load. After the charge has been melted in an electric furnace it is poured into molds. Sheet metal is cast in bar form, the molds being of various widths, while rod, wire, and tube are cast into round billets. After the metal has cooled, the molds are opened and gate ends (the metal on the top of the mold) removed by shearing or sawing, as these ends are somewhat porous and do not make good brass.

The rolling mill takes the bars from the casting shop and by a series of passes through heavy metal rolls reduces the thickness to the gauge required. Since the rolling process hardens the metal, it is put into annealing furnaces and softened after a certain percentage reduction in gauge. Hence the equipment of a rolling mill consists largely of rolls and furnaces. The finishing operations consist of pickling, inspecting and trimming or slitting to the required width. Some metal is shipped in coils and some flat cut to various lengths.

The first operation in the rod mill is extrusion. Billets are brought to red heat in a furnace and immediately placed in an extrusion press, a particularly large piece of equipment that pushes the metal through a die so that it is formed into rods, the diameter varying with the size of the die. The rods are drawn to smaller diameters of proper temper by pulling them through dies. Finishing operations consist of pickling, straightening, cutting to length, inspection, etc. Rod, when coiled, becomes wire. The wire mill takes coils from the rod mill and by pulling them through dies in wire drawing machines gradually reduces the diameter. Anneals are required between drawing operations to keep the metal soft.

Tube making equipment varies as there are several methods of starting the billet. One method is extrusion similar to that used for extruding rod, but more difficult. The resulting tube is drawn down to smaller outside and inside diameters on drawbenches where it is pulled through a die to reduce the outside diameter while a plug on the end of a rod inserted through the tube controls the inside diameter. Frequent anneals are required between drawing operations. As the tube becomes longer it is sawed into shorter lengths as long straight tubes cannot be handled. This is a tricky process from the cost viewpoint as the two tubes that result from

cutting take different courses and one or both may later be cut again. The processing of some tubes made from short ends is greater than if the same tubes were made from long ends, yet it is often more economical to process the short ends than to scrap them. Since tubes are generally made to order in varying diameters, both outside and inside, and in varying lengths, best results can be obtained only when available orders fit manufacturing conditions. Variances can be unusually large. Hence not only are tube cost standards difficult to establish, but also the measurement of variations from standard cost is very complex. The finishing operations consist of cutting to final length, testing, inspecting, and packing.

Production Order System

The production office prepares an advance schedule for each mill and makes delivery promises based thereon. Orders for a given alloy are grouped to determine the casting schedules for each alloy and the pounds of bars (subdivided into various widths) and billets to be delivered to the various mills each week. The mills are given production orders stating the finished dimensions, alloy, temper, customer, and shipping instructions. A duplicate of the order is a work ticket that accompanies the metal through the mills so that it can be identified at all times. When a customer's order is so large that it will be processed in several lots or loads, a separate set of orders is made for each lot or load.

II. How to Design the Cost System

What Information is Required

The cost system must provide effective control of inventories, operating expenses, and profits. The essential features are as follows:

1. There must be control of inventory—in pounds and in value, in raw material stores, work in process, and warehouse stocks—so as to keep it in proper balance and avoid the accumulation of slow moving stocks.

2. Purchase prices of base metals and scrap must be related to sales prices of the finished product. It is a characteristic of the industry that the selling prices of its products vary directly with the prices of raw materials. If an alloy with 70% copper content has a base price of 25.2 cents per pound today, and the price of copper goes up 1 cent per pound tomorrow, the base price of this alloy will be increased immediately to 25.9 cents per pound. Therefore, it is important to know the extent to which the mill covers its sales commitments with purchases at any given price level.

3. Although the prices of different sizes of a given alloy are established by list extras over base prices in accordance with published lists that seldom change, it is essential to know how the cost compares with these extras. Therefore the cost system must be designed to produce a cost for each diameter, width, gauge, length, etc., for each alloy. There are literally thousands of combinations.

4. Since the incentive wage system provides a direct labor cost for most operations, it is necessary to provide standard direct labor costs only for operations performed on a daywork basis. In order to keep the mill management informed as to the effectiveness of direct labor, variations from standard must be measured and reported not only in total but by the various mill operations.

5. Overhead control is important in this industry as in others. Standard allowances for indirect labor, supplies, maintenance, etc., are established based upon ratios to direct labor.

6. It is desirable that essential statistics be drawn from the accounting records as far

as possible. Governmental and other agencies require reports of production and sales, not only in terms of brass in its various forms and alloys, but also in terms of base metal content.

7. The profit-and-loss statement must bring the facts together in such a way that the net results are clearly shown. Details should be available so that analyses of any particular variations can be made readily.

Standard Costs

Due to the wide variety of product, brass mills have been rather slow in installing standard cost systems and many of them today continue with actual costs or combinations of actual and standard costs. However, most mills are installing standard costs with the full realization that it is a long and difficult undertaking.

Checking and Timekeeping Procedures

In order to measure variances it is necessary to record each operation on original time tickets in great detail showing not only a complete description of the work done, but in some cases an almost equally detailed description of the way it ought to be done. In addition, wage incentive plans, although simple in principle, are complex in administration. Hence time tickets are much more involved and complicated than those that are found in most industrial plants, and the number of calculations per time ticket is probably far in excess of average. Mill timekeeping is therefore a very intricate procedure and the success of any cost system is dependent upon the training and skill of the timekeeping staff.

Scrap Records

In the manufacture of brass it is necessary to make scrap but, needless to say, high efficiency demands that scrap losses be kept to a minimum. Therefore, it is necessary to analyze the scrap coming out of each mill by alloy and operation in order to locate those places where scrap is made beyond normal expectations.

III. Description of the Cost System

Inventory Accounts

Inventory values are carried in the general ledger in a single control account with three subaccounts:

Mill Inventory
Supplies
Reclamation

The mill inventory account is a control account for a ledger in which all entries are posted in pounds as well as value, together with the average prices per pound. Practically every account in the subsidiary ledger controls a group of more detailed records. Inventory control is exercised much more by means of quantity or tonnage figures than it is by values. Hence the greatest care is taken to assure accuracy of quantities on all movements of metal that are the subject of journal entry. Throughout all entries, accounts, and reports, "metal" values are segregated from "toll" values. The term "metal value" means the purchase price of raw material either in the form of refinery shapes or scrap. The term "toll value" means the value added by manufacture, chiefly direct labor and overhead. These two sets of

accounts parallel each other and, since tonnage is posted in each account, the total pounds in all accounts is twice the quantity actually on hand, or, to put it another way, the pounds in the metal accounts are equal to the pounds in the toll accounts.

MILL INVENTORY

TRIAL BALANCE, DECEMBER 31, 1946

Metal Accounts:	*Pounds*	*Average per Pound*	*Value*
Copper	6,400,000	$0.105	$ 672,000
Zinc	3,400,000	0.07	238,000
Lead	100,000	0.065	6,500
Tin	20,000	0.50	10,000
Nickel	80,000	0.35	28,000
Sub-Total	10,000,000		$ 954,500
Toll Accounts:			
Base Metal Stores	1,000,000	—	—
Scrap Stores	1,000,000	—	—
Casting Work in Process	100,000	—	—
Rolling Mill Work in Process	2,000,000	0.04	80,000
Rod Mill Work in Process	1,500,000	0.025	37,500
Wire Mill Work in Process	500,000	0.06	30,000
Tube Mill Work in Process	1,400,000	0.07	98,000
Warehouse Stocks—Sheet	500,000	0.08	40,000
Warehouse Stocks—Rod	1,000,000	0.05	50,000
Warehouse Stocks—Wire	500,000	0.08	40,000
Warehouse Stocks—Tube	500,000	0.12	60,000
Sub-Total	10,000,000		$ 435,500
Grand Total	10,000,000		$1,390,000

Fig. 1.

This is illustrated by a condensed trial balance given in Figure 1. It shows an inventory of 10,000,000 pounds valued at $1,390,000. The metal accounts show the base metal content of the inventory and the value of the metals as such while the toll accounts show its location and the value added by manufacture. The only inventory that is in base metal form is the 1,000,000 pounds in base metal stores; the other 9,000,000 pounds are alloys. The amount of each alloy is not a matter of record in the ledger, but the base metal content of the various alloys plus the metals in base metal form equals the tonnage in the metal accounts.

Treatment of Base Metal Purchases

The common base metals are generally purchased in carload lots and the contents of each car are placed in a separate pile identified by the car number. When the metal is taken from stores, the requisition indicates the car number it was taken from. Hence the base metal stores account is the control account for a number of cards, each card showing the pounds of metal, the car number it came in, the pounds received, the pounds used, and balance on hand. It is customary to with-

draw metal from one car until it is consumed before using the metal received in another car.

If a car of copper is received weighing 60,000 pounds and the price is 15 cents per pound including freight, the copper account is charged with 60,000 pounds valued at $9000.00 and the base metal stores (toll) account is charged with 60,000 pounds, no value, as the only labor expended on it is the cost of unloading and that is charged to the overhead of the casting shop.

Treatment of Scrap Purchases

Scrap is purchased in alloy form and therefore it is essential to ascertain its base metal content. Not only is this necessary for accounting purposes, but also it is necessary for control of quality of product. Therefore, all lots of brass scrap are analyzed by the laboratory and the results of the chemical analysis received before the scrap is classified. Each lot is then given an alloy number. Before being placed in bins the scrap is put through a scrap processing department for cabbaging (compressing), running through a magnetic separator to remove iron, or doing anything else that is necessary to assure proper grading and make it ready for the furnaces. The cost of processing the scrap, cost of analyses, etc., are combined with the purchase price and incoming freight to give the total cost of scrap purchased.

The pounds of scrap purchased during a month are classified by alloy, and in some cases by alloy groups where the mixtures (base metal contents) differ little from one another, and the quantity of each alloy or alloy group is multiplied by the percentages of the various base metals it contains. For example, 1000 pounds of 18% nickel silver scrap is divided into 650 pounds of copper, 170 pounds of zinc, and 180 pounds of nickel. By doing this to all alloys purchased, the number of pounds of copper, zinc, lead, tin, and nickel in the scrap is determined. Next the quantity of copper is multiplied by the average market price of copper that prevailed during the month, and the same is done with zinc, lead, tin, and nickel. The sum of these extensions is compared with the total cost of the scrap and the difference between the two is prorated among the five metals in proportion to value. The entries are made from the prorated figures.

To illustrate, suppose 1,000,000 pounds of brass scrap of various alloys were purchased during a month and the cost was $125,000 consisting of

Payments to Vendors	$102,000
Freight	9,000
Scrap Processing	10,000
Analyses	4,000
Total	$125,000

The base metal content is given in Column 1, the average market prices for the month in Column 2, the extension in Column 3, the prorated cost in Column 4, and the final cost per pound in Column 5.

	1	2	3	4	5
	Pounds	*Market per Pound*	*Extension*	*Prorated Cost*	*Cost per Pound*
Copper	660,000	$0.15	$ 99,000	$ 91,396	$0.1385
Zinc	310,000	0.09	27,900	25,757	0.0831

Lead	15,000	0.10	1,500	1,385	0.0923
Tin	5,000	0.60	3,000	2,769	0.5538
Nickel	10,000	0.40	4,000	3,693	0.3693
Total	1,000,000		$135,400	$125,000	

The entry is to charge the copper account with 660,000 pounds valued at $91,396, charge the zinc account with 310,000 pounds valued at $25,757, charge the other metal accounts likewise, and charge scrap stores (toll) account with 1,000,000 pounds at no value, crediting vouchers payable with $111,000 and overhead with $14,000. The labor and overhead cost of processing scrap is added to the metal value, because scrap is generally purchased at prices below those for the equivalent base metals and can be used in limited quantities in place of base metals in the manufacture of brass. Therefore, the extra cost of handling the scrap is taken out of overhead and used to build up the scrap cost.

Cost of Sales—Metal Value

As the metal moves through the various departments and processes, no entries are made in the metal accounts—the progress is recorded in the toll accounts. The metal accounts are not credited until the metal is sold and charged to cost of sales. Meanwhile the metal may move from an eastern mill across the continent to a warehouse in San Francisco without disturbing the metal accounts.

Sales invoices are analyzed to determine the number of pounds of each alloy or alloy group sold. The tonnage sold is broken down into copper, zinc, lead, tin, and nickel by applying the percentage formulas for each alloy. The metal cost of sales is then determined by pricing the various base metals from the metal accounts by the average cost method, first-in, first-out method, or last-in, first-out (Lifo) method. Most brass mills are using the Lifo method. The cost is usually broken down into at least four subdivisions—sheet, rod, wire, and tube—but it may be broken down further if it is desired to show profit and loss figures on various kinds of brass.

Metal Price Variance

A refinement used by some mills is to analyze sales tonnages by price lists and price the metal content of sales with the base metal prices applicable to each list. As stated before, brass prices change with base metal prices and, since such changes are frequent in normal times, sales in any given month will include the same brass billed at two or more different prices merely because the dates that orders were placed were not the same and each order was priced at the price prevailing on the date it was placed. Hence, if copper prices were going up, being 12 cents per pound on June 1, 13 cents on June 20, 14 cents on August 12, and 15 cents on September 2, August sales would include some brass sold on the basis of 12 cent copper, some on the basis of 13 cent copper, and some on the basis of 14 cent copper. By analyzing tonnage sales according to the price lists used in billing, the number of pounds of copper sold on each price list can be determined. Sales costed by extending pounds sold on each price list by the applicable base metal prices will show profits exclusive of "speculative" profit (or loss) and scrap profit (or loss).

The difference between the metal cost thus obtained and the actual cost as represented by the credit to the inventory account is known as "metal price variance"

that can be divided into purchase price variance and scrap price variance. Since base metal price fluctuations can be expected to occur, the purchase price variance may be great enough to wipe out all manufacturing profit if purchases are not correlated with sales. If a mill sold huge quantities of brass on a 12 cent copper base and did not cover its requirements at the same time so that later it was forced to buy the copper at 14 cents per pound, it would suffer a speculative loss of 1.4 cents on every pound of brass sold with a 70% copper content. Profit margins in the business are so close that this sort of thing might be disastrous. It is imperative that performance in this regard be measured and results stated separately on the profit-and-loss statement.

Scrap price variance is also included in metal price variance. Going back to the example given when discussing scrap purchases, it can be seen that by taking the copper content of scrap purchases in at 13.85 cents per pound when the market was 15 cents sets the stage for a favorable scrap price variance that will materialize if an equal quantity of brass is billed on a 15 cent copper base. However, scrap prices fluctuate with brass mill products prices which in turn fluctuate with base metal prices. If copper went from 12 cents to 14 cents and a mill covered all its 12 cent base brass commitments with purchase contracts, it would later purchase scrap based on 14 cent copper so that its over-all purchases of 14 cent copper would be excessive. Of course the mill could refuse to buy brass scrap under these circumstances, but if it did it would act counter to trade custom. It is the usual practice of a mill to buy scrap at any time in any quantity from its customers at the then current price, and holders of brass scrap have been alert to sell at high prices and hold back when prices are low. The result is that in a fluctuating market the scrap price variance and the metal price variance, the two parts of the metal price variance account, become interrelated and a certain amount of supposition is required to separate them.

Metal Losses

There is some loss in the weight of metal in the casting operation due to several causes. Since zinc has a lower melting point than copper or nickel, some of it disappears and becomes "stock loss" when the temperature of the furnace is brought to the high melting points required for the other metals. Although scrap is carefully prepared, it contains some oil, especially rod turning scrap, that evaporates in the melting process. Impurities are skimmed from the surface of the molten metal before pouring, but the skimmings contain brass as well as impurities. Thus, in order to recover the metal, the skimmings are put through a reclamation process. The difference between the weight put into the furnaces in a month and the weight of the resulting bars and billets gives the sum total of all losses. The weight lost extended by the cost price is a credit to the metal accounts while the charge is divided between the reclamation account and the casting work in process (toll) account, the division being made on the basis of data tables built up from experience. The debit to the reclamation account is such that, when the reclamation costs are added to it, the sum will equal the value of metals reclaimed. Needless to say this ideal is never attained, but the results are close enough for all practical purposes. The remaining loss is charged to casting work in process account.

Standards have been developed for casting losses that are used in standard costs and will be described later. The important thing is that metal losses do not appear

in metal cost, and hence there is no metal quantity variance. When the market price of copper is 15 cents per pound and zinc 9 cents per pound, the metal cost of a brass alloy with 2 parts copper and 1 part zinc is 13 cents, it being assumed that in the long run the metal price variance account will equalize itself.

Lifo Inventory Value

The last-in, first-out inventory method gives more accurate profit and loss figures than any other method that has been approved by the Bureau of Internal Revenue, although its administration is somewhat complex particularly as regards monthly statements. Referring to Figure 1, it is assumed that the copper inventory was valued as follows:

On Hand December 31, 1938 at Cost	5,000,000	lbs. @	$0.10	$500,000
Added in 1939	800,000	lbs. @	0.11	88,000
Added in 1946	600,000	lbs. @	0.14	84,000
Total	6,400,000	lbs. @	$0.105	$672,000

To have reached this situation, the copper inventory on December 31, 1939, was at least 5,800,000 pounds, probably more, but whatever it was on December 31 in subsequent years it was always above 5,800,000 pounds until on December 31, 1945, it was exactly 5,800,000 pounds. The prices on the 5,800,000 pounds never changed throughout the period. The 600,000 pounds added in 1946 are at the 1946 average purchase price of both base metal and scrap, although the mill, had it elected to do so when it adopted the Lifo method in 1939, could have used the average cost of the first 600,000 pounds of copper purchased in 1946 or the last 600,000 pounds purchased.

Let us suppose that in January, 1947, the copper account had the following entries:

Purchases of Base Metal	640,000	lbs. @	$0.15	$ 96,000
Purchases of Scrap	160,000	lbs. @	0.14	22,400
Total Purchases	800,000	lbs. @	0.148	118,400
Receipts from Reclamation	10,000	lbs. @	0.148	1,480
Less Casting Losses	20,000	lbs. @	0.148	2,960
Net Charge before Cost of Sales	790,000	lbs. @	$0.148	$116,920

If the copper content of sales were exactly 790,000 pounds, cost of sales would be $116,920. If the copper content of sales were 590,000 pounds the inventory would be increased by 200,000 pounds @ $0.148 or $29,600 and cost of sales would be charged with 590,000 pounds @ $0.148. On the other hand, if the copper content of sales were 990,000 pounds, the cost of sales would be the sum of the following:

January, 1947 purchases	790,000	lbs. @	$0.148	$116,920
From 1946	200,000	lbs. @	0.14	28,000
	990,000	lbs.		$144,920

This could be an understatement of cost by 8 mills per pound on 200,000 pounds or $1600 as the inventory might be built up in subsequent months and, if so, the first 200,000 pounds added must be valued at 14 cents per pound. Monthly figures

are not final like year-end figures. Therefore, reductions in inventory in a rising market are watched carefully and overstatements of monthly profits are avoided by altering the formula and costing excess sales at estimated replacement values.

Work in Process Accounts

Work in process accounts are charged with labor and overhead absorbed. Casting work in process, as stated earlier, is also charged with metal losses on the melting operation. The various bars and billets produced by the casting shop are priced at standard toll cost and the casting variance (difference between total debits and standard cost of production) prorated to all items. The whole account is wiped out at the close of each month, the debit being to the rolling, rod, wire, and tube mill work in process accounts. Transfers between mills are made at standard cost plus variance. There are not many of these, the chief one being transfers from the rod mill work in process to the wire mill work in process. Production goes either to customers or to various warehouses located throughout the country. Some mills have perfected their accounting to such a degree that each item produced is costed at standard toll cost, while others cost sales at average toll prices per pound for each product class. Considerable attention is given to the "spread" (difference between average selling price per pound and average metal cost per pound, and also to the work in process accounts for any great variation in the average inventory price per pound. Since metal is usually fairly well distributed among the operations in any given mill, its average inventory toll value should not change very much from month to month, and if it does it usually indicates that something is wrong with the cost of sales figures.

Warehouse Accounts

Although inventory records are kept of stocks in each warehouse by alloy, size, etc., these records show pounds only and agree in total with the pounds carried in the control account. For example, referring to Figure 1, the control account shows 1,000,000 pounds of rod in warehouse. There are subsidiary records, maybe hundreds or thousands of them, showing where it is located and complete description. It being impractical to carry a cost on each item and extend the cost of each individual sale, average inventory toll costs are used to cost sales on the first-in, first-out basis.

Overhead Accounting

Brass mills usually absorb overhead at standard rates on all direct labor, different rates being used for different departments. Some have developed standard labor and overhead costs per hour for each machine. In order to establish the rates a normal production in pounds is arrived at by taking into consideration capacity and demand for the product. Brass mills invariably operate more than one shift. The casting operation is always run on a three shift basis, 24 hours a day. The normal on other operations varies, but where costly units are involved the minimum is usually two shifts. Certain testing, inspecting, and packing operations are figured on a one shift basis. Once the normal tonnage production is decided upon, it is fairly simple to estimate the normal direct labor required. The expected overhead expenses are related to direct labor so that a standard overhead rate of, say, 200% may provide 50% for indirect labor, 10% for salaries, etc. In fact the over-all per-

centage is broken down into all the usual expense classifications. By applying these percentages to direct labor, the overabsorbed and underabsorbed overhead is broken down to show how much is over- or underabsorbed on each item of expense in each

PRODUCTION DEPARTMENTS OPERATING COST

DEPT. NO. _____

DEPT. NAME _____

MONTH

	STANDARD	ACTUAL	DIFFERENCE
DIRECT LABOR			
Productive			
S110 Repairs & Variances			
Set-Up			
TOTAL DIRECT LABOR			
S111 Daywork Variances			
S112 Unearned Wages			
S114 Overtime			
S117 Shift Extras			
S103 Toolsetting			
Other Hourly Indirect			
Salaries			
TOTAL INDIRECT LABOR			
Vacation Reserve			
Payroll Tax			
TOTAL VR & PT			
Dept'l. Supplies			
Fuel Oil & Propane Gas			
Maint. Supplies — Plant			
" " — Tools			
" " — X			
TOTAL SUPPLIES			
Maint. Labor — Plant			
" " — Tools			
" " — X			
TOTAL MAINTENANCE LABOR			
Depreciation			
Property Taxes			
Other Fixed Charges			
TOTAL FIXED CHARGES			
TOTAL DEPARTMENTAL COST			
POWER & STEAM			
RENT			
SERVICE OVERHEAD			
GENERAL PLANT EXPENSE			
GENERAL DEPT'L. EXPENSE			
TOTAL GENERAL CHARGES			
TOTAL COST			

Fig. 2.

department. This serves as a budget standard and reports are made weekly to each foreman as to where he stands on the expenses under his control. Summaries are prepared for the superintendents including expenses under their control as well as the expenses under the control of their foremen. One of the forms used is illustrated in Figure 2.

Profit and Loss Statement

This profit and loss statement shows factory cost divided into four parts: standard metal costs, standard toll cost, metal price variance and toll variance, arranged so as to show the "spread" (see Figure 3). The pounds sold and the averages per

PROFIT AND LOSS STATEMENT

SHEET BRASS

	This Month		Year to Date	
		Per Pound		*Per Pound*
Pounds Sold	1,000,000		7,000,000	
Sales Value	$ 260,000	$0.26	$1,680,000	$0.24
Less Standard Metal Cost	130,000	0.13	840,000	0.12
Spread	130,000	0.13	840,000	0.12
Less Toll—Normal Overhead	80,000	0.08	490,000	0.07
Normal Gross Profit	50,000	0.05	350,000	0.05
Metal Price Variance	2,000	0.002	7,000	0.001
Toll Variance	(2,000)	(0.002)	(28,000)	(0.004)
Overhead Balance	(3,000)	(0.003)	(42,000)	(0.006)
Gross Profit	47,000	0.047	287,000	0.041
Less				
Selling and Administrative Expense	20,000	0.020	147,000	0.021
Cash Discount	2,000	0.002	14,000	0.002
Transportation	6,000	0.006	42,000	0.006
Total	28,000	0.028	203,000	0.029
Net Profit	$ 19,000	$0.019	$ 84,000	$0.012

Fig. 3.

pounds are also included, as all brass men think and talk in terms of pounds and prices per pound.

Casting Cost

There are three direct labor operations in the casting shop: Weighing up charges, melting, and finally sawing or shearing the gates from billets and bars. The operators are paid on an incentive wage basis and direct labor is figured accordingly. There is a separate overhead for each operation which is applied on direct labor. Here is a case where a single overhead would suffice for cost purposes as all metal goes through the same three operations, but for budgetary control it is desired to keep expenses separate by production centers as three foremen are involved. Each foreman has his own departmental budget with a budgeted ratio to direct labor for each item of expense. With segregation of expense and preparation of standards carried this far, it is a simple matter to complete the picture by absorbing different rates on the different operations.

Since metal losses are included in casting shop toll cost, standard metal losses are determined and included in standard cost. These vary with the alloy. Figure 4 is a typical standard casting cost card showing the labor and overhead cost and

the standard metal loss for a particular alloy cast in bar form. The total cost per thousand pounds melted is $18.68, but since the yield is 90%, that is the weight of the bars going to the rolling mill is 90% of the weight of the metal that is melted, $18.68 is divided by 0.9 to obtain $20.76, the toll cost of the bars as they start the first operation in the rolling mill.

STANDARD CASTING COST PER THOUSAND POUNDS

ALLOY: 50 Bars MIXTURE: 66⅔% copper, 33⅓% zinc
YIELD: 90% COPPER LOSS 2%, ZINC LOSS 6%

Weigh Up	$0.50 direct labor per M lbs. cast + 100% overhead			$ 1.00
Melt	3.00 direct labor per M lbs. cast + 360% overhead			13.80
Shear	0.25 direct labor per M lbs. cast + 200% overhead			.75
Total				15.55
Metal Loss:				
Copper 2% of 667 lbs.		13.3 lbs. @ $.15	$2.00	
Less Reclamation Value		13.3 lbs. @ .05	.67	
			1.33	
Zinc 6% of 333 lbs.		20.0 lbs. @ .09	1.80	3.13
Total Cost per M Pounds Melted				$18.68
Total Cost per M Pounds to Rolling Mill ($18.68 ÷ 90%)				$20.76

Fig. 4

Not all mills use a flat overhead on the melting operation for all alloys. Some alloys use more power in proportion to tonnage and burn out the furnace linings and molds at a faster rate. Although the direct labor cost on the more expensive alloys such as nickel silver is higher than on high brass, the overhead costs are still higher. Hence it is not unusual to find one overhead rate for melting high brass, a higher one for low brass, and a still higher one for 18% nickel silver, all for use on the same type of furnace.

Mill Cost

Picking up the same bars illustrated in Figure 4, the standard cost of processing these bars through the rolling mill to produce coiled metal 3½ inches wide with a thickness of 0.031 inch is presented in Figure 5. The direct labor cost is in two columns, the first being the labor cost per thousand pounds for the particular operation while the second is the labor cost for that part of the 1000 pounds that goes through the operation. The two columns are identical through the first three operations as no scrap is made until the third or "overhaul" operation. This is a machining operation that shaves off the outer surfaces of the bar to remove pits and other imperfections. The standard scrap loss is 8% leaving 920 pounds to go to the annealing furnaces. The direct labor cost to anneal 1000 pounds is $0.182 and this is entered in the first labor column, but the cost to anneal 920 pounds is 92% of $0.182 or $0.167—the entry in the second column. The standard overhead on the annealing operation is 400% or a factor of 5.00. This is multiplied by the cost in

the second labor column to give a labor and overhead cost of $0.835 for annealing 920 pounds.

There follows a series of further rolling and annealing operations that are omitted on Figure 5, but the scrap loss, labor, and overhead are indicated as 6.5% and $34.063 per thousand pounds respectively. There are 860 pounds to be inspected where a loss of 2% is expected, leaving 843 pounds to be slit. The slitting loss is 7% and, since this is the final machining operation, there are 784 pounds shipped out of the 1000 pounds started. Therefore, the total labor and overhead cost, including the casting cost, of $61.58 is divided by 784 pounds to obtain a standard toll cost of $0.0785 per pound.

This cost card is an outgrowth of an actual cost system where a lot of metal was followed through the mill, and the direct labor cost of each operation recorded and the scrap loss noted. An actual cost would record only the direct labor expended on the lot at each operation and hence only one labor cost column would be required. However, the accumulated cost would be divided by the number of pounds actually finished to determine the cost per pound.

Labor Variances

The standard cost in Figure 5 is one that cannot be lowered with existing facilities, except possibly for scrap losses. The operation costs are figured on the lowest cost equipment at the best speeds. With standards of this type variances are to be expected, and, therefore, a standard variance percentage for each type or kind of metal is established based upon experience. In the illustration in Figure 5 the standard variance is 10% on the mill operations or $0.0052 per pound. Even with considerable data available it is not easy to establish a standard variance percentage for each product class as some variances occur on the simplest operations—contingencies so to speak such as unavailability of lowest cost equipment, new help, etc. —while others can be traced to inherent difficulties in processing particular kinds of metal such as extra machining to remove unusually deep pits, extra inspection, etc. The rolling operation often gives rise to variance as the piecework prices vary with the running time of the metal through the rolls. Each mill has rolls of different diameters operating at different speeds and designed to reduce the thickness of a given alloy at a given temper by a given percentage per pass through the rolls. For various reasons, chiefly because orders received from customers are such that the schedule piles up on certain rolls leaving others more or less empty, some metal is put through rolls where it is known in advance that the cost will be greater and a variance will ensue. Variance is treated in the accounts as a form of direct labor and overhead is absorbed on it.

Completing the Standard Cost

Selling and administrative expenses are included in cost at standard rates per pound. Brass mill terms are 1% cash discount, freight prepaid to destination. These items are included in cost along with the mixture and the toll. If copper is 15 cents per pound and zinc 9 cents, the metal cost of an alloy made up of 66⅔% copper and 33⅓% zinc is 13 cents. Figures 4 and 5 show that it is necessary to melt about 1100 pounds to produce 784 pounds of this alloy 3½ inches wide, 0.031 inch thick, and therefore considerable scrap results from the mill operation. This scrap is generally described as run-around scrap as it goes back to the casting shop

STANDARD MILL COST

MILL ROLLING DATE ALLOY 50

FINISH 3 1/2" EXACT 0.031 GAUGE COILS SIZE 7" BAR

SCRAP STANDARD PER CENT	SCRAP STANDARD UNIT WGT.	OPERATION	FACTOR	LABOR PER M LBS.	LABOR COST	LABOR AND OVERHEAD		Per Pound
	1000	Casting Cost					20.76	0.0264
		Roll to 750 3 passes	4.00	0.250	0.250	1.000		
		Straighten	3.50	0.100	0.100	0.350		
8%		Overhaul	3.50	0.221	0.221	0.774		
	920	Anneal	5.00	0.182	0.167	0.835		
		Roll to 475 3 passes	4.00	0.350	0.322	1.288		
		Anneal	5.00	0.182	0.167	0.835		
	(	)						
6.5%	(	etc.)			8.100	34.063		
	(	etc.)						
	860 (	)						
2%	860	Inspect	2.20	0.400	0.344	0.757		
7%	843	Slit to 3 1/2"	2.60	0.380	0.320	0.832		
	784	Pack and Ship	2.20	0.050	0.039	0.086	40.82	0.0521
		Total			10.030		61.58	0.0785
		Variance 10%						0.0052
								0.0837
		FORWARD						

Fig. 5.

to be remelted. The mixture value is not altered by this fact and no entries are made in the mill metal accounts to record the flow of scrap. The only entry made for scrap generated in the rolling mill is to debit scrap stores account and credit rolling mill work in process (both toll accounts) with the pounds of scrap, no values being transferred.

The cost illustrated is completed as follows:

Metal	$0.13	per pound
Toll	0.0837	per pound
Factory Cost	0.2137	
Selling and Administrative	0.0200	
Freight	0.0070	
Cash Discount	0.0028	
Total	$0.2435	

COST ACCOUNTING FOR THE CANNING INDUSTRY

By
RALPH H. BARR *

I. DESCRIPTION OF THE INDUSTRY

The function of the fruit and vegetable canning industry is to preserve, in tin or glass containers, fruits and vegetables, such as peaches, pears, cherries, apricots, berries, corn, peas, spinach, asparagus, tomatoes, etc. These may be canned, each variety by itself, or in combinations of more than one variety in the same can for salads and cocktails. The same organization of plant may produce other items, such as jams, frozen fruits and vegetables, dried fruits and vegetables, pickles, canned fish, etc. But this discussion will be confined to canned fruits and vegetables.

There are somewhat unusual features of this industry which have an important bearing on the matter of cost accounting. The contracts for the purchase of the raw product of each variety govern the quantity of that variety which may be packed during the entire year. The harvest season for each crop is short. Usually the raw products are highly perishable. If the benefit of cost controls is to be obtained through economy in packing costs, the information must be available immediately; otherwise the pack will be over before the economies have been put into effect. Likewise prompt decisions must be made as to the style of packing and the sizes of containers. These decisions must be based upon the demand on the one hand, and upon the profitableness of the different products on the other hand; which products, with due regard to the quality of the raw product, will yield the greatest return from the available supply.

Sources of Raw Materials

The raw materials which are used in the canning industry are the following: Raw product, sugar, salt, condiments, spices, and flavorings, and other materials which form an integral part of the finished product; peeling compounds, ripening materials, fuel, water, and other materials which aid in the processing, but do not form part of the finished product; and containers, tin cans, glass jars, shipping cases, labels, and other materials such as glue, wire for strapping, etc. Fuel is inincluded in the direct costs for the reason that it is used to produce steam to cook the products, also to aid in the process of peeling peaches, and not for the production of power.

The raw product is usually purchased directly from various growers. The type of grower and purchasing methods vary both with the district and with the variety of raw product. The raw product may be an annual crop, or the crop from trees having a life of many years. Although some of the product is purchased annually, it is more

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desirable to have term contracts with the growers, thereby assuring a source of supply and avoiding the annual cost of buying. Some canners also grow part of their own crops. While accounting does not generally recognize profits between departments, in connection with crops which the canner may grow on its own orchards or farms, the only practicable basis to value the crop as a credit to the farm operations and as a charge to the canning operations is the market value. With various kinds of raw products grown on one farm, joint costs make the determination of accurate costs by commodities impracticable.

There are few features pertaining to the other raw materials that differ sufficiently from other manufacturing enterprises to require special comment. The policy generally followed is to purchase for the year's requirements only, to avoid the locking up of capital for several months of idleness. This is particularly applicable to the first two groups of raw materials listed. The entire year's pack is not usually sold immediately, some of it may well be held over until the next season's crop is in production. This requires a supply of shipping cases and labels throughout the year.

Organization of the Plant

The production of canned goods requires a purchasing department for the raw product which may or may not be coordinated with the plant management, but there must be close cooperation between them. It is the function of the purchasing department for raw product to keep the relationship with the growers such that the cannery will receive the maximum quality of raw product at the proper prices. This involves signing contracts with the growers competent to furnish the required quantity and quality of raw product, and giving the growers information, advice and instructions as to the production of the crops, particularly with regard to pruning, thinning, and harvesting.

The cannery itself is organized into departments for receiving the raw product, preparing, canning (that is putting the fruit in the cans), cooking, and finally warehousing and shipping. There must be adequate supervision, for upon this depends the quality of the pack, and the economy with which it is packed. There must be planning with the purchasing departments to assure the orderly receipt of raw product in the proper degree of ripeness, to assure a supply of cans adequate for the daily needs but not such a surplus as to require unnecessary handling.

Production Order Systems

Production order systems such as are generally used in manufacturing industries are not required in the same manner in this industry. The plans must be prepared to pack daily what has become available that day, by reason of receipts and condition of the fruit, particularly as to ripeness. The plant should have received earlier instructions as to what product, styles of pack, sizes of containers, and grades it is desirable to pack, with due regard both to the condition, size, and other physical conditions of the fruit, and also to the demand of the consumers and the profitableness of the various items.

Usually crops are harvested but once a year, and the entire productive capacity of the organization is limited to the raw product contracted before the harvest season. Consequently great care must be used in estimating the season's requirements from the sales viewpoint, to see that the product is put into the sizes, grades, and styles on which the margin for profit is highest, consistent with the demand. This is

the major problem in directing the pack. During the packing season care must be taken day by day to see that the budgeted pack is produced. If there is a falling short or a running over, guidance must be exercised so that the shortages are at the point best able to take them, and that the overages relate to items for which the demand, with due regard to relative profits, is highest. This requires constant attention daily given to the pack already put up and the prospective pack out of the raw product yet to be received.

II. How to Design the Cost System

What Information Is Required

The cost accounting department should furnish cost information at three different seasons and for three somewhat different purposes. First, it is quite essential that the sales department be provided with cost estimates before the packing season, to plan their selling campaign and to direct the pack. As the cost per ton of the raw product is not ordinarily finally determinable at this time, this requires the estimates to be based upon raw product costs at varying prices, at intervals of $5.00 or $10.00 per ton.

Second, during the packing season the cost department must furnish the management with costs daily to show how the operating costs are running in relation to the previously prepared standards.

Third, at the close of the season it is necessary to compute the completed standard costs for the various items packed to be used as bases for establishing the profit and loss by varieties of product, for inventory valuations, and also as a comparison with the previously prepared standards as a guide for future estimates.

This industry has one outstanding advantage over most manufacturing industries. This is the fact that to a high degree each day's pack is complete at the close of the working day. The raw product that is processed during the day is usually completely processed during the day. Therefore there is usually either no work in process at night, or, if any, it is likely to be negligible. Complete daily costs may therefore generally be prepared for the entire day's output with no partially completed work to consider. This greatly reduces the mass of detail and makes the preparation of cost information for direct costs simple and inexpensive, and the three groups of cost information mentioned above can be simply and readily prepared.

The production costs of the individual canner usually have little effect on selling prices. In periods free from government price controls, competition largely governs the selling prices, and the effect of cost studies on selling prices is more important on an industry wide basis than from that of an individual canner. However, since sales of considerable volume may be made before the pack, and therefore before actual costs are known, it is essential to have estimated costs as a guide to judge the adequacy of prevailing prices, and to offer the opportunity to book sales in the more profitable items. These are usually prepared on the basis of various estimates for raw product costs.

During the packing season it is necessary to obtain actual costs as the pack is being made. These may be substituted for the estimates as a guide to the selling, but their prime purpose is to control the packing costs. These daily costs are ob-

tained by comparing the actual costs of the various elements with the respective standard costs. The most important elements for which daily costs must be watched are raw product, sugar, and labor, the labor being generally broken down to the preparation, canning, and cooking departments.

The containers—cans or glass jars—and the cases and labels constitute a large part of the direct costs. It is usually unnecessary to compare actual costs of these items with standard costs, for the reason that losses are usually quite low, fairly uniform, and provision for normal wastes is generally made in the cost estimates. Any abnormal loss becomes apparent from the operating side and accounting figures are usually not only unnecessary, but also very difficult to obtain on a daily basis.

Fluctuations in the cost per case for the raw product occur from three causes: variation in the percentages of the various grades, variation in the quantity of raw product used per case (case yield per ton), and variation in the cost per unit of the raw product. It is essential to know what the cost deviations are for each of these factors; otherwise corrections of operating losses cannot be readily made. The cost of collecting this information is relatively inexpensive, compared with the value. Assume the raw product costs $40.00 per ton and a normal yield is 40 cases per ton. This is an average case cost of $1.00. If the yield drops to 38 cases per ton, the average cost per case rises to nearly $1.053 per case. If the day's pack is 10,000 cases, this represents a loss of $530 in cost of raw product alone, plus the extra cost of preparation labor, and the loss of overhead and profits that would have been earned on the two cases per ton, had they been produced and available for sale. A loss of two cases per ton in yield can go undetected without cost controls. Grade losses may also be undiscovered and serious in amount.

Cost information during the pack must be current to be of value. The pack of certain varieties lasts only a few days, and few varieties last more than 60 days. Unless the information is available daily as the pack is going on, it is too late to effect economies by the control of unnecessary wastes and losses.

Final costs prepared after the pack is over are produced in much the same manner as the estimated costs, actual total costs for the various elements being substituted for the estimates.

Considerations in Designing the System

A peculiarity of the canning industry is that a large portion of the costs are "joint costs." With the exception of the labels and containers, nearly every element of cost must be figured as a joint cost. It is usually impossible to follow a specific lot of fruit or vegetables from the receiving department to its ultimate destination in the cans. Certain of the costs are "joint" costs as between varieties, and others are "joint" costs as between sizes, grades, and styles of pack within a variety. Great care and good judgment are required to apportion these joint costs intelligently.

Undoubtedly the simplest way to segregate the joint costs to the specific varieties, sizes, and grades to which they logically belong is to prorate on the bases of preconceived standards. These standards should be compiled to show both the quantities and the cost of raw product and materials required for the various packs. The standard quantities can usually be used from year to year, being modified only as packing standards change or other unusual conditions arise to require changes.

The profit-and-loss statement should be arranged to show the net profit by varieties, together with the details giving the net result. This requires a segregation by varieties of sales; of deductions from sales such as brokerage, cash and other discounts and allowances; and of the cost to the canner of outgoing freight to get the net returns from sales.

The cost of goods sold must then be compiled by varieties, which involves the segregation of the inventory at the beginning of the period, the cost of purchases of finished goods, the cost of goods packed, the shipping costs, and the closing inventory of finished goods. The cost of goods packed should be broken down into direct factory costs, and indirect factory expense. Finally there must be a segregation of the general overhead expenses. When certain varieties show final net losses, it does not follow that it would be wise to discontinue their production. From the cost standpoint and irrespective of matters of sales policy, the item should be discontinued only if it results in a final decrease in net profits. The final net profits will be decreased only if the net loss shown by the variety is greater than the total amount of fixed overhead which it has absorbed. Stated from a different viewpoint, a variety showing a net loss still contributes something to the net profit if the net returns are greater than the direct costs and expenses which could be saved by the discontinuance of producing the variety.

Considerations Relating to Overhead

The canning industry is a highly seasonal one. The direct costs reach a high peak during certain seasons of the year and drop almost to nothing during other seasons. The factory and general overhead expenses on the other hand are on a yearly basis, either they tend to be uniform through the year or they are incurred only occasionally through the year but without any relation to the amount of direct costs incurred. It is necessary that the total factory indirect expense for the year be prorated over the total packing direct costs for the year. In order to obtain the correct amount of factory indirect expense to be charged in the costs it is necessary to prepare an estimate of the anticipated factory expenses for the year and an estimate of the direct packing costs for the year, and then determine the percentage of the indirect factory expenses to the total direct costs. This percentage can be estimated with a very satisfactory degree of accuracy if it is given the proper attention. The amount of factory indirect expense to be charged to each item is obtained by applying this percentage to the total direct costs.

The basis on which the factory indirect expenses should be spread is assumed here to be the total direct packing costs. This is generally the most suitable method, although it has certain objections. One of the major objections is the fact that the cost per ton of raw product varies widely for different varieties, and from year to year with the same variety. Taking depreciation as an example and to the extent that it is caused by the *use* of equipment there is considerable objection to charging it to the different varieties on a basis that may include berries at $250 per ton and to vegetables at $20.00 per ton. Even this, however, has some logic. Depreciation and the other indirect expenses are joint costs and the ability to bear these joint costs may be the most equitable basis. On this basis the higher priced items are likely, although not necessarily so, to have the greater ability to stand the indirect costs.

Sometimes superintendent's salaries and indirect labor are charged to the items

in proportion to the direct labor. This makes a second prorating, and should have considerable merit to justify it. There are some distinct objections to this method. With the use of labor-saving machines the labor cost of some varieties is reduced very materially compared with those requiring hand labor. This method seems to favor unduly those varieties having the low labor cost, for the amount of effort the superintendent has to give to the quality of the pack, obtaining necessary materials and supplies, and watching the packing program is not affected by the use of machines instead of hand labor.

The general and administrative expenses are generally prorated on the basis of sales. A similar yearly estimate is necessary for these expenses as for factory indirect expenses to determine the percentage that these will be to sales for the year. When selling prices are known the amount of these expenses is obtained by applying the proper percentage. Brokerage, cash, and other discounts and allowances are usually known quite accurately and bear a fixed percentage to the selling price. Expenses of the sales department are most conveniently handled as part of the general and administrative expenses.

In the preparation of the yearly profit-and-loss account, the factory indirect expense is absorbed by the year's pack, as previously mentioned, but the general and administrative expenses and also the brokerage, cash discounts and allowances are prorated over the year's sales. The inventory at the end of the year, if based on costs, carries its proper portion of the factory indirect expense, but the administrative expense is all charged off against the sales made during the year, which usually will be part of the preceding year's pack, plus a major part of the current season's pack. Eventually the sales of the unsold part of the current year's pack will have to stand its portion of the administrative expense of the year in which sold. For the basis of cost estimates the use of the previous year's experience for determining the percentage to be added is fairly accurate. However any known variations should be provided for.

A Modification of the "Standard Cost" System Is Favored

It is doubtful whether the cost accounting method herein outlined is strictly speaking a "standard cost" method. It is a method which uses previously prepared standards as a basis for prorating actual total costs to the items produced. Due to peculiarities of the industry the fluctuations of the costs can be very high, and they do not necessarily reflect the difference in the capability of the management. Raw product prices can change materially after standards are prepared, and the condition of the fruit both as to size and quality can make tremendous differences in the cost of the pack. Variances of this kind appear to be legitimately part of the cost of production and not properly charged or credited to a variance account. These variances may greatly exceed the variances due to the competence of the management, and there does not seem to be sufficient advantage to warrant separating these variances. To the extent that the variances are due to case and fruit yields, it would be difficult to determine what portion was due to management and what portion due to crop conditions.

III. Description of the Cost System

Because of limitations of space most attention will be given to the preparation of the standard schedules, their use in calculating the daily costs, and the comparison of the daily costs at standard rates with the actual costs. The accounting records must be so designed that the weight and cost of raw product by varieties are available daily, together with the weight carried over at night. There must be a record of sugar used each day. This requires a record of the weight of sugar which has been dumped into the syrup kettles during the day, and a record at the close of the day of the sugar on hand in the form of unused syrup. Tables show the weight of sugar per gallon of syrup of the various degrees. Other tables should be prepared to show the gallons of syrup in each tank, per inch or fraction of syrup remaining in the tank. This reduces to a minimum the work required to calculate the quantity of sugar used in the day's pack, from which the cost is obtained at the average cost per pound.

Daily time cards must be used to record the time worked during the day and, in case of piecework, the quantity of work produced. The piecework cards are printed with small squares numbered consecutively from "0" up, the squares being punched out consecutively to record each unit of work performed. The lowest unpunched number at any time shows the quantity of work produced. Day work labor should be segregated to departments, receiving, preparation, canning, cooking, and warehouse. The piecework cards for preparation labor should be tabulated according to variety of raw product, and classified according to the operation performed.

How the Standards are Created

The standards for the cost of the raw product must recognize the "going-in" weight, that is, the weight of the prepared raw product in the can plus the wastes in preparing the product. These wastes arise from the loss in weight by pitting, peeling, removing seeds, etc. There is also a factory waste arising from spillage and also a shrinkage in the weight of the fruit between the time of harvesting and the time of packing. There are also special wastes in certain processes. On fruits the style of packing may be whole, halves, sliced, or diced. The fruit may also be peeled or unpeeled. There may be a different weight in the can for "whole" fruit from "halves," the latter having a tendency to nest in the can, thereby requiring a greater weight of contents to fill the can than the whole fruits. This differential is greater as the diameter of the fruit increases or as the size of the can decreases. The wastes just mentioned vary for the different kinds of raw products, for the methods of preparation, and for the size of the fruit. They are not susceptible of exact determination, yet the average can be ascertained by tests with a very satisfactory degree of accuracy.

Fruits and vegetables are usually packed in various grades, depending upon the quality. On fruits the grade is determined by color, firmness, perfection in workmanship, size, ripeness, etc. Typical grades are Fancy, Choice, Standard, Seconds, Water, and Pie. There is a differential which the consumer will pay, or is willing to pay for the higher grades, and which he will not pay for the lower grades. Usually the price which may be obtained for the lower grades will not pay for all the added costs of packing, cans, cases, sugar, etc., and leave sufficient to compen-

sate for the average cost per ton for the raw product. The price is, however, usually high enough to pay for the added out-of-pocket costs (cans, cases, sugar, etc.) and leave something toward paying for the raw product, and perhaps overhead. It therefore pays to salvage this low-grade fruit if it sells for more than the out-of-pocket added costs. However the deficiency by which these low grades fail to pay these added costs *plus the average cost of the raw product* is in effect nothing more than an added cost of the higher grades. It is impossible to purchase fruit which will yield uniformly the highest grade only, and the loss on the lower grades of necessity received with the higher grades is in effect part of the inevitable cost of packing the higher grades.

Preparation of the Standards

Exhibit 1 shows the calculation of the standard cost for the raw product. This is the most complicated element of cost to figure. After this is understood the preparation of the other standards becomes simple. The figures are illustrative only because actual figures of wastes, costs per ton and grade yields will vary widely for different kinds of fruits and vegetables, but the principles involved are quite similar.

Section 1 estimates the required weight of raw product for a case from the known factor of ounces per can of pitted and prepared fruit actually put in the can. Pie grades are packed in several ways and there is usually an added waste (not shown in these figures) depending upon the method of processing.

Section 2 calculates the cost of the raw product per case for the various grades. It is important to bear in mind that, although the same price is paid for the entire crop, irrespective of grades that may come from it, it is necessary to apportion the cost of the various grades that are obtained in the packing in some relation to the realizable value of the pack in the various grades. The differentials shown are arbitrary but have been widely used for many years on peaches and pears, the differential on pie pears being 20 instead of 50. This schedule is calculated on an assumed cost per ton delivered of $80.00 for the raw product, which has to be apportioned over the various grades in the ratio of the relative grade values shown. If it were possible to pack all the fruit in fancy grade, the average cost would be 4 cents a pound. If all the fruit had to go to the pie grade, the cost would also be 4 cents a pound. By reason of the high percentage of fancy and choice grades compared with the low percentage of seconds, water, and pie grades, the average value

EXHIBIT 1

PREPARATION OF STANDARD COST PER CASE FOR RAW PRODUCT

SECTION 1

Weight Required per Case

Size Container	Weight of Contents Oz. per Can	Ratio: Lbs. per Case to Oz. per Can	Net Contents Lbs. per Case	Gross Weight Required lbs. per Case
24/2½	19	1.500	28.50	36.80
6/10	70	.375	26.25	33.90
6/10 Pie	110	.375	41.25	53.27
24/2	13	1.500	19.50	25.18

The gross weight per case is the raw weight of fruit or vegetables as received and paid for required to pack a case. In the figures above 36.80 pounds must be purchased in order to obtain 28.50 pounds of prepared fruit to fill the can. These weights are based on estimated losses of 12% for pitting and 12% for peeling. Since 100 pounds of raw product on this assumption yield only 88 pounds of pitted fruit, and 100 pounds of pitted fruit yield only 88 pounds of peeled fruit, the yield of pitted and peeled fruit from 100 pounds purchased is 0.88 multiplied by 0.88, or 0.7744. Since, in the preparation of these schedules, the net weight is known, the gross weight is obtained by dividing the net weight by 0.7744.

SECTION 2

CALCULATION OF COST OF RAW PRODUCT PER POUND FOR EACH GRADE

Grade	Estimated Per cent Each Grade To Be Obtained	Relative Grade Value	Product	Average Grade Cost per Ton	Average Grade Cost per Pound
Fancy	8	130	1040	100.8729	0.0504360
Choice	43	115	4945	89.2338	0.0446169
Standard	32	100	3200	77.5946	0.0387973
Seconds	5	75	375	58.1960	0.0290980
Water	6	75	450	58.1960	0.0290980
Pie	6	50	300	38.7973	0.0193987
	100		10310		

This table is based on an assumed delivered cost of the raw product of $80.00. Since the standard grade is placed at 100% and, by reason of high-grade yields, the average grade price is 1.0310 of cost, the cost for the standard grade is $80.00 divided by 1.0310, which is $77.5946 per ton. Other grade costs are obtained by multiplying this figure by the relative grade values shown.

SECTION 3

PREPARATION OF STANDARD COST PER CASE FOR RAW PRODUCT

Size	Gross Weight per Case	Cost per Case of Various Grades at Grade Prices Shown Below from Section 2, and at Gross Weights per Case from Section 1					
		Fancy 0.0504360	Choice 0.0446169	Standard 0.0387973	Second 0.0290980	Water 0.0290980	Pie 0.0193987
24/2½	36.80						
6/10	33.90	1.85604	1.64190	1.42774	1.07081	1.07081	
6/10 pie	53.27	1.70978	1.51251	1.31523	0.98642		1.03337
24/2	25.18	1.26998	1.12345	0.97692			

of the prospective pack as shown in the column in section 2 headed "Product" is 103.10%. The effect of this is to reduce the cost of each grade. If the percentages were such that the sum of the product column added to exactly 100, the cost of the standard grade would have been $80.00 With these percentages the cost of the standard grade becomes $77.5946 ($80.00 divided by 103.10). The average cost

per ton of the other grades is obtained by multiplying $77.5946 by the respective relative grade values.

Section 3 computes the cost of the raw product per case for the various grades and sizes of containers by multiplying the gross pounds required per case as shown in the first section by the relative grade price per pound.

The schedule for the standard cost of sugar is obtained by multiplying the number of pounds of sugar required per case by the average cost of sugar per pound. The number of pounds of sugar required per case is calculated by taking the quantity of syrup per case in gallons and multiplying by the pounds of sugar per gallon according to the degree of syrup.

The standard for preparation labor and receiving labor are based upon the pounds of raw product per case. The standards for canning and cooking labor are based upon time studies showing the relative time required for a case of the various sizes.

The standard for the cost of containers should be increased by a small amount, usually ½ or ¼ of 1% to cover the inevitable loss. With the inclusion of this provision for factory losses the standard may be used for the actual cost during the season, to be corrected at the close of the year's pack.

When these schedules of standard costs are prepared for the various elements, they are summarized to show a total direct cost per case. This figure is used in determining the efficiency of the day's operations. These standards are also used from time to time as a basis from which to prepare estimates of actual costs. To the direct costs there must be added shipping costs, and percentages for factory indirect expense and general administrative expenses.

Whether shipping cases and labels and the labor involved in casing, labeling and shipping should be included in the direct packing cost or should be added as shipping costs depends upon the nature of the operations. If casing and labeling is done immediately and the goods go into the warehouse ready for shipment, then the cost of cases and labels and warehouse labor should be added to the direct cost. With many canners, however, the type of business does not permit immediate labeling. In this case it is simpler to confine the daily cost controls to the direct packing costs, to and including the cost of cooking, but omitting the shipping cases, labels, and other shipping costs.

Exhibit 2 combines the standard costs from the various schedules into a total of standard direct cost for use in comparing the daily actual costs with the standards.

EXHIBIT 2. SUMMARY OF STANDARD COSTS

QUANTITIES	24/2½ Fancy	24/2½ Choice	24/2½ Standard	6/10 Fancy	6/10 Pie	24/2 Fancy	24/2 Choice
Gross Weight Per Case							
Raw Product	36.80	36.80	36.80	33.90	53.27	25.18	25.18
Sugar	9.33	6.35	3.72	8.10		6.29	4.28
COSTS							
Raw Product	$1.8560	$1.6419	$1.4277	$1.7098	$1.0334	$1.2700	$1.1235
Sugar	0.4280	0.2913	0.1706	0.3715		0.2885	0.1963
Receiving and Preparation Labor	0.1892	0.1892	0.1892	0.1743	0.2876	0.1294	0.1294
Canning Labor	0.2600	0.2600	0.2600	0.1680	0.0600	0.2500	0.2500
Cooking Labor	0.1000	0.1000	0.1000	0.0700	0.0700	0.1000	0.1000

Miscellaneous Items for which Daily Comparisons Are Not Necessary:							
Containers	0.6000	0.6000	0.6000	0.3700	0.3700	0.5000	0.5000
Peeling Compounds	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Royalty and Expense of Labor Saving Equipment .	0.0469	0.0469	0.0469	0.0432	0.0679	0.0321	0.0321
Fuel, Water and Power	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300
Total Miscellaneous Items ..	0.6819	0.6819	0.6819	0.4482	0.4729	0.5671	0.5671
Total Direct Costs	$3.5151	$3.1643	$2.8294	$2.9418	$1.9239	$2.6050	$2.3663

Exhibit 3 shows the method by which the total standard cost for the various elements of direct costs, and for the total direct costs, is calculated for the entire pack.

The calculation of the total standard costs for the day's pack is shown in Exhibit 3. The first two columns show the items packed for the day, the number of cases packed of each, and the total pack. The other columns show the total standard costs for the elements of cost for which standard cost comparisons are required, and the total standard direct cost of $46,263.91. The lower part of the schedule shows the total standard weight of raw product and of sugar, and also the grade yields actually produced out of the day's pack. Note that the grade yields are considerably higher (that is the percentages are greater for the higher grades, and lower for the lower grades) in this illustrative pack than the estimated grade yields on which the standards were constructed as shown in Section 2 of Exhibit 1.

Exhibit 4 shows the comparison of the actual and the standard costs for the various elements and for the total costs, the amount of the variation in weights and amounts being shown and also the percentage of variation. The quantities in the "Actual" column are taken from the daily record of actual costs, the labor is compiled from the daily time cards, the fruit from the record of actual fruit consumed valued at the estimated actual cost delivered to the plant, and the sugar from the actual quantity used, priced at the average cost per pound. The item "all other costs" comprises the other elements of direct costs, such as cans, fuel, power, water, rental and royalties on labor saving equipment, etc. These costs may not be subject to sufficient variations which can be controlled to justify daily comparisons, and the actual cost may be taken as being the amount of the standard cost, during the packing season, assuming that in the standard sufficient allowance has been made for normal wastes and losses.

As these figures indicate, the cost of raw product is generally the most important item, and justifies careful examination as to the reasons for variations. These variations can be caused by the quantity of fruit used, the relative percentages of grade yields, and the average cost per pound. In this illustration the cost of the raw product has been "over" $440.29, that is, the actual cost has exceeded the standard cost by $440.29, which is an excess of 1.844%. However, the pounds of raw product used were "over" 28,948, an excess of 5%. The cost of fruit per pound has been figured at the same price as used in the schedule, that is 4 cents per pound. It is evident that the grade yields must have been better than the standards to give a final result of only an excess of 1.844% when the weight of actual raw product used exceeded 5%. This can be proved readily. At the bottom of Exhibit 3 is a summary of the standard weights by grades and the relative percentages. Valuing

EXHIBIT 3

CALCULATION OF TOTAL STANDARD COSTS BY ELEMENTS

Size and Grade	Cases Packed	Raw Product Cost Per Case	Raw Product Total Cost	Sugar Cost Per Case	Sugar Total Cost	Preparation Labor Cost Per Case	Preparation Labor Total Cost	Canning Labor Cost Per Case	Canning Labor Total Cost	Cooking Labor Cost Per Case	Cooking Labor Total Cost	All Other Costs Cost Per Case	All Other Costs Total Cost	Total Costs Cost Per Case	Total Costs Total Cost
		$	$	$	$	$	$	$	$	$	$	$	$	$	$
2½ Fancy	995	1.8560	1,846.72	0.4280	425.86	0.1892	188.25	0.26	258.70	0.10	99.50	0.6819	678.49	3.5151	3.497.52
Choice	6,784	1.6419	11,138.65	0.2913	1,976.17	0.1892	1,283.53	0.26	1,763.84	0.10	678.40	0.6819	4,626.00	3.1643	21.466.59
Stand.	5,045	1.4277	7,202.75	0.1706	860.68	0.1892	954.51	0.26	1,311.70	0.10	504.50	0.6819	3,440.18	2.8294	14,274.32
10 Fancy	734	1.7098	1,254.99	0.3715	272.68	0.1743	127.94	0.168	123.31	0.07	51.38	0.4482	328.98	2.9418	2.159.28
S. P. Pie	946	1.0334	977.59			0.2876	272.07	0.06	56.76	0.07	66.22	0.4729	447.36	1.9239	1,820.00
2 Fancy	261	1.2700	331.47	0.2885	75.30	0.1294	33.77	0.25	65.25	0.10	26.10	0.5671	148.01	2.6050	679.90
Choice	1,000	1.1235	1,123.50	0.1963	196.30	0.1294	129.40	0.25	250.00	0.10	100.00	0.5671	567.10	2.3663	2,366.30
Total	15,765		23,875.67		3,806.99		2,989.47		3,829.56		1,526.10		10,236.12		46,263.91

CALCULATION OF TOTAL STANDARD WEIGHTS OF RAW PRODUCT AND SUGAR

Size and Grade	Cases Packed	Raw Product Weight Per Case	Raw Product Total Weight	Sugar Weight Per Case	Sugar Total Weight
2½ Fancy	995	36.80	36,616	9.33	9,283
Choice	6,784	36.80	249,651	6.35	43,078
Stand.	5,045	36.80	185,656	3.72	18,767
10 Fancy	734	33.90	24,883	8.10	5,945
S. P. Pie	946	53.27	50,393		
2 Fancy	261	25.18	6,572	6.29	1,642
Choice	1,000	25.18	25,180	4.28	4,280
	15,765		578,951		82.995

GRADE YIELDS

Grades	Actual Weights	Per Cent by Grades
Fancy	68,071	11.7577
Choice	274,831	47.4705
Standard	185,656	32.0677
S. P. Pie	50,393	8.7041
	578,951	100.0000

these at the relative grade values used in the preparation of the standards gives a total value of 106.29578, as shown below:

Grades	Weights	Per Cent of Grades	Relative Grade Value	Product
Fancy	68,071	11.75764	130	15.28493
Choice	274,831	47.47052	115	54.59110
Standard	185,656	32.06765	100	32.06765
Pie	50,393	8.70419	50	4.35210
	578,951	100.00000		106.29578

Exhibit 1 shows that the estimates were based on an aggregate value of 103.10. Since the actual grade yields achieved result in a product of 106.29578, the grade yields have been more favorable than the estimates, reducing the cost of the raw product to 96.994% of the estimate. This is obtained by dividing 103.10 by 106.29578.

The cost of the raw product due to grade yields was 96.99% of normal but the cost due to weight used was 105% of normal. The product of these two percentages is 101.844%, the actual cost compared with the standard. It is important to know these cost variations for each day's operations so that corrections may be applied promptly as necessary. However it is also very essential to know what the total costs are from the beginning of the pack (for the variety) and their variations as well as the variations for the day alone. This is readily accomplished by accumulating the total costs by elements both standard and actual in parallel columns, along with the daily comparisons. The totals to date are accumlated by adding the day's figures to the cumulated totals for the previous day. The total actual costs for the season to date are used at the completion of the pack as the charge to Finished Goods.

A separate cost schedule as illustrated in Exhibit 4 is prepared daily for each variety packed. When the variety of raw product is used for canning and freezing or drying, a separate cost record should be kept for each kind of preserving, which will require an appropriate segregration of the cost of the raw product to each group.

The seasonal figures are important for two reasons. Daily costs tend to fluctuate, and only through the seasonal figures can the result for the complete pack as it progresses be determined. Also daily figures are subject occasionally to inevitable errors which correct themselves as the season progresses. This is sometimes difficult to avoid in the weight of raw product used when the inventory on hand at night is large compared with the quantity used during the day. A slight error in estimating the average weight per box in the inventory is materially exaggerated in the quantity run during the day if the number of boxes of raw product run is much smaller than the number of boxes in the carry-over.

From the ratios shown in the "Season to date" section of Exhibit 4 it is simple to prepare the cost on any individual item of pack desired, or for all items packed, if desirable. It is usual to prepare daily the cost of the most typical item packed for each variety.

Exhibit 5 shows the method, taking the standard costs for Size 24/2½, Choice Grade as shown in Exhibit 2, and adjusting them to the actual costs as shown by

EXHIBIT 4

	Today Only				Season to Date			
Costs	Standard	Actual	Ratio	Over* or Under	Standard	Actual	Ratio	Over* or Under
Raw Product	$23,875.67	$24,315.96	1.9184	$440.29*	$332,900.30	$345,750.25	1.0386	$12,849.95*
Sugar	3,806.99	3,768.92	0.9900	38.07	54,156.00	53,343.66	0.9850	812.34
Preparation Labor	2,989.47	2,840.00	0.9500	149.47	39,721.34	38,768.03	0.9760	953.31
Canning Labor	3,829.56	3,772.12	0.9850	57.44	52,175.98	53,605.60	1.0274	1,429.62*
Cooking Labor	1,526.10	1,649.71	1.0810	123.61*	21,398.47	22,470.53	1.0501	1,072.06*
All Other Costs	10,236.12	10,236.12	1,0000		143,305.68	143,305.68	1.0000	
Total	$46,263.91	$46,582.83	1.0069	$318.92*	$643,657.77	$657,243.75	1.0211	$13,585.98*
WEIGHTS								
Raw Product	578.951	607,899	1.05	28.948	8,105,314	8,267,420	1.0200	162,106*
Sugar	82,995	82,166	0.99	829	1,180,634	1,162,925	0.9850	17,709

* Over indicates that actual costs are running over the standard and is an unfavorable factor.

the ratios in Exhibit 4, for the total direct costs. To these are added shipping costs, factory indirect expense, and general and administrative expense. These are added at the amounts estimated for the season, subject to corrections from time to time as more accurate information is available.

To determine the profit on any item the total cost as shown in Exhibit 5 is deducted from the net selling price, that is, the selling price less discounts and allowances to the buyers, and less brokerage.

EXHIBIT 5

SIZE 24/2½ CHOICE GRADE

	Standard Cost	*Ratio*	*Actual Cost*
Raw Product	$1.6419	1.0386	$1.7053
Sugar	0.2913	0.9850	0.2869
Containers	0.6000	1.0000	0.6000
Peeling Compounds	0.0050	1.00	0.0050
Labor:			
Preparation	0.1892	0.9760	0.1847
Canning	0.2600	1.0274	0.2671
Cooking	0.1000	1.0501	0.1050
Rental and Royalties on Labor-Saving Equipment	0.0469	1.0000	0.0469
Fuel and Water	0.0300	1.0000	0.0300
Total Direct Packing Cost	3.1643	1.0069	3.2309
Cases, Labels and Shipping Labor and Expenses			0.2500
Total			3.4809
Factory Indirect Expense 6%			0.2088
Total Packing and Shipping Cost			3.6897
General and Administrative Expenses 5%			0.1845
Total Cost Exclusive of Selling Expenses and Allowances to Buyers			$3.8742

General and administrative expenses are treated as being proportionate to sales, rather than to packing costs, and in the preparation of annual profit-and-loss accounts should be so handled. In preparing estimated costs, however, it is convenient to add these expenses to the direct costs as shown, the percentage being determined as the relation of the year's general expenses to the year's direct costs. This in effect applies a portion of the current year's general and administrative expenses to the following year, to the extent of the portion applicable to the goods not sold until the following year, whereas, in the preparation of the annual profit and loss account, the entire year's expense will be charged off currently.

In calculating the final costs for the year it is very essential that they be prepared from the accounts as stated in the ledger, being sure that all expenses have been charged to the proper manufacturing and other accounts. Unless the expenses and packing costs are obtained from the ledger, it is altogether too likely that they will be based on estimates which will prove to be unreliable through oversight and failure to obtain all the expenses involved.

COST ACCOUNTING IN COTTON MILLS—YARN AND CLOTH MANUFACTURING

By
ROGER A. SEEBE *

I. DESCRIPTION OF THE INDUSTRY

The manufacture of cotton yarn and cloth is a very specialized industry and also one in which the manufacturing methods are quite generally standardized.

Since the introduction of power driven machines for the carding and spinning of cotton and the weaving of cloth, there have been no revolutionary changes in methodology. There have, however, been improvements in machine design, resulting in more efficient operation and, in some instances, greater operating speeds.

Many cotton mills perform the full cycle of operations beginning with opening the baled cotton, as it comes from the gin, to packing the finished cloth. Different mills will specialize in particular qualities or weights or widths. In other words, the product of most mills (except the very large ones) is usually of a limited variety.

The quality of the yarn and the resulting cloth is determined by the types of raw cotton used in each mix or batch. For lower grades of cloth, where strength is not a prime requirement, some of the waste cotton is reclaimed and used in conjunction with raw cotton in preparing the mix. For the best grades of cloth only high-grade cotton is used. Of the technical phases of cotton mill operation, the proper grading of raw cotton and the determination of the mix formula are important.

Materials needed, in addition to the cotton, are sizing and starch, used in slashing the warp yarn, and burlap and tubes for packaging the finished product. Some mills manufacture their own burlap from waste cotton.

Organization of Mill

A typical cotton mill would comprise departments as follows:

SERVICE DEPARTMENTS:

Power	To supply and distribute power for driving machines and for illumination. Also to supply steam for slashing and heating.
Humidifying	To provide the proper moisture content in required areas and maintain such equipment.
Machine Shop	For maintenance and repairs.
Warehouse	For storing and handling cotton.
Drayage	Automotive equipment and services.
Village	Many mills own and maintain living quarters and recreation halls for the employees for which a nominal rent may be charged.

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PRODUCTIVE DEPARTMENTS:

	Process	*Equipment and Facilities*
Carding	*Opening* cotton bales; *picking,* in which the tightly packed fibers are separated and dirt removed, leaving cotton in long rolls called laps; *carding,* in which the fibers are laid parallel and some short fibers are removed, leaving cotton in long slivers about 1 inch in diameter; *drawing,* where six slivers are combined into longer slivers of same diameter; *slubbing* or *speeding,* in which the slivers are drawn and twisted into rovings.	Openers, pickers, cards, drawing frames, slubbers, and speeders. Derricks, trucks and roving cans for handling the product. Blowing equipment may be needed to convey the opened cotton to the pickers.
Spinning	*Spinning* the rovings into yarn; *winding fill yarn on spools* suitable for use in loom shuttles; *winding warp yarn on beams.* If multiple-ply yarn is needed, two or more strands of yarn are *twisted* together.	Spinning frames, yarn twisters, spoolers, and warpers. Also derricks and trucks for handling the product.
Weaving	Coating the warp yarn with sizing (*slashing*); *drawing* the ends of the warp yarn through the loom heddles and through the reed dents; for repeat styles where the threads were previously drawn through, ends of a new supply of warp yarn are *tied-in* to the loose ends in the heddles; *weaving* the cloth.	Slashers, drawing-in frames, tying-in frames, and looms. Derricks and trucks for handling.
Cloth	Inspecting cloth; trimming loose threads; stitching pieces together; brushing; folding; baling; packing.	Inspecting frames, stitching machines, brushers, folders and balers. Derricks and trucks for handling.

Cotton mills fall under the category of a continuous process industry. In an ideal layout, where a mill is considered "balanced" all departments work at uniform capacity, so that there will be no large overstocking or no shortages at any stage of the operations. Sometimes, to keep a mill "balanced," one or more productive departments must work overtime or on a second shift.

Throughout the various stages of operations considerable waste occurs. It is important that this waste be properly reclaimed and controlled, because its volume determines the efficiency of both the cotton buyer (for quality) and the plant overseers (for efficient operation). Also, most waste is salable or can be reused. The type of waste and its market value depends upon the operational stage at which the waste occurs. There is also a certain amount of invisible waste which must be considered.

II. How to Design the Cost System

What Information Is Required

The cost system should be established to give the following information:

1. Standard cost-over-cotton of every yarn or cloth being produced.
2. Record of actual production and actual expenses incurred, and comparison with standards.
3. Application of variances from standards to provide actual costs.
4. Computation of "quotation" costs of any construction under consideration but not being produced.

The "Standard Cost" System Is Favored

Cotton mill operations lend themselves readily to a standard cost system of accounting. The nature of the product and its processes are such that output per unit of time can be fairly accurately predetermined as to count of yarn or construction of cloth. Likewise, the costs can be predetermined for any yarn count or any cloth construction, because the labor cost and overhead costs are ascertainable at any stage of operation per unit of time. The labor rates for the various occupations are usually uniform, and all labor classifications are well defined as to duties.

Considerations in Designing the Systems

In order to establish such a cost system, it will be necessary first to determine the normal capacity desired and whether the mill will be "balanced." If overtime or a second shift is required to establish a "balance," this must be considered in setting the budget. Based on such normal capacity, an annual budget must be determined. This budget should show labor and expense costs for each major type of equipment (cost center) to arrive at equipment rates per unit day. The "units" are either machines; deliveries (for drawing frames); or spindles (for slubbers, speeders, spinning frames and spoolers). A typical budget summary and equipment rate schedule is shown in Figure 1.

The labor costs are determined for each type of equipment, based on weekly rates of number of employees needed for the chosen normal capacity. Some indirect laborers, such as fixers, can be allocated directly to the equipment; others would be allocated in ratio to direct labor in each department. Labor in service departments is considered a part of expense.

The allocation of mill expense by type of equipment requires the determination of the following:

Book value of all equipment	—For distribution of repairs and general supplies; depreciation; realty taxes and fire insurance; and service departments (except power and humidifying).
Rated horsepower of all equipment	—For distribution of electric power.
Area covered by all equipment	—For distribution of heating, lighting, and humidfying.

Summary Annual Mill Expense Budget and Equipment Rates

Based on 50 weeks of forty hours

Department and Operation (Cost Centers)	Annual Budget				Equipment Deliveries in Place	Annual Productive Basis		Equipment Rates per Unit Day		
	Direct Labor	Indirect Labor	Expense	Total		Unit Days	Unit	Direct Labor	Indirect Labor	Expense
Carding * —Openers	$ 9,000	$ 6,000	$ 8,000	$ 23,000	4	2,000	Machine	$ 4.500	$ 3.000	$ 4.000
Pickers	7,000	5,000	16,000	28,000	10	5,000	Machine	1.400	1.000	3.200
Cards	25,000	12,000	28,000	65,000	180	90,000	Machine	0.278	0.133	0.311
Drawing	15,000	5,000	11,000	31,000	360	1,800	100 Deliveries	8.333	2.778	6.111
Slubbers	17,000	6,000	10,000	33,000	1,800	9,000	100 Spindles	1.889	0.667	1.111
Speeders	37,000	11,000	18,000	66,000	5,100	25,500	100 Spindles	1.451	0.431	0.706
Spinning *—Fill Spinning	27,000	6,000	15,000	48,000	5,200	26,000	100 Spindles	1.038	0.231	0.577
Warp Spinning	100,000	40,000	80,000	220,000	34,000	170,000	100 Spindles	0.588	0.235	0.471
Twisters	35,000	10,000	25,000	70,000	9,300	46,500	100 Spindles	0.753	0.215	0.538
Spoolers	25,000	10,000	15,000	50,000	1,000	5,000	100 Spindles	5.000	2.000	3.000
Warpers—Low speed.	4,000	2,000	3,000	9,000	4	2,000	Machine	2.000	1.000	1.500
High speed	9,000	6,000	5,000	20,000	2	1,000	Machine	9.000	6.000	5.000
Weaving —Slashers	7,000	6,000	75,000	88,000	7	1,750	Machine	4.000	3.429	42.857
Drawing-In	2,000	200	1,000	3,200	1	250	Machine	8.000	0.800	4.000
Tying-In	6,000	800	3,000	9,800	2	500	Machine	12.000	1.600	6.000
Looms—40″	50,000	30,000	34,000	114,000	420	105,000	Machine	0.476	0.286	0.324
46″	12,000	7,000	7,000	26,000	78	19,500	Machine	0.615	0.359	0.359
54″	10,000	3,000	3,000	16,000	35	8,750	Machine	1.143	0.343	0.343
64″	45,000	28,000	38,000	111,000	290	72,500	Machine	0.621	0.386	0.524
Cloth —Inspectors	28,000	9,000	8,000	45,000	20	5,000	Machine	5.600	1.800	1.600
Stitchers and Brushers	7,000	2,000	3,000	12,000	3	750	Machine	9.333	2.667	4.000
Folders and Baler	2,000	700	1,000	3,700	1	250	Machine	8.000	2.800	4.000
Packing and Marking	5,000	1,300	18,000	24,300	1	250	Job	20.000	5.200	72.000
	$484,000	$207,000	$425,000	$1,116,000						

*** Carding and Spinning departments budgeted at two shifts per day.**

Fig. 1.

Payroll taxes and compensation and group insurance would be distributed on basis of total labor. Special charges and credits, such as roller coverings, starch, loom harness and shuttles, burlap, coal, village income, etc., must be ascertained on basis of past experience and estimated requirements. These must be allocated to specific equipment or service departments.

After the basic data underlying such a budget are once ascertained, the budget and equipment rates per unit day can easily be revised whenever there is a substantial change in the set-up.

The next step is to set standard cost rates per pound for each size of product at each operation. The standard production per eight-hour day must be ascertained, in pounds per equipment unit. For this purpose it will be necessary to obtain basic data relating to the equipment, such as roller speeds and diameters, and normal stoppages during eight-hour day for creeling, doffing, cleaning, etc. The speeds and diameters on most machines determine the *size* or *count* of the product. On some operations, the *quality* of the cotton will affect the rate of production. After the standard production per day is once ascertained for each size of product, such data will remain unchanged unless some new equipment is obtained or a change in processes is made.

To obtain the standard direct labor cost per pound for each size at each operation, it will be necessary to gather data for each direct labor classification; rates of pay and number of pieces of equipment tended by each man. Many of the jobs are paid on piecework basis, such as "frame hanks," or "sides" or "picks." Except in the case of learners, practically all jobs are usually at uniform rates of pay. From this direct labor data, the standard labor cost per day is obtained which, divided by the standard production per day, will give the standard cost per pound.

To obtain the standard cost per pound of indirect labor and expense, the equipment rates per day, as developed through the budget, are divided by the standard production per day. These rates are obtained for each size at each operation and, once determined, they remain fixed unless there is a considerable change in the budget or in the manufacturing processes.

The standard costs in dollars per pound should be expressed to at least four decimal places.

The cost system should supply labor and expense costs for any desired cloth construction either being manufactured or contemplated. The cotton cost is added at its actual cost or market rate, subject to waste factor allowance. The cost system should provide a means of giving the departmental overseers periodic reports of standard and actual costs and ratio of standard capacity actually employed. The system should also provide management with operating efficiencies, variances from standards, and actual cost of each product.

III. Description of the Cost System

Cotton mill cost accounting systems in use vary from predetermined estimates, which are not tied-in with the accounts, to standard cost systems that will provide detailed actual costs and form a part of the general books. The particular system herein described is a standard cost system in which the standards are not controlled by the general ledger, but are used dually with departmental actuals in the cost ledger to provide at all times a departmental ratio of standard to actual. The actual

figures are always under general ledger control. Similar systems are in actual use and give satisfactory results. After once established their operating costs are low.

Computing Cloth Standard Costs

The operational standard costs, as described in the previous section, are used to determine the standard cost-over-cotton of any cloth, as shown in the following example:

Construction	38 — 84 × 28 — 2.00
Fill yarn	2/16 — 5% contraction
Warp yarn	14 — 12% contraction
Sizing	8%
Number of ends	3208

$$\text{Fill} = \frac{\text{width} \times \text{picks} \times (1 + \text{contraction})}{\text{yarn count} \times 840} = \frac{38 \times 28 \times 1.05}{8 \times 840} = 0.1663 \text{ \#/yd.} = 33.5\%$$

(formula continued on page 514)

LABOR AND EXPENSE, STANDARD COSTS

ENDS	FILLING	WARP	WIDTH	SLEY	PICKS	STD YD.	DATE	STYLE NO.
3,208	2/16	14	38	84	28	2.00	Jan. 14, 1946	1150

LABOR & EXPENSE			RATES		STANDARD		CONTENT	
OPERATIONS	YARN	% WGT	LABOR	EXPENSE	LABOR	EXPENSE		PER CENT
THRU DRAW	76. gr.		0.0069	0.0050			FILLING	33.5
SLUBBERS	.60		0.0018	0.0008			SIZING	4.9
SPEEDERS	1.80		0.0043	0.0019			WARP	61.6
SPIN	16.		0.0167	0.0124			TOTAL	100.0
SPOOL	16.		0.0041	0.0017				
TWIST	2/16		0.0101	0.0053				
FILLING YARN	2/16	33.5	0.0439	0.0271	0.0147	0.0091	SUMMARY	
THRU DRAW	76. gr.		0.0069	0.0050			YARN LABOR	0.0371
SLUBBERS	0.60		0.0018	0.0008			CLOTH LABOR	0.0276
SPEEDERS	1.80		0.0043	0.0019			YARN EXPENSE	0.0222
SPIN	14		0.0163	0.0109			CLOTH EXPENSE	0.0179
SPOOL	14		0.0039	0.0016			TOTAL	0.1048
TWIST								
SPOOL								
WARP	14		0.0031	0.0011				
WARP YARN	14	61.6	0.0363	0.0213	0.0224	0.0131		
TOTAL YARN MAKING		95.1			0.0371	0.0222	COTTON	
SLASHING		66.5	0.0019	0.0103	0.0013	0.0068		
TIE IN		66.5	0.0018	0.0009	0.0012	0.0006		
WEAVING		100.	0.0178	0.0075	0.0178	0.0075		
CLOTH ROOM		100.	0.0073	0.0030	0.0073	0.0030		
TOTAL CLOTH MAKING					0.0276	0.0179		

Fig. 2.

$$\text{Warp} = \frac{\text{ends} \times (1 + \text{contraction}) \times (1 + \text{sizing})}{\text{yarn count} \times 840} = \frac{3208 \times 1.12 \times 1.08}{14 \times 840}$$

$$= 0.3300 \text{ ♯/yd.} = 66.5\%$$

Total $0.4963 \text{ ♯/yd.} = 100\%$

$$\text{Warp cotton content} = \frac{66.5}{1.08} = 61.6\%$$

$$\text{Fabric cotton content} = 33.5 + 61.6 = 95.1\%$$

_____ DEPARTMENT _____ SHIFT _____ DATE

Size	From	Kind Cotton	Frames On	Spindles Each	Std. Wgt.	Run	Hours Run	Pounds Produced	Spindle Days	Remarks

DAILY PRODUCTION REPORT

Fig. 3.

With these data and the operational standard costs, the cloth standard cost can be computed as shown on Figure 2. A record on such forms should be kept for every yarn or construction being produced.

Daily Production Reports

The actual production should be measured and recorded daily. For this purpose each machine should be supplied with measuring devices such as hank clocks or pick counters. For recording the daily production a form as in Figure 3 can be used. It is important that the daily production reports show product sizes before and after the operation, the number of machines run, number of hours run, production either in weight, hanks, cuts, picks, or yards as applicable.

Weekly Cost Summaries

From the daily production reports, weekly cost summaries are prepared showing the production for each size and each operation in pounds; also the unit days of machine use. Using the standard rates as developed, the standard cost of the week's production in direct labor, indirect labor and expense, is obtained. The expense absorbed is computed by operations only, by multiplying unit days of operation by daily equipment rates.

Weekly Summary of Production

Next, a weekly summary of production is prepared, showing:

By cost centers—Actual direct labor per payroll.
Standard direct labor per weekly cost summaries.
Expense absorbed per weekly cost summaries.
Standard expense per weekly cost summaries.
Differences in above factors in actual and standard, expressed in both value and percentage.
Weekly budgeted expense (from annual budget) and ratio of this amount to expense absorbed, which gives the capacity ratio.

By departments—Actual indirect labor per payroll.
Standard indirect labor per weekly cost summaries.
Differences in above actual and standard, expressed in both value and percentage.

This weekly summary of production gives a basis for weekly reports to management and to the department overseers.

For monthly entries to the cost ledger, it is recommended that four and five week periods be used to obviate splitting weekly figures. The weekly summaries of production must be summarized in four or five periods, showing both actual and standard figures. A waste summary must also be prepared for the same period showing pounds made at each operation and cumulative standard costs at these operations.

The Cost Ledger

The cost ledger would have accounts as follows:

Raw cotton (separate account for each major grade)—in pounds and actual cost
Process cotton (separate account for each major grade)—in pounds and actual cost

Process labor yarn—in actual and standard and ratio

Process labor cloth—in actual and standard and ratio

Process expense yarn—in actual and standard and ratio

Process expense cloth—in actual and standard and ratio

Finished goods—in pounds, actual cost and unit cost (also subsidiary ledger with account for each style)

Waste

Sizing and starch

Supplies

Production departments—analytical sheet for each department with columns for each type of distributable expense in accordance with budget, showing total *actual* expenses; also, expense absorbed, normal budget expense, and resultant expense variance and capacity variance.

Service departments—analytical sheet for each department with columns for each type of distributable expense in accordance with budget, showing total *actual* expenses; also normal budget expense.

Monthly Journal Entries

Monthly journal entries should be made as follows:

1. Cotton opened—Debit process cotton accounts and credit cotton account per warehouse report of cotton opened.
2. Labor—Debit process labor accounts at standard and actual and service departments at actual, as shown on monthly summary of production. Credit accrued payroll with actual.
3. Expense absorbed—Debit process expense accounts at standard and actual as shown on monthly summary of production. Credit production departments.
4. Expenses—Debit production and service departments with actual expenses of supplies used, and with power consumed, depreciation, taxes, etc., distributed in same ratio as budgeted. Credits will be to supplies, accounts payable, accruals and reserves, as applicable.
5. Service departments—Distribute total actual to production departments in same ratios as budget. Credit the service departments.
6. Waste—Debit in pounds and dollars (market value) with waste produced per waste summary. Credit process cotton account. Also credit, at standards only, process labor and process expense accounts as shown on monthly waste summary. This will reflect the waste factors affecting those accounts.

Monthly Summary of Cost of Finished Goods Produced

Before journalizing the monthly cost of finished goods produced, a monthly summary must be prepared. This summary would show for each style produced, the following:

Production in pounds

Per cent of cotton (from standard cost sheets)

Standard rates of labor and expense per pound (from standard cost sheets)

Standard cost of labor and expense (pounds $\times$ standard rates)

Pounds of cotton (production $\times$ percentage of cotton)

Actual cost—cotton (pounds of cotton × average cost, per process cotton account in cost ledger)

Actual cost—labor and expense (standard costs × ratios as determined monthly in the process accounts and departmental accounts in the cost ledger)

From the monthly summary of finished goods produced a journal entry is made debiting finished goods in pounds and value, and crediting process cotton in pounds and value, and process labor and expense accounts in standard and actual values.

Checking Inventories and Measuring Wastage

At regular intervals the poundage of process cotton per cost ledger should be checked up with a physical inventory. Such an inventory can readily be taken when the tubes from opener to pickers are empty. The weight of cotton in the machines must of course be estimated.

At such times that a physical inventory is taken, the amount of invisible waste that has occurred can also be determined. To accomplish this, the over-all gross waste produced is ascertained as follows:

Cotton in Process, Beginning of Period	89,000	lbs.
Cotton Opened during Period	1,482,000	
	1,571,000	
Cotton in Process, End of Period	83,000	
	1,488,000	
Cloth Produced during Period	1,285,000	
Gross Waste Produced	203,000	
Measured Waste Recovered	188,000	
Invisible Waste	15,000	lbs.

Cost of Cotton in Finished Product

The effect of waste on the unit price of cotton in finished cloth may be determined as follows, using the waste computation given above:

Market price of recovered waste $5,500.00
At 22 cents, this would purchase 25,000 pounds of cotton

$203{,}000 - 25{,}000 = 178{,}000$

$1{,}488{,}000 - 25{,}000 = 1{,}463{,}000$

$$\% \text{ of net waste} = \frac{178{,}000}{1{,}463{,}000} = 12.17\%$$

Cost of raw cotton 0.2200

$$\text{Cost of cotton in product} = \frac{0.22}{1 - 0.1217} = 0.2505$$

Monthly Summary of Expenses

In addition to weekly reports to management and departmental overseers, as obtained from the *weekly summary of production,* a monthly summary of expenses should be prepared for management, as follows:

Department	Actual Expenses	Normal Budget	Expense Absorbed	Variance		Percent	
				Expense	Capacity	Expense	Capacity
Carding							
Spinning							
Weaving							
Cloth							
TOTALS							

Continuous comparisons of the cost ratios and the expense and capacity percentages show trends and give management an effective aid in controlling costs.

COST ACCOUNTING IN DRUG RETAILING

By
PAUL C. OLSEN *

I. DESCRIPTION—*Number and Kind of Establishments and Characteristics*

In the United States there are between 45,000 and 50,000 retail drug stores. Difficulties of definition prevent an exact determination. State laws may require a retail establishment to obtain a license as a drug store if it is to retail medicinal and other poisons. Such a store, to all outward appearances, may be a department store or even a food market. Similarly, a retail establishment may maintain the appearance but not the name of a drug store. It may offer for sale all of those lines of merchandise which people customarily expect to buy in drug stores, except those which state law restrict to drug stores licensed by the state.

These restrictions apply to medicinal and other poisons, narcotics, and to articles which, for the protection of the public health, the state has decided should be sold at retail only in drug stores under the supervision of licensed pharmacists. The administration of these restrictive laws and regulations is usually under the direction of a group of retail pharmacists appointed by the state and designated as the Board of Pharmacy. They serve on a part-time basis and receive a very low rate of compensation or no compensation at all. Oftentimes, in the administration of these state laws, it has been difficult to distinguish considerations of the public health from the economic interests of retail drug store owners.

Of this total of 45,000 to 50,000 drug stores, about 4000, or something less than 10%, are branches of chain-store organizations. There is some concentration of ownership in the largest of these chain-store companies. More than one thousand, or over one fourth of all the chain drug stores in this country are operated by the two largest companies: the group owned by United Drug, Inc., and operated under such names as Liggett, Owl, and Sontag; and the Walgreen drugstores. These thousand or more stores are divided about equally between the two companies. On the other hand, these are about 275 other chains of drug stores, each with four or more stores, and operating a total of close to 3000 stores.

The division of sales between the chain and the individually owned drug stores is about 25% chain and 75% individually owned. Thus, with less than 10% of the total number of drug stores, the average sales volume of a chain drug store is typically two and one-half times that of an individually owned establishment. Most chain drug stores are in population centers. Close to three fifths are in cities of over 100,000 population. Only a little over one third of the individually owned stores are in such dense population centers.

Drug stores also can be classified by lines of merchandise featured and types of trade sought.

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1. City Center Drug Stores

These are elaborately equipped and offer an extensive restaurant service as well as all the usual drug store lines. They are to be found mostly in cities over 100,000 population, but a number are located in smaller places that are trading centers for large surrounding areas. This is the type of store that has been chosen most commonly for chain operation.

2. Limited Service Stores

These stores are often referred to derisively by their competitors as "pine board" stores. This is a characterization of the plain and inexpensive fixtures used in these stores. They ordinarily do not operate soda fountain or restaurant services. This is not because of a lack of appreciation of the profit possibilities of this department; the proprietor of a limited service store simply desires to restrict to a minimum his investment in fixtures and equipment. Soda fountain and restaurant operation requires special and costly fixtures and equipment, the selection and training of skilled employees, and the allocation of a considerable amount of floor space which may be idle except at mealtimes.

Limited service stores are about equally divided in number between those which are chain operated and those which are individually owned. They are located in spots adjoining and accessible to the busiest shopping areas of cities 100,000 up, but avoid the higher proportionate rental costs of the busiest shipping areas. Their chief promotion device is mass displays of merchandise, the value of which is apparent from its appearance. Some of these limited service stores are to be found in places under 100,000 when the drawing power of the community is unusually large.

3. City Neighborhood Drug Stores

There are about 20,000 such stores. Thus numerically they are one of the largest groups of drug stores. This group is severely limited in growth opportunities by the nearness and intensity of competition, not only from other stores of the same type, but also from the city center and limited service drug stores and the department stores, variety stores, and other retail outlets which deal in many or all of the same kinds of goods. Virtually all city neighborhood drug stores are individually owned.

4. Small Town Drug Stores

More than 15,000 drug stores in the United States are located in places with a population of less than 2500 and about 8000 more in places having a population of 2500 to 10,000. Of these drug stores, 99% are individually owned. This large concentration of drug stores in small towns in this country is to be expected because well over 40% of the population lives on farms and in places under 2500. With an average population per drug store in the United States of about 3000 it follows that any particular small-town drug store is likely to be the only drug store in the community. This makes possible the sale in the store of a variety of side lines which a city neighborhood drug store would not stock because of the competition of nearby establishments specializing in the line.

5. Suburban Drug Stores

With the movement of families with above average incomes to the areas surrounding the largest cities, there has come a corresponding development of drug

stores in these suburban areas. These people expect credit, telephone order and delivery service from the retail stores, including the drug stores which serve them. The specialized nature of this service has caused these stores generally to be individually owned.

6. Drug Stores Serving Foreign Born Residents

With the immigration restrictions in effect in the United States for more than two decades, these stores have declined steadily in number and sales. The Americanization that is characteristic of descendants of immigrants extends to the type of retail stores that they patronize. A few drug stores catering to foreign born residents survive in seaports and border areas where there are appreciable numbers of visitors from foreign countries. The unusual nature of these stores causes them to be individually owned.

7. "Professional" Drug Stores

This name is a misnomer because it implies that drugstores dealing in a variety of merchandise are not professional. Actually the people of the United States have demonstrated by their patronage that they will seek the professional services of a pharmacist as readily in stores offering a variety of unrelated goods as they will in drug stores which devote themselves exclusively to prescription compounding and related professional services and merchandise. Petty's Pharmacy in Newark, N. J., is said to fill more prescriptions than any other drug store in the United States. This store offers a soda fountain and restaurant service and the other merchandise lines that Americans have come to expect in their drug stores. Similarly, R. H. Macy and Company, a department store in New York, fills prescriptions in numbers comparable with that of any drugstore in this country.

Of the total of about 5000 drug stores in the United States in which is concentrated at least 75% of the prescription receipts of all drug stores, approximately 500 are drug stores devoted exclusively to prescription compounding and related professional services and merchandise. Thus only about 1% of all the drug stores in this country are of the so-called "professional" type.

The kinds of merchandise and services offered in drug stores have been the butt of much critical comment. Actually the bulk of the sales in even the most bizarre establishments is directly related to health protection, and for the other goods stocked there is frequently a logical explanation.

About two thirds of all drug stores have soda fountains and their offerings in this department range from the simplest refreshment service to complete meals served round the clock. The proportions of these and other sales are typically as follows:

	%
Prescriptions	12
Drugs, Medicines and Medicinal Chemicals	25
Drug Sundries, Rubber Goods, and Surgical Supplies	10
Toilet Articles and Preparations, including Soaps	10
Tobacco Products	15
Confectionery	5
Soda Fountain and Restaurant	20
Other Articles	3
Total	100

Apart from the soda fountain sales, this division of sales is also characteristic of drug stores without soda fountains. In states in which the sale by the package of intoxicating beverages is permitted in drug stores, these sales usually amount to about 10% of the total sales of drug stores handling this line.

It will be seen from the above tabulation of the proportion of sales by line of goods that the first four lines listed amount to almost three fifths of the sales of all drugstores. For virtually all of the other lines, the logic of their presence in drug stores is understandable. Confectionery had its origin in the efforts of physicians and pharmacists to make their prescriptions and other concoctions more palatable. The flavoring agents used at a soda fountain are, in many cases, the same as those used for this purpose in prescriptions, household remedies, and other medicines. Even the tobacco products have their medicinal counterpart in the cubeb cigarettes and other medicines administered by inhalation.

The very prominence with which the outlandish articles offered in some drug stores must be displayed gives them a seeming significance far out of proportion to their sales importance. If these strange articles were not displayed prominently they would not sell at all because people would not be looking for them in a drug store.

The featuring of these side lines in drug stores indicates a general knowledge by store owners of joint costs and break-even points that is far greater than that with which they are commonly credited. The daily hours of operation of a drug store are longer than those of most other retail establishments, and seven day a week operation is customary. The professional training required of a pharmacist results in an educational level for drug-store owners that is sure to be higher than that of other retail proprietors. This results in greater understanding and alertness to opportunity by the store owner and greater prestige among his customers than is enjoyed by proprietors of other types of stores.

The drug-store owner thus may create acceptance in his community for the sale of an article or line of merchandise wholly unrelated to the practice of pharmacy. The total sales that can be made of the article or line are small but the gross margin per unit is usually large. Since the article or line is ordinarily handled without any addition to the direct costs of operation of the store, such margins as are realized from its sale are direct additions to the net profits of the store. Thus a small volume of sales of wholly unrelated side lines can exert a strong leverage on total profits in a drug store.

II. How to Design the Cost System

The design, for a drug store, of a cost system, as distinguished from the customary accounting records, therefore, falls into three divisions. Since about two thirds of the sales volume of a drug store comes, typically, from the sale of packaged articles, the cost system as applied to packaged articles is considered first. The prescription department is essentially a manufacturing operation in which orders are filled in conformity with individual specifications. The soda fountain, too, is a specialized type of operation.

Information Required for a Cost System for Packaged Articles

Studies by the U. S. Department of Commerce and reported in its bulletin, "Costs, Sales and Profits in the Retail Drug Store," Domestic Commerce Series No. 90, 1934, and by this author in "The Cost of Handling and Selling Packaged Articles in Typical Drug Stores," in the *Druggists Circular* for October 1937, indicate that the following are the causes of variations in costs of handling and selling packaged articles in retail drugstores.

1. *The Rate of Turnover of the Article under Consideration.*—This should not be confused with the volume of sales of the article. The rate of turnover is a measure of the frequency with which stock moves based on the time which elapses between the purchase of sales of the article by the retail druggist and its sale by him. It is the ratio of stock on hand to sales.

2. *The Unit of Sale.*—The smaller the dollar amount of the unit of sale, the higher the cost to handle and sell the particular item.

3. *The Time Required to Make the Sale.*—This is of most importance when the customer usually exercises choice after coming into the store—as between various shades and odors of a face powder.

4. *Commissions to Sales People.*—It is sometimes the custom for sales people to receive a special commission for the sale of particular articles. These may be articles on which the gross margin offered the store owner is unusually large, or they may be articles for which the manufacturer has made a special allowance to the proprietor to be used for this purpose.

5. *Unallocable Costs.*—Some of the costs of handling and selling packaged articles in a drug store are not affected in any discernible manner by the preceding variables. Following the practice in other trades and industries, these costs are allocated as a percentage of sales.

A comparison of these variables with those named for the wholesale drug trade indicates that the variables for turnover rate, sales unit, special commissions to sales people, and unallocable costs are similar. There is also a similarity between the retail variable for selling time and the wholesale variable for sales in full case and in broken case lots. The special costs in the wholesale trade from the sale of products requiring refrigeration and other special care parallel those in the retail trade in the prescription laboratory and at the soda fountain.

Capacity Operation and Break-Even Points

The tremendous rise in costs that results from a reduced sales volume and generally under-capacity operation offer a challenge to the cost accountant to present these facts in a convincing and readily understandable manner. Unallocable costs are usually not easily reducible. If they are a large proportion of the total costs, they become the strongest influence on the profits of a drug store.

III. Description of the Cost System

Profit-and-Loss Statement

The usual classification of the costs and their typical percentage amounts in 1944 are shown in Table 1. These typical figures are reported annually by Eli

Lilly and Company, pharmaceutical manufacturers, of Indianapolis, from their surveys of drug stores.

TABLE 1. TYPICAL COSTS AND PROFITS OF RETAIL DRUG STORES
(Net Sales = 100.0 %)

Sales	100.0
Cost of Goods Sold	67.5
Gross Margin	32.5
Expenses:	
Manager's Salary, or Salary Allowance for the Owner If He Serves as the Store Manager	8.0
Employees' Wages	7.0
Rent	2.5
Heat	0.4
Light and Power	0.5
Taxes and Licenses	0.8
Insurance	0.3
Interest Paid	0.1
Repairs	0.3
Delivery	0.1
Advertising	0.5
Telephone	0.3
Bad Debts Charged Off	0.1
Depreciation of Fixtures and Equipment	0.5
Miscellaneous	1.3
Total Expenses	22.7
Net Profit before Federal and State Taxes on Profits	9.8
Annual Rate of Turnover of Merchandise Stock	4.5 times

Following the lead of the National Wholesale Druggists' Association in 1929, the drug trade engaged the U. S. Department of Commerce to make the survey of retail operations which resulted in the publication in 1934 of the results of this National Drug Store Survey as "Costs, Sales and Profits in the Retail Drug Store," Domestic Commerce Series No. 90.

Of the above list of expenses of operation of a retail drug store, the following were found to vary with the rate of turnover of the merchandise stock.

TABLE 2. RETAIL DRUG STORE OPERATING COSTS VARYING WITH THE RATE OF TURNOVER OF MERCHANDISE STOCK
(Net Sales = 100.0 %)

Rent	2.5
Heat	0.4
Light and Power	0.5
Taxes and Licenses	0.8
Insurance	0.3
Interest Paid	0.1

Repairs	0.3
Telephone	0.3
Depreciation of Fixtures and Equipment	0.5
Miscellaneous	1.3
Total	7.0

In this table, the retail drug store operating costs varying with the rate of turnover of the merchandise stock average 7.0% of total sales. The average rate of turnover of the merchandise stock is 4.5 times a year, or once in 81 days, and the average profit shown in Table 1, 9.8% of sales. This average rate of profit of 9.8% thus is realized in 81 days. If the average rate of turnover of a particular packaged article in a drug store is doubled, or 9.0 times a year, the costs varying with the rate of turnover are reduced from 7.0% of the price received for the article to 3.5%. If other costs are unchanged, the net profit is raised from 9.8% to 13.3%.

An increase in the average rate of turnover from 9.0 times to 18.0 times results in a further reduction in operating costs varying with the rate of turnover from 3.5% to 1.75%. Another increase in turnover rate from 18.0 times to 36.0 times cuts these costs from 1.75% to 0.875%.

A reduction in the rate of turnover from the general average in this illustration of 4.5 times to 2.25 times raises the operating costs varying with the rate of turnover of the merchandise stock from 7.0% of the price received for a packaged article to 14.0%. A further drop in the rate of turnover from 2.25 times to 1.125 times raises these costs to 28.0%.

The savings to be effected by reductions in the costs varying with the rate of turnover are thus of far greater significance in the slower rates than they are with the more rapid rates of turnover. This is a point at which profits are often lost in the management of drug stores. The effect of the rate of turnover on profits is easy to understand. The error lies in the application of this principle to the articles on which a satisfactory rate of turnover already is being obtained, instead of to the articles on which the rate of turnover is inordinately slow.

Time studies were made in the National Drug Store Survey to find such relationship as might exist between the rate of turnover, the unit amount of sales, and the selling time involved. These time studies revealed little relation between the length of time required in drug stores for selling, wrapping, and receiving payment for packaged articles and the unit amount of the sale. The results which appear in Table 3 show that the only exceptions are a small number of articles at the extremes.

A relationship was discovered between the rate of turnover for packaged articles and the length of time required for selling, wrapping, and receiving payment. These results are shown in Table 4. While the results are reduced here to a time cost of 50 cents an hour, they may be readily recalculated for any wage rate.

The National Drug Store Survey also has provided a classified tabulation of the sales of packaged articles in the stores studied by lines of merchandise and rates of turnover. From these results, the classification of sales by rate of turnover that appears in Table 5 has been prepared.

Such a tabulation as appears in Table 5 provides a basis for determining the ratio of time for selling, wrapping, and receiving payment for packaged articles to the total working time of persons in drug stores. Studies of this kind will show

TABLE 3. SELLING TIME REQUIRED FOR PACKAGED ARTICLES IN DRUGSTORES

Average Selling Time (seconds)	Number of Classes of Articles	Range of Average Selling Prices	
		Lowest	Highest
1– 9	1	$0.12	$0.12
10– 19	9	0.02	0.17
20– 29	7	0.05	0.64
30– 39	22	0.04	0.83
40– 49	16	0.11	0.42
50– 59	36	0.13	0.83
60– 69	13	0.12	0.58
70– 79	14	0.16	0.63
80– 89	9	0.24	1.15
90– 99	13	0.13	1.10
100–109	7	0.31	1.06
110–119	4	0.54	0.97
120–129	4	0.35	1.14
130–139	3	0.46	1.07
140–149	3	0.10	1.27
150–279	4	1.01	3.19

TABLE 4. COST OF TIME FOR SELLING, WRAPPING, AND RECEIVING PAYMENT FOR PACKAGED ARTICLES IN DRUGSTORES

1 Rate of Turnover of Article (times a year)	2 Average Time to Sell, Wrap, and Receive Payment (seconds)	3 Average Amount of Sale (cents)	4 Cost of Time (at 50 cents per hour) Used in Selling, Wrapping, and Receiving Payment (cents)	5 Per Cent Cost of Time (per cent of selling price)
0.9 or less	90	50	1.251	2.5
1.0 to 1.9	70	40	0.973	2.4
2.0 to 2.9	55	35	0.764	2.2
3.0 to 3.9	55	35	0.764	2.2
4.0 to 4.9	50	30	0.695	2.3
5.0 to 5.9	40	25	0.556	2.2
6.0 to 6.9	35	15	0.486	3.2
7.0 to 12.9	25	15	0.348	2.3
13.0 up	15	10	0.208	2.1

that, in a drug store, this selling time is one fourth to one third of working time. This ratio is similar to that shown in time studies of the activities of wholesale druggists' salesmen as those of salespeople in other retail and wholesale trades.

This residue of working time is actually the largest part of the costs of handling and selling packaged articles in a drug store. For packaged articles on which the rate of turnover is rapid, it is the largest single item in the cost of handling and selling them. It is appropriate in a drug store which is operating at, or close to, capacity to designate this residue of working time as the cost for buying and

TABLE 5. CLASSIFICATION OF SALES BY RATE OF TURNOVER

1 Rate of Turnover of Article (times a year)	2 Average Time to Sell, Wrap, and Receive Payment (seconds)	3 Average Amount of Sale (cents)	4 Relative Number of Sales at Each Rate of Turnover	5 Relative Amount of Sales at Each Turnover (3x4) (dollars)	6 Relative Selling Time at Each Turnover (2x4) (seconds)
0.9 or less	90	50	4	2.00	360
1.0 to 1.9	70	40	12	4.80	840
2.0 to 2.9	55	35	11	3.85	605
3.0 to 3.9	55	35	10	3.50	550
4.0 to 4.9	50	30	5	1.50	250
5.0 to 5.9	40	25	5	1.25	200
6.0 to 6.9	35	15	1	.15	35
7.0 to 12.9	25	15	32	4.80	800
13.0 up	15	10	20	2.00	300
Totals			100	23.85	3940

TABLE 6. THE COST OF STOCKING AND SELLING PACKAGED ARTICLES IN A TYPICAL DRUG STORE WITH AVERAGE DAILY SALES OF $40 TO $45 (STORE STAFF CONSISTING OF THE PROPRIETOR OR MANAGER)

(Expressed as a percentage of selling prices received)

Amount of Sale	Rates of Turnover											
	1	2	3	4	5	6	8	10	12	18	24	48
$0.05	65.6	44.2	36.6	33.1	29.4	26.4	23.8	22.0	20.5	18.6	17.3	16.0
0.10	54.5	35.5	29.0	25.8	23.2	21.0	19.1	17.8	16.8	15.4	14.5	13.5
0.15	50.5	32.6	26.4	23.4	21.1	19.3	17.5	16.4	15.6	14.3	13.2	12.3
0.20	48.9	31.2	25.2	22.2	20.1	18.4	16.8	15.7	15.0	13.8	13.1	12.2
0.25	47.8	30.3	24.4	21.4	19.4	17.9	16.3	15.3	14.6	13.4	12.8	12.1
0.30	47.0	29.7	23.9	20.9	19.0	17.5	16.0	15.0	14.3	13.2	12.6	11.9
0.35	46.5	29.3	23.5	20.6	18.7	17.3	15.8	14.8	14.2	13.1	12.5	11.8
0.40	46.1	29.0	23.2	20.3	18.5	17.1	15.6	14.7	14.0	13.0	12.4	11.7
0.45	45.7	28.7	23.0	20.1	18.3	17.0	15.4	14.6	13.9	12.9	12.3	11.6
0.50	45.5	28.5	22.8	20.0	18.2	16.9	15.3	14.5	13.8	12.8	12.3	11.6
0.55	45.3	28.4	22.7	19.8	18.1	16.8	15.2	14.4	13.8	12.7	12.2	11.5
0.60	45.2	28.3	22.6	19.7	18.0	16.7	15.2	14.3	13.7	12.7	12.2	11.5
0.65	45.0	28.2	22.5	19.6	17.9	16.6	15.1	14.3	13.7	12.6	12.1	11.4
0.70	44.9	28.1	22.4	19.6	17.8	16.6	15.1	14.2	13.7	12.6	12.1	11.4
0.75	44.8	28.0	22.3	19.5	17.7	16.5	15.0	14.2	13.6	12.5	12.1	11.4
0.80	44.7	27.9	22.3	19.4	17.7	16.5	15.0	14.2	13.6	12.5	12.1	11.4
0.85	44.6	27.8	22.2	19.4	17.6	16.4	15.0	14.1	13.5	12.5	12.0	11.3
0.90	44.5	27.8	22.2	19.3	17.6	16.4	14.9	14.1	13.5	12.5	12.0	11.3
0.95	44.5	27.7	22.2	19.3	17.6	16.4	14.9	14.1	13.5	12.4	12.0	11.3
1.00	44.4	27.7	22.1	19.2	17.5	16.3	14.9	14.0	13.5	12.4	12.0	11.3
1.25	44.2	27.5	21.9	19.1	17.4	16.2	14.8	13.9	13.4	12.4	11.9	11.2
1.50	44.0	27.4	21.8	19.0	17.3	16.2	14.7	13.9	13.4	12.3	11.9	11.2
2.00	43.9	27.3	21.7	18.9	17.2	16.1	14.6	13.8	13.3	12.3	11.8	11.1

management. In a drug store which is operating at less than capacity it is proper to call it a cost for buying, management, and readiness-to-serve.

The results of such a study as here outlined of the costs of handling and selling packaged articles in a drug store should be summarized in some form which permits ready reference to these results. The author's own study appeared in the form shown in Table 6 in his book, "The Marketing of Drug Products," published by Harper and Brothers in 1940. The results could be presented as well in fractional cent amounts as in the percentages shown.

Design of a Cost System for a Drug Store Soda Fountain

The National Drug Store Survey determined the average amount of the sale at a drug store soda fountain to be 11 cents. Results were not reported for the selling time involved in these sales. At the same time, A. C. Nielsen Company of Chicago undertook for the Coca-Cola Company, of Atlanta, a study of selling time and other costs involved in sales at drug store soda fountains in July 1931. The results were published by the Coca-Cola Company in 1932 in a book, "Seven of Every Ten."

In this study by A. C. Nielsen Company, fountain sales of drug stores offering exclusively a refreshment service were found to be 23.7% of their total sales. In drug stores with a luncheonette or restaurant service, the fountain sales average 31.0% of total sales, divided 21.7% for refreshments and 9.3% for food items.

It was also determined in this study that 61 to 71% of all drug store patrons were customers of the soda fountain. Of particular interest to the Coca-Cola Company was the fact that 33.3% of fountain patrons bought Coca-Cola, a 5-cent carbonated beverage. These results, as reported by A. C. Nielsen Company, allow the following summary to be constructed.

TABLE 7. AMOUNT AND DISTRIBUTION OF DRUG STORE FOUNTAIN AND OTHER SALES

	Distribution of Sales per $100	Number of Sales	Average Amount
Coca-Cola	$ 2.95	59	5.0¢
Other Fountain Sales	20.75	119	17.4¢
Total for Fountain Sales	23.70	178	13.3¢
Total for All Other Sales	76.30	96	79.5¢
Grand Total	$100.00	274	36.5¢

It will be seen from this summary that the average amount of the sales at drug store soda fountains of 13.3 cents is not much different from the average of 10 to 11 cents determined in the National Drug Store Survey.

The following classification of costs for a drug store soda fountain is suggested.

1. Cost of materials or ingredients used.
2. Direct labor costs.
3. General and unallocable costs.

In its study for Coca-Cola Company, A. C. Nielsen Company reported the following costs per order for materials or ingredients used.

The determination of direct labor costs at a drug store fountain requires a calculation of the average wage rate per hour of employees working there. Time

TABLE 8. CLASSIFICATION OF SODA FOUNTAIN SALES AND EXAMPLES OF COSTS PER ORDER FOR MATERIALS OR INGREDIENTS

	Amount of Sale	Ingredient Cost
Coca-Cola	0.05	0.0156
Root Beer	0.05	0.0108
Other Syrup Drinks Without Ice Cream.		
Syrup Cost $0.70 to $1 a gallon	0.05	0.0073
1.00 to 1.50	0.05	0.0107
1.50 to 1.70	0.05	0.0156
Fresh Fruit Orangeade	0.10	0.0307
Fresh Fruit Lemonade	0.10	0.0407
Fresh Fruit Limeade	0.10	0.0197
Chocolate Milk	0.05	0.019
Chocolate Milk	0.10	0.036
Milk Shake with Ice Cream	0.15	0.064
Malted Milk	0.15	0.094
Malted Milk	0.20	0.126
Ice Cream Soda	0.10	0.043
Ice Cream Soda	0.15	0.067
Ice Cream Cone	0.05	0.034
Ice Cream	0.10	0.053
Ice Cream Sundaes, One Flavor	0.15	0.063

studies undertaken by A. C. Nielsen Company do not reveal any increased productivity with higher wage rates. The direct labor costs it determined for various types of refreshments vary in direct proportion with the wage rates. Such minor differences as do appear are probably the result merely of rounding of fractional amounts to the nearest 1/10 cent. This may have been caused by the time studies being made in stores in which the hourly wage rates for direct labor costs were at, or close to, the same figure. It is probable therefore that these figures are illustrative rather than standards.

TABLE 9. FOUNTAIN LABOR COSTS AT VARIOUS HOURLY WAGE RATES
(Average Delivery Labor Included)

Class No.	LEADING SODA FOUNTAIN ITEMS	WAGE RATES—CENTS PER HOUR								
		10	12½	15	17½	20	22½	25	27½	30
		Total Labor Cost Per Individual Order								
1	COCA-COLA	$0.004	$0.004	$0.005	$0.006	$0.007	$0.008	$0.009	$0.010	$0.010
2	Other Simple Fountain Beverages Without Ice Cream	$0.005	$0.006	$0.007	$0.008	$0.009	$0.010	$0.012	$0.013	$0.014
3	Fresh Fruit Ades and Plain Juices	$0.009	$0.011	$0.013	$0.015	$0.017	$0.020	$0.022	$0.024	$0.026
4	Machine-Mixed Milk Drinks	$0.009	$0.012	$0.014	$0.016	$0.019	$0.021	$0.024	$0.026	$0.028
5	Ice Cream Soda	$0.008	$0.010	$0.012	$0.014	$0.016	$0.018	$0.020	$0.022	$0.024
6	Plain Ice Cream, Dishes and Cones	$0.005	$0.006	$0.007	$0.008	$0.009	$0.011	$0.012	$0.013	$0.014
7	Simple Sundaes	$0.006	$0.007	$0.009	$0.010	$0.012	$0.013	$0.015	$0.016	$0.018
8	Fancy Sundaes	$0.010	$0.013	$0.016	$0.018	$0.021	$0.024	$0.026	$0.029	$0.031

Class No.	WAGE RATES—CENTS PER HOUR											
	32½	35	37½	40	42½	45	47½	50	52½	55	57½	60
	Total Labor Cost Per Individual Order											
1	$0.011	$0.012	$0.013	$0.014	$0.015	$0.016	$0.017	$0.017	$0.018	$0.019	$0.020	$0.021
2	$0.015	$0.016	$0.017	$0.018	$0.020	$0.021	$0.022	$0.023	$0.024	$0.025	$0.026	$0.028
3	$0.028	$0.030	$0.033	$0.035	$0.037	$0.039	$0.042	$0.044	$0.046	$0.048	$0.050	$0.052
4	$0.030	$0.033	$0.035	$0.038	$0.040	$0.042	$0.045	$0.047	$0.049	$0.052	$0.054	$0.056
5	$0.027	$0.029	$0.031	$0.033	$0.035	$0.037	$0.039	$0.041	$0.043	$0.045	$0.047	$0.049
6	$0.015	$0.016	$0.018	$0.019	$0.020	$0.021	$0.022	$0.023	$0.025	$0.026	$0.027	$0.028
7	$0.019	$0.021	$0.022	$0.024	$0.025	$0.027	$0.028	$0.030	$0.031	$0.033	$0.034	$0.036
8	$0.034	$0.037	$0.039	$0.042	$0.044	$0.047	$0.050	$0.052	$0.055	$0.058	$0.060	$0.063

The general and unallocable costs that are related to the operation of a drug store soda fountain include:

1. Depreciation, maintenance costs, and repairs of equipment.
2. Supplies purchased, such as ice, water, fuel, light, laundry, glassware, utensils, straws, napkins, uniforms.
3. Rent for space occupied.
4. Value of supervisory services by store manager or proprietor.

In the absence of facts which permit these costs to be distributed on any other basis, they are charged in proportion to fountain sales. In the A. C. Nielsen Company survey these costs were found to average 13.5% of fountain sales in stores offering only a refreshment service and 22.0% in the stores which also offered food items. The average for both was reported as 20.4%. In this survey an understandable relationship was found between these general and unallocable costs and fountain sales volume and the investment in fountain equipment. This is ingeniously revealed in the two following charts and the accompanying directions for their use.

Design of a Cost System for a Drug Store Prescription Department

The problems involved in the development of a cost system for a drug store prescription department are strikingly similar to those in the fountain department. The prescription department is essentially a manufacturing department in which the output is made to individual specifications. Compliance with these individual specifications requires the services of one or more professionally trained pharmacists. Thus the "hourly wage rates" and "direct labor costs" in the prescription department will be higher than for the fountain, but the method of applying them to individual sales is the same. Time studies were made in the National Drug Store Survey for various types of prescriptions. This survey also revealed average gross margins, and thus ingredient costs and unit amounts of sales. They are summarized in Table 10.

The procedure described for the drug store soda fountain in measuring general and unallocable costs can be adapted and applied with equal facility to the prescription department.

A cost system of this kind provides a sound basis for pricing prescriptions that is fair to customer, prescriber, and to the store itself. Such a cost system will provide a measure of the share in the total earnings of the store that the prescrip-

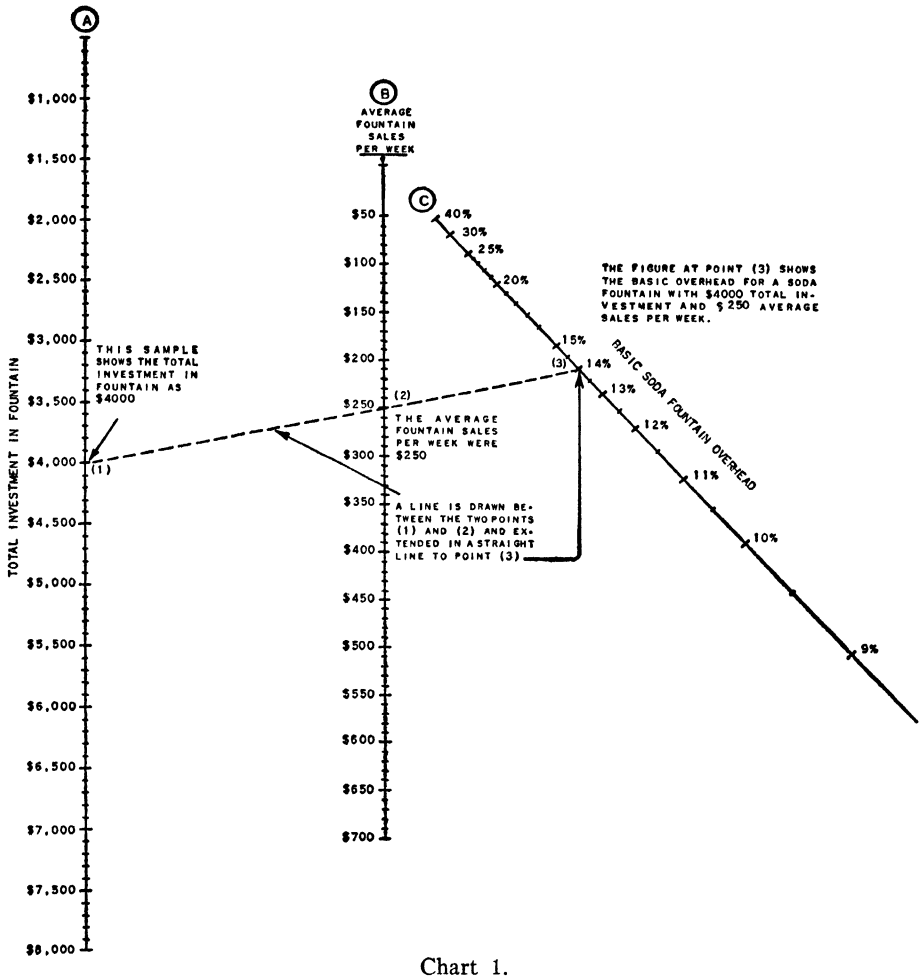


Chart 1.

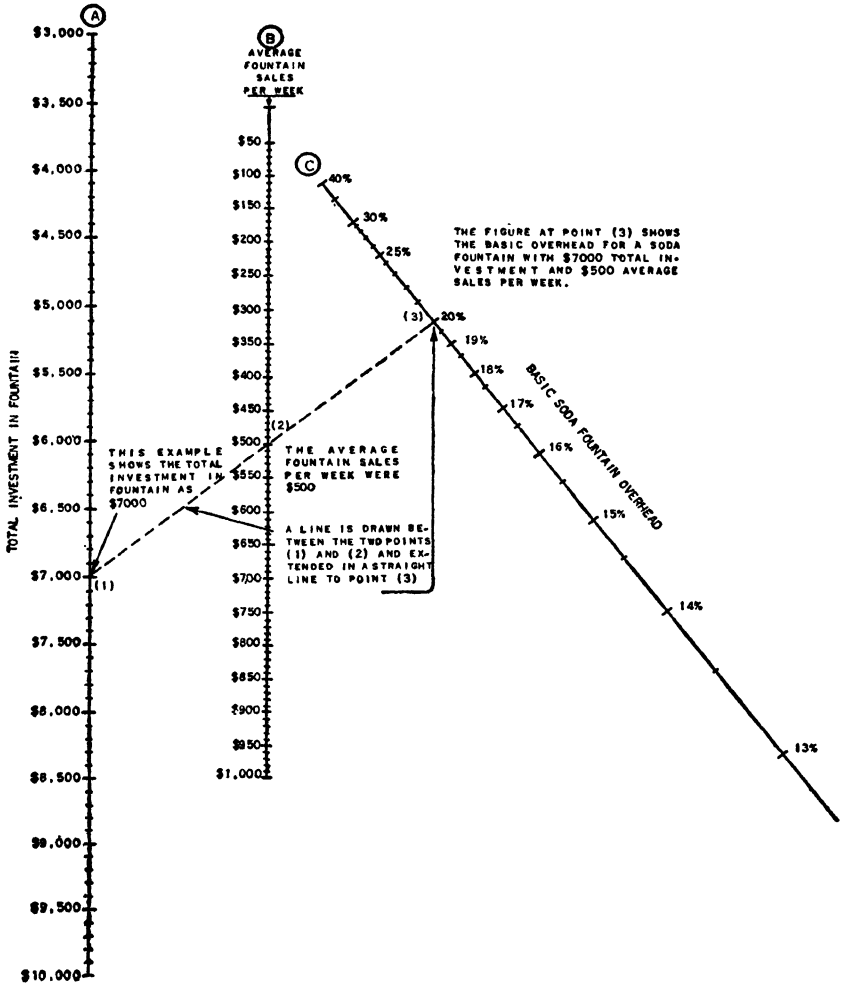
If the total investment in luncheon equipment at your fountain is *less* than $100, use this chart to determine the overhead cost at your soda fountain. Proceed as follows:

First—Compute your total investment at your fountain.

Second—On Line A, find this figure for total investment at your fountain and indicate it by marking a dot on Line A with your pencil.

Third—Add your total fountain and lunch sales at the fountain for the past twelve months and divide by 52 to determine the average weekly fountain sales. Find the figure on Line B above and indicate it with a pencil dot.

Fourth—With a ruler, draw a line from the dot on Line A indicating total investment in fountain to the dot on Line B indicating average fountain sales per week and continue until you cross the diagonal Line C. The point where your pencil line crosses Line C indicates your soda fountain overhead. For convenience, it is suggested you use the nearest full number, as 23%, 35%, etc.



If the total investment in luncheon equipment at your fountain is *more* than $100, use this chart to determine the overhead cost at your soda fountain. Proceed as follows:

First—Compute your total investment at your fountain.

Second—On Line A, find this figure for total investment at your fountain and indicate it by marking a dot on Line A with your pencil.

Third—Add your total fountain and lunch sales at the fountain for the past twelve months and divide by 52 to determine the average weekly fountain sales. Find this figure on Line B above and indicate it with a pencil dot.

Fourth—With a ruler, draw a line from the dot on Line A indicating total investment in fountain to the dot on Line B indicating average fountain sales per week and continue until you cross the diagonal Line C. The point where your pencil line crosses Line C indicates your soda fountain overhead. For convenience, it is suggested you use the nearest full number, as 23%, 35%, etc.

TABLE 10. AVERAGE GROSS MARGINS, UNIT SALES, AND COMPOUNDING TIME FOR PRESCRIPTIONS

Kinds of Prescriptions	Average Gross Margins (per cent of sales)	Average Sale	Average Preparation Time (seconds)
Liquids	70.2	$0.92	299
Capsules	80.2	1.05	643
Tablets	62.9	0.92	219
Charts	88.2	0.79	682
Ointments	74.5	0.73	429
Bulk powders	72.2	0.79	319
Effervescent salts	52.7	1.15	364
Pills	81.2	0.86	364
Suppositories	59.8	1.18	364
Packaged specialties	44.1	0.59	94
Bulk Preparations (household remedies)	66.5	0.26	100
Biologicals	40.8	2.06	132
Prescription liquor	36.4	2.57	397
Average	58.1	0.91	360

tion department is producing. If the made to order manufacturing facilities of the prescription department should develop into the production in the store of ready-made preparations, the store starts its career as a pharmaceutical manufacturer with the advantage of an accurate and helpful cost system, or at least with a knowledge of the value of a cost system in its expanded operations.

This expansion of retail drug stores into the manufacture of pharmaceutical specialties is by no means uncommon. Some of the most famous products in the drug field are the outgrowth of spare time experimentation in drug store prescription departments.

COST ACCOUNTING IN DRUG WHOLESALING

By
PAUL C. OLSEN *

I. DESCRIPTION—NUMBER AND KIND OF ESTABLISHMENTS AND CHARACTERISTICS

There are about 275 wholesale druggists in the United States which are of the type known in the trade as "full-line" houses. They are characterized by complete stocks, extensive order solicitation services, and liberal credit terms. Of these "full line" houses, more than 60, or about one fourth, are branches of the McKesson and Robbins chain. They account for about one third of the sales of all full-line wholesale druggists.

The average rate of turnover of the merchandise stock of a full-line wholesale drug house is about five times a year. Salesmen's compensation and other selling expenses are about one fourth of total operating costs. Well over 90% of total sales are on credit. For about one third of total sales, credit terms are for more than 30 days and an additional half of total sales are on credit terms of 10 days to 30 days. Outstanding accounts and notes receivable from customers equal about 45 days' sales.

In addition to these 275 full-line wholesale druggists, there are about 25 retailer-owned or "mutual" wholesale drug houses. They endeavor to limit their stock to the most popular items and offer order-taking and credit services that are much more limited than those of the full line wholesale druggists. Consequently, the average rate of turnover of the merchandise stock is somewhat more rapid than in the full line establishments. Selling expenses, including compensation for salesmen, is only about one fourth as much proportionately as in the full line establishments and, as a percentage of sales, total operating costs are about one third less. This does not mean, necessarily, that operations are carried on any more efficiently than in the full-line wholesale drug houses. It means that the type of operations carried on results in lower total costs. Close to two thirds of total sales of retailer-owned wholesale druggists are made for cash or on credit terms of 10 days or less, and less than 5% of total sales are on credit terms more liberal than 30 days. As a result, accounts and notes receivable average about 20 days' sales.

In addition to the full-line wholesale druggists and the retailer-owned groups, there are a number of wholesale distributors who seek to attract trade on the basis of limited stocks and services and resultant lower prices. As many as 1500 such establishments are considered, by themselves at least, to be wholesale houses, but the sales volume of most of them is small. There are probably fewer than 50 with annual sales of as much as $500,000 each. The most successful of these limited service wholesalers add more and more to their stocks and services and thus come to be known as full-line wholesale druggists.

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The division of trade between these three classes of wholesalers is about 80% for the full-line wholesale druggists and 10% each for the other two types of limited service establishments.

Of the 275 full-line wholesale druggists, about 50, or a little over one sixth, sell intoxicating liquor for beverage use. Liquor sales average about 20% of the total sales of the full-line establishments which sell liquor. Liquor is not an important line in the two other types of wholesale drug houses.

The distribution of other sales in the wholesale drug houses dealing in liquor and of the total sales in other wholesale drug houses is about as follows:

	%
Drugs, Chemicals, and Pharmaceuticals	35
Proprietary Medicines, Toiletries, and Toilet Soap	45
Industrial and Heavy Chemicals; Paints, Varnishes, and Related Products	5
Surgical and Hospital Equipment and Supplies	5
All Other Sales	10
Total	100

Well over 90% of the sales of all three types of wholesale druggists are to retailers and, of these sales to retailers, virtually all are to retail druggists. For the retailer-owned group, the percentage is necessarily very close to 100%. Full-line wholesale druggists make some sales to hospitals and other institutional and industrial users, but these average less than 5%.

Wholesale druggists provide the most important outlet for the manufacturers of drugs, chemicals, and pharmaceuticals; proprietary medicines, toiletries and toliet soap; and surgical and hospital equipment and supplies for home use. While individual manufacturers may select other methods of marketing their products, to the partial or complete exclusion of the wholesale druggists, the greater part, by far, of the total output of these classes of products is marketed through wholesale druggists.

This predominant position of the wholesale druggists seems secure. There are more than 5000 producers of these products in the United States. Many are small and make only one or a few products. It would be hopelessly unprofitable for them to attempt to deal directly with retailers. Likewise retailers would find themselves burdened with a great amount of additional expense if they had to buy directly from each of these 5000 or more producers.

Laboratory Products

A peculiarity of the wholesale drug business is its invariable involvement to some degree in drug product manufacturing. Extra profits and cost savings frequently are to be found in buying staple articles in bulk and reselling them in household packages. From this packaging activity for staple products a logical development is the creation and packaging of individual specialties. There are usually called laboratory products. Most full-line wholesale drug houses produce some specialties, either directly or through manufacturing affiliates.

II. How to Design the Cost System

Information Required

The National Wholesale Druggists' Association, of which virtually all the full line wholesale druggists are members, has made extensive studies of the average and total operating costs of its members. Studies also have been made of the costs of handling and selling individual items. As a result of these studies, the following were found to be the causes of variations in costs of handling and selling individual items in the wholesale drug trade.

1. *The Rate of Turnover of the Article under Consideration.*—This should not be confused with the volume of sales of the article. The rate of turnover reflects the time which elapses between the purchase of the article by the wholesale druggist and its sale by him. It is the ratio of stock on hand to sales. If stock is valued at cost, the ratio to be determined is its relation to the cost of sales for the period under study. If the figures for actual sales are used, then stock on hand should be valued at its selling price.

2. *The Bulkiness of the Item.*—Items such as paper napkins, cleansing tissues, and ice cream containers occupy far greater space per dollar of sales than do such articles as pharmaceuticals and razor blades.

3. *The Unit of Sale.*—The smaller the dollar amount of the unit of sale, the higher is the cost to handle and sell the particular item.

4. *The Extent of Full Case and Broken Case Sale of the Article.*—This is related to, but distinct from, the unit of sale. The shipping case for the 10-cent size of a packaged article is usually 3 dozen, while for the 50-cent size it is 1 dozen. Goods are handled and sold in the wholesale drug trade at a lower cost in shipping case lots than in broken case packages. None of the costs of placing stock on shelves and picking orders, checking, and packing are applicable to goods shipped in the original shipping containers.

5. *Special Costs Are Incurred in the Handling and Sale of Some Articles in the Wholesale Drug Trade.*—Vaccines, serums, and other biological products require refrigeration and other special care. For narcotics the Federal and state laws require the maintenance of elaborate and costly records.

6. *Salesmen's Commissions.*—Wholesale druggists' salesmen may be paid a special commission for the sale of particular articles. These goods may be laboratory products, in which the wholesale druggist is seeking margins both as a manufacturer and as a wholesaler, or they may be the products of an independent manufacturer who seeks the favorable consideration of the wholesale druggist by allowing concessions in the purchase cost to the wholesale druggist.

7. *Costs Which Are Not Affected by the Nature of the Articles Sold.*—The traditional practice is to allocate these costs as a flat percentage of sales. It is manifest that the value of a cost system for wholesale druggists depends upon the extent to which costs can be distributed among the first six of the cost variables listed above. The greater the proportion that remain as an indissoluble residue in this seventh classification, the less is the accuracy and usefulness of the cost accounting system for a wholesale druggist.

Capacity Operation and Break-Even Points

The alert and imaginative cost accountant also will want to design a cost system which will clearly and dramatically demonstrate to the operating heads of a wholesale drug house the effects upon costs and earnings of operations at less than capacity. He will also want to show the leverage upon costs and earnings of relatively small changes in sales volume above and below the break-even point. This is particularly important in new businesses and in those of small size. For example, the unallocable costs in Item No. 7 above may be as much as 50% of total operating costs in a wholesale drug house with annual sales of $150,000. In a wholesale drug house with annual sales of $1,500,000 they very well could be as little as one third of total operating costs.

Also to be guarded against in the establishment and operation of a cost accounting system for a wholesale drug house is the misleading interpretations which can come from changing dollar values. The $3,000,000 sales of the current year may be no nearer a capacity operation than the $1,500,000 sales of past years. For these reasons, the number of transactions and the physical quantity of goods dealt in may provide a more accurate indication of the degree of capacity operation. The change in dollar volume may come partly or entirely from changes in the price level. It also may come from voluntary or involuntary trading up resulting from increased purchasing power and from unavailability of goods formerly bought. These influences work in reverse. The wholesale drug house which had $3,000,000 sales in an inflation year may have handled the same physical quantity of goods in a subsequent deflation year although its dollar volume was only half as much.

Value of the Cost System

Competition always has been keen in the wholesale drug business and gives no indication of becoming any less active. The appeal to retail drug store owners and other customers of wholesale druggists of price reductions on standard, identified merchandise has proved to be well nigh irresistible. Even in the war years of extreme merchandise shortages, retail druggists had continuously available to them more than 400 different special offers, known in the trade as "free goods deals." They all represented in one form or another a quantity discount or some other type of price reduction.

A suitable cost system enables a wholesale druggist to maximize his return from each item he carries. This happy result comes from his knowledge of the volume of sales of the item, gross margins realized, and the costs of handling and selling it.

Even if a wholesale druggist is not himself the aggressor in a price competition, the cost system supplies him with the information necessary to determine the extent to which he can afford to go in meeting this price competition. It also is of very great help in deciding on a sound buying policy. All too often the tendency has been in wholesale drug houses to buy merchandise of unproved or doubtful salability in too large quantities and to buy the goods which sell readily and quickly in too small quantities.

III. Description of Cost System

Profit-and-Loss Statement

The usual classification of the costs and profits of a wholesale druggist and their percentage amounts which might be found in a full-line house are shown in Table 1.

TABLE 1. TYPICAL COSTS AND PROFITS OF FULL-LINE WHOLESALE DRUGGISTS
(Net Sales = 100.0 per cent)

Gross Sales	103.0
Less Returns and Allowances	3.0
Net Sales	100.0
Cost of Goods Sold	83.0
Gross Margin	17.0
Cash Discounts Received on Purchases	1.5
Gross Margin Including Cash Discounts Received on Purchases	18.5
Cash Discounts and Freight Allowed on Sales	3.5
Gross Margin After Discounts	15.0
EXPENSES:	
General and Administrative:	
Executive Salaries	1.0
Office Salaries	2.0
Taxes, Except on Income, Profits and Real Estate	0.5
Other General and Administrative Expenses	1.5
Total General and Administrative	5.0
Selling:	
Salesmen's Compensation	2.0
Salesmen's Traveling	1.0
Other Selling Salaries	0.5
Other Selling Expenses	0.5
Total Selling	4.0
Warehouse and Handling:	
Salaries and Wages	2.0
Other Expenses	0.5
Total Warehouse and Handling	2.5
Trucking and Delivery:	
Wages Paid or Payments to Contractors	0.5
Other Expenses	0.5
Total Trucking and Delivery	1.0
Occupancy:	
Rent or Rental Value of Premises Owned	0.5
Other Occupancy Costs	0.5
Total Occupancy	1.0
Total Operating Expenses	13.5
Bad Debt Losses	0.5
Total Operating Expenses Including Bad Debt Losses	14.0
Net Operating Profit	1.0
Nonoperating Income	1.0
Total	2.0
Nonoperating Expenses	0.5
Net Profit Before Federal and State Taxes on Profits	1.5
Annual Rate of Turnover of Merchandise Stock	5.5 times

The cost studies begun in 1929 by the National Wholesale Druggists' Association are largely responsible for dispelling in this trade a fallacy that is all too popular in many other trades and industries. One of the most common expressions of this fallacy is the assertion that if the margin available on an article to be resold is less than the distributor's average cost of doing business, he of necessity must lose money on the resale of the article. This is as absurd as saying that because the annual mean temperature of a city is so many degrees Fahrenheit, the day-to-day temperature of the city through the year never fluctuates from that average.

A corollary assertion, equally fallacious, is that if a gross margin is realized on each sale that is at least as large as the average cost of doing business, the entire business cannot help but be profitable. Such a procedure necessarily results in setting prices for some article at figures which yield very high profits per unit sold. The high prices divert trade to competitors more fully aware of their costs. The original distributor is left with an ever growing proportion of his sales of the articles with above average handling and selling costs. This, in turn, raises his average costs to higher and higher figures. A vicious circle of cost-raising circumstances is thus set in motion.

The following classified summary of wholesale druggists' operating costs appears in Statistical Division Bulletin No. 24, "Revised Cost Data on the Wholesale Distribution of Proprietary Drugs and Sundries," published in March 1938, by the National Wholesale Druggists' Association.

TABLE 2. CLASSIFIED SUMMARY OF WHOLESALE DRUGGISTS' OPERATING COSTS

(Net Sales = 100.0 per cent)

1. Costs Varying with the Rate of Turnover	0.22
2. Costs Varying with Bulkiness and Rate of Turnover	0.96
3. Costs Varying with the Unit Amount of the Sale and from the Extent of Full Case and Broken Case Lot Sales	4.27
4. Salesmen's Compensation	1.74
5. General and Unallocable Costs	4.10
Average Total Costs	11.29

The costs varying with bulkiness and rate of turnover are shown in Table 3. In Table 3 very concentrated merchandise is rated as occupying one tenth as much space per dollar of inventory as the average. Concentrated merchandise is considered to be one half the average bulk. Bulky merchandise is five times as bulky as average and very bulky merchandise is ten times the average.

Table 4 is a determination of wholesale druggists' operating costs which vary with the unit amount of the sale.

Table 5 shows the wholesale druggists' operating costs which are unaffected by the nature of the goods sold.

In Table 6 wholesale druggists' general and unallocable costs have been combined with costs varying with the unit amount of the sale to show costs for various sales amounts, both for sales in broken case lots and in full or shipping case lots.

The following procedure is to be used to determine from these tabulations the cost of handling and selling an individual article by a wholesale druggist.

TABLE 3. WHOLESALE DRUGGISTS' COSTS VARYING WITH BULKINESS AND RATE OF TURNOVER

(Net Sales = 100.0 per cent)

Rate of Turnover	Very Concentrated (per cent)	Concentrated (per cent)	Average (per cent)	Bulky (per cent)	Very Bulky (per cent)
1	2.63	3.55	5.95	25.15	49.15
2	1.32	1.78	2.98	12.58	24.58
3	0.88	1.18	1.98	8.38	16.38
4	0.66	0.89	1.49	6.29	12.29
5	0.53	0.71	1.19	5.03	9.83
6	0.44	0.59	0.99	4.19	8.19
7	0.36	0.51	0.85	3.59	7.02
8	0.33	0.44	0.74	3.14	6.14
9	0.29	0.39	0.66	2.80	5.36
10	0.26	0.36	0.60	2.52	4.92
11	0.24	0.32	0.54	2.29	4.48
12	0.22	0.29	0.49	2.10	4.10
13	0.20	0.27	0.46	1.94	3.78
14	0.18	0.25	0.43	1.80	3.51
15	0.17	0.24	0.40	1.68	3.28
16	0.16	0.22	0.37	1.57	3.08
17	0.15	0.21	0.35	1.48	2.89
18	0.14	0.20	0.33	1.40	2.73
19	0.13	0.19	0.31	1.33	2.59
20	0.13	0.18	0.29	1.26	2.46

TABLE 4. WHOLESALE DRUGGISTS' OPERATING COSTS THAT VARY WITH THE UNIT SALE

	Average Per Cent of Net Sales
Cost of Telephone Sales	0.336
Cost of City Desk	0.106
Other Selling Costs	1.635
Pricing, Extending, Billing and Auditing	0.577
Statistical Analysis	0.105
Scanning	0.103
Order Filling	0.855
Checking	0.239
Packing	0.316
Total	4.272

TABLE 5. WHOLESALE DRUGGISTS' GENERAL AND UNALLOCABLE COSTS
(Net sales = 100.0 per cent)

	Average Per Cent of Net Sales
General and Administrative Costs	1.385
Credits and Collections	0.302
Buying	0.608
Order Registry Filing	0.114
Claims	0.130
Customers' Ledger	0.133
Creditors' Ledger	0.089
Receiving	0.172
Shipping	0.131
City Delivery	0.459
Warehouse Labor	0.071
Bad Debts	0.500
Total	4.094

TABLE 6. PERCENTAGE AMOUNTS OF WHOLESALE DRUGGISTS' GENERAL AND UNALLOCABLE COSTS AND COSTS VARYING WITH UNIT AMOUNTS OF SALES

Amount of Line Extension (unit sale)	Cost When Sold in Broken Case Lots (per cent)	Cost When Sold in Shipping Case Lots (per cent)
$ 0.10	67.72	—
0.20	35.91	—
0.30	25.31	—
0.40	20.01	—
0.50	16.82	—
0.60	14.50	—
0.70	13.19	—
0.80	12.05	—
0.90	11.17	—
1.00	10.46	8.39
1.25	9.18	7.54
1.50	8.37	6.96
1.75	7.73	6.55
2.00	7.58	6.25
2.50	6.64	5.82
3.00	6.22	5.53
4.00	5.69	5.17
5.00	5.37	4.96
7.50	4.92	4.67
10.00	4.74	4.53
12.50	4.60	4.44
15.00	4.52	4.39
20.00	4.42	4.32
25.00	4.35	4.27
30.00	—	4.24
40.00	—	4.21
50.00	—	4.19
100.00	—	4.14

1. For the unit amount of sale under consideration, select the applicable percentage figure from Table 6. This covers the variations in the cost of handling and selling the article resulting from differences in the unit amount of the sale, the extent of the sale of the article in full or in broken case lots, and the general and unallocable costs of the wholesale druggist.

2. Add the proper amount shown in Table 3. This covers the variations in the cost of handling and selling the article resulting from its rate of turnover and its bulkiness.

3. Add the percentage amount of any special costs of handling and selling the article that can be separately determined. This may happen with biological products, narcotics, and articles for which special records are required, such as those subject to excise taxes. Special records are also required in connection with the sale of medicinal alcohol and of alcoholic beverages.

4. Add the percentage amount of any commission paid by the wholesale druggist to his salesmen for the sale of the particular article.

The total resulting from the addition of these four amounts is the estimated cost of handling and selling the article under consideration by a wholesale druggist. This figure is expressed as a percentage of the net amount received for the article by the wholesale druggist.

COST ACCOUNTING IN THE ELECTRICAL APPLIANCE INDUSTRY

By
THOMAS R. EVANS *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

The products of the electrical appliance industry are familiar to everyone. This section will be confined to the portion of the industry that produces a large volume of the major appliances.

A listing of the products, segregated by product line, follows:

Heating Devices	—Irons
	Non-automatic toasters
	Automatic toasters
	Roasters
	Grills
Refrigerators	—Household refrigerators
	Household freezers
Home Laundry Equipment	—Conventional washer
	Automatic washer
	Flat plate ironers
	Rotary ironers
	Dryers
Vacuum Cleaners	—Floor type
	Tank type
	Commercial
Fans	—Household
	Office
	Commercial
	Attic ventilating
	Marine
Electric Sink and Cabinet	—Dishwashers
	Disposalls
	Kitchen cabinets
Other	—Electric blankets
	Heating pads
	Sunlamps

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Organization of Plant

The business is organized as a group of decentralized units with over-all responsibility in a staff.

Each decentralized division is indicated by the main product line caption in the above listing. Each division has its own manufacturing, accounting, engineering, and sales organizations.

Separate balance sheets and profit-and-loss statements are issued by each division in addition to all control statements. Financial reports are consolidated in a general section for use of general management.

The manufacturing plants are located in ten different cities and towns with four of the divisions sharing a portion of a large plant in addition to their smaller outlying plants.

The financial responsibility in each division is assumed by a "Division Accountant." A "Works Accountant" is located at each branch plant and is responsible to both the "Division Accountant" and local "Works Manager."

The "Division Accountant" is responsible to the "Division Manager" and to the "Department Comptroller."

The "Accountant" is responsible for cost accounting, general accounting, including manufacturing and commercial, payroll and order service sections. The "Division Accountant" is a member of the "Division Management Committee."

The financial staff consists of "Cost Accountant," "General Accountant," "Tax Accountant," "Statistician," "Manager of Credit and Collections" and "Supervisor of Payrolls," with the "Department Comptroller" at the top. "Department Comptroller" is the title of the highest financial position, as the complete organization described here is a part of one of the largest electrical manufacturers in the world.

II. How to Design the Cost System

Flexibility of a Uniform Cost System in Various Lines of Manufacture

The organization described probably indicates a wide variety of cost accounting methods and possibly a lack of uniformity in the system, but actually the opposite is true.

To further illustrate the flexibility of a modern cost accounting system, I will mention the fact that within the same department described here in detail another industry is included. This industry is the "Electrical Construction Materials Industry" which produces and markets wire and cable, conduit, cord sets, switches, fuses, outlet boxes fluorescent lighting parts, etc.

One single cost accounting system, operating under a single set of established principles and identical general instructions, is used in all divisions at each of twenty-two plants in eighteen cities and towns in which the department is located.

Consolidation of cost control statistics, such as direct labor efficiency, material price control, spoilage, and indirect manufacturing expenses, is made possible by a uniform set of principles that guide the system which is applied to a wide variety of products, varied types of incentive and daywork labor payment systems and located in large, medium, and small manufacturing plants.

The basic cost accounting system would be the same if all manufacturing were done in a single plant and there were only a single line of product.

Certain basic information is required from the cost accounting system wherever materials are converted into semi-finished or completed product, and the volume of production depends on human effort. The difference between the information required in various manufacturing operations lies in the fact that the character of the product may require that greater emphasis should be given to certain cost elements in one line of product, while in another, entirely different cost elements may require the greatest attention. Nevertheless, the complete cost system should recognize and segregate each cost element and produce control statistics commensurate with the elements which affect the product cost.

Objectives and Principles of the System

Every angle of the system is pointed toward indicating the amount that profits are affected by performance and wherever possible the "reason why."

As "Cost Accounting" may be regarded as differing from "General Accounting" in that its only reason for existence is to provide management information to a greater degree than general accounting usually does, it follows that unless "Cost Accounting" contributes to management in every phase of its activity, that phase usually can be carried out more economically by general accounting methods and personnel.

It is often the practice to compile current and repetitive management information in the form of cost statistics as memoranda rather than include these statistics in the actual book accounts. Close inspection of the reason for carrying these statistics as memoranda in most systems results in the disclosure that the principles of costing for cost control work differ from the principles that regulate the manner in which product cost is stated for cost of output or cost of sales.

If the concept that cost accounting exists only for management information is accepted, cost control statistics should appear in the book accounts so that the profit-and-loss statement reflects the operating performance for the period, based on the same principles of cost accounting that the organization uses in supervising and managing the manufacturing part of the business.

For example, assume that a spoilage budget for a month is exceeded by $10,000. Each foreman responsible should know the amount for which he is responsible. The general foreman and superintendent should know the amount and "reasons why." They should also know that budgeted profits have been reduced by that amount. As it is sound accounting policy to write off losses as soon as they are known, the profit margin should be reduced that month by $10,000 and this should appear on the profit-and-loss statement.

The concept of cost accounting for profits or management may seem to disregard many previously formed ideas regarding the proper statement of product costs. The principle described above assumes there is a different product cost for any item if the conditions differ. For example, the standard cost represents the cost if all conditions of material supply and price, labor rate and efficiency, expenses, etc. are at the most favorable rates. The current month's production cost would be the standard cost adjusted by the rates of variance, based on the ratio of variance to expenditures. The sales cost is the standard cost adjusted by the same dollar amount of variances but allocated to the number of units sold. This latter cost differs from the production cost in that the number of units sold usually differs from the amount of production.

Estimated costs of future production may be the same as current production cost or may differ to the extent that it is anticipated that conditions may change from the present.

The question may be asked: What value is the sale product cost? As the sales cost is the one that has a direct bearing on the current profits, management is vitally interested. A profit minded organization must be able to focus its attention on both the short-range and long-range objectives. As high tax rates are expected to be a permanent thing it is necessary to regard product cost on a time cycle.

The cost of producing and selling a certain product in the current year is the cost that is based on the same principles that control the profit-and-loss statement. Following this same concept, the period of one month is treated the same as the complete year and losses incurred in the month are charged off to profits in that same month and simultaneously increase the cost of sales for the same period.

Standards for the cost variables, that is, spoilage, non-productive direct labor, indirect expenses, etc., are used for cost control measurement of weekly and monthly production of each of the various sections of a complete manufacturing unit. For instance, a screw machine section may exceed their standard rate for non-productive direct labor for a period by $1000. The same standard, which is used for the measurement of the efficiency of that screw machine section, is included in the standard product cost of the products using the parts produced by the screw machine section. The inventory ledger carries the proper accounts to record the excess of $1000. A journal entry credits the inventory account and charges cost of sales with the $1000 variance. Again we have the standard product cost adjusted by the variances to produce the sales cost. The screw machine foreman, superintendent, accountant, and manager know that a $1000 loss occurred. Product cost for the period reflects the increase and each segment of the system fits with all other segments without contradiction.

Sequence of Installation Phases

With the major principles and final objectives clearly in mind, the first step in designing the cost system is to set up the routines that supply the basic information for measurement of direct labor, direct materials, and indirect expenses.

The second step is to design the cost control reports that will keep the supervisory force informed currently on performance.

The third step is to design the standard cost of products sheet.

The fourth step is to lay out the ledger accounts.

The fifth step is to design the management reports, including the profit-and-loss and classified sales reports.

Note: The sequence in which the steps are described is important in that full emphasis is given to the need for cost control information by setting up the basic cost control routines first, control reports second, and book accounts fourth. The reverse procedure is often followed, to the detriment of cost control.

By waiting until steps one and two have been worked out, before setting up the standard cost of products sheet, the principles of cost control will reflect in the rules established which will govern the method in which standard product cost is compiled.

Fitting the System to the Organization

The best designed forms for disseminating cost control information are practically valueless unless they are generally used throughout the supervisory organization.

Control reports must reflect shop language, not accounting jargon.

The average shop supervisor is repelled by a great many figures on a single sheet. Often it is more advisable to use a simple chart which shows performance in picture form rather than figures. Cost control statistics are readily adapted to chart form and results of current performance compared with budget and related to past history can usually be seen at a glance on a chart but require a great many figures on a report. We emphasize the use of charts for watching over-all performance and supplement them with reports. The reports are only for the purpose of reference into a detail of the over-all performance.

Some supervisors are reluctant to use statistics in any form and a great deal of patience is required and a knowledge of individual characteristics is necessary to get them to appreciate the value of financial figures in their work. One of the surest means of getting the foreman interested in financial results is to have the general foreman or superintendent continually refer to costs when in conversation with the foreman and to use the charts and reports wherever possible at meetings of the supervisors.

Training the Organization Into Full Use of the System

Training within industry is receiving greater attention today than ever before. It is only natural that shop people, including supervisors, assume that large profits are being made whenever completed product is being shipped, even though the rate of production is only a fraction of capacity.

If cost accounting is treated from the managerial point of view, instead of straight accounting, it can be a subject for training that can add to the value of every member of the industrial organization from machine operators to president.

In a large organization, such as the one described in this section, it is the practice to conduct three different types of cost courses.

1. A complete cost accounting course for financial people.
2. An industrial cost course for factory supervisors.
3. A cost course designed for engineers.

Obviously, these courses are based entirely on the cost accounting system as it is operated within the organization.

The engineers' and supervisors' courses provide the financial training and viewpoint required by every operating man.

In addition to the formal education provided by courses, financial training and assistance to the supervisors is continually being carried on by informal meetings and contacts with operating supervisors by members of the cost accounting organizations.

The training of a complete industrial organization, into full use of a managerial cost accounting system, is a greater task than designing and setting up the routines of an adequate system. If the organization is not trained in the use of the system only a fraction of the potential value of the system will be realized.

Small organizations can make use of financial training within their organizations to the same degree as the large ones, provided the management is receptive to the idea and talent to some degree is available.

Budgets, An Integral Part of the Cost System

A cost accounting system of the managerial type must measure efficiency of operation currently.

The cost accounting system can operate under the principle that the budgets are represented by the cost standards, or that cost standards represent the long-range objective, and the budget for the current period is represented by the standards plus a budgeted variance.

Budgets should represent the plan of operation for the period, so that variations from the budget indicate changes in the original plans, inability to operate as efficiently as planned, or performance better than planned.

Successful operation of a manufacturing business depends, to a large degree, on ability to plan well. Budgeting on the theory described here is designed to increase planning ability by providing continuous information on the quality of planning that exists in the organization.

Manufacturing operations, commercial expenses, sales, and investment budgets must all form a part of a single profit-and-loss budget.

III. Description of the Cost Accounting System

Direct Labor Accounting

All payments to labor operators, who are working directly on the product, with the exception of overtime premiums and night bonus, are classified as a separate element of cost under the caption "Direct Labor." Overtime premium and night bonus expenditures are charged to indirect manufacturing expenses.

The fact that only a portion of the total direct labor represents efficient productive effort is recognized, and that portion is identified as "Standard Productive Direct Labor." The balance of the payments, with the exception noted in the preceding paragraph, is identified as "Non-Productive Direct Labor." The ratio of the non-productive direct labor to the standard productive direct labor provides the measuring stick of efficiency and cost.

The reason for identifying both productive and non-productive direct labor as being included in the same element of cost is to provide the foremen with direct labor statistics that present the efficiency, in dollars, of all the operators under his supervision. In some systems it is the practice to charge the non-productive portion of direct labor payments to indirect manufacturing expenses. Another reason for including all payments to direct labor as a separate element of cost is to compile product cost by these separate elements so that the effect of each on the total manufacturing cost is readily seen.

Standard Productive Direct Labor

Standards are set for each repetitive planned operation required to fabricate the product. If wage payment is on an incentive basis (usually individual or group piecework) the standard is the piecework price for each operation. If the planned

operation is performed by a daywork operator, a standard is set up by the operation planning section.

The standard productive direct labor amounts provide the measure of volume of production. These standards usually remain unchanged for a period of one year. Volume of production for any section of the factory is determined for financial purposes by the amount of standard productive direct labor. It is difficult and sometimes impossible to determine by any other means the volume of production in a machine shop that is machining hundreds of different parts and not producing any completed product.

As the amount of standard productive direct labor is a true index of volume, all factory expenses are stated in terms of percentages to the base labor.

There is a basic fact and a basic principle of cost accounting involved in the method described in the preceding paragraph.

The basic fact is that the only reason for existence of the manufacturing plant and organization is to perform the standard productive direct labor and that all other expenditures are incidental to this main purpose.

The principle is based on the theory of balance. The ratio of expenses to volume of production must remain within fixed limits or profits suffer.

Following this principle completely requires that all cost control statistics provided for management contain the ratio of expenditures to standard operation direct labor, as well as the dollar amount of the expenditures.

Non-Productive Direct Labor

Non-productive direct labor consists of payments to operators for reworking defective product, setting up machine tools to perform the operations required, and all payments made due to inefficiencies, either avoidable or unavoidable by operators or management. In addition, there is included in non-productive direct labor the amount of decrease or increase represented by changes in design of product, equipment and methods, since the cost standards were set up at the beginning of the year. This latter is captioned "Design and Planning Changes."

A standard for non-productive direct labor is set in terms of a percentage of standard operation direct labor. This labor item is regarded as a separate class of factory expenses.

Direct Material Accounting

Standards for the material entering directly into the product are of several different types:

Components made from basic raw materials.

The most economical quantity required per unit is determined by the planning section and this becomes the standard amount. As tool design regulates to a degree the amount of material required, the determination of the standard material quantity and design of dies and other special tools is done at the same time. The standard price, stated in the same manner as the material is purchased, that is, pounds, gallons, etc., is the contract price at time of setting standards or the lowest quotation from qualified vendor. The purchase quantities are "normal" ordering quantities.

Note: No attempt is made in this system to set "ideal" standards for any element of cost. "Ideal" raw metals' standards would not include "quantity extras." The reason "ideal" standards are not determined is due mainly to the fact that the expense required to obtain them and keep them up to date is greater than the additional benefits obtained according to our viewpoint. The measuring stick which is used is represented by "practical" standards determined on the basis of "best obtainable performance" for the long-range viewpoint and budgets for current period measurement.

The standard material quantity at the standard raw material price, plus the standard finish cost if any, becomes the standard direct material cost of a component made from basic raw material.

Parts and subassemblies, purchased completely fabricated or semifinished, have a standard cost based on the current contract at time standards are set up or best quotation from qualified vendor.

Spoilage Accounting

Raw materials, finished and semifinished parts, and subassemblies and completed products that are defective and cannot be reworked economically are scrapped and regarded as spoilage. Spoilage is valued at standard direct material, plus standard direct labor, plus standard indirect manufacturing expense rate, less salvage value. The spoilage "loss" appears on supervisors' control reports and is a separate element of product cost.

Indirect Manufacturing Expense Accounting

All manufacturing expenses, other than those mentioned previously, except "development" or "engineering expenses" are included in indirect manufacturing expense.

This includes salaries of superintendents, foremen, clerical and service employees, shop supplies, nondurable tools, maintenance, depreciation, insurance, etc.

The distribution of indirect manufacturing expenses follows the theory that all items sharing the same facilities should bear the same rate of burden. It is common practice to have a single standard rate of indirect manufacturing expense for a complete division which includes various machine shops, assembly sections, stock rooms and complete division management, financial and operating organizations, when the complete division is under the same roof.

All models and lines produced within a division share to some degree the same facilities unless the facilities are physically separate.

Cost control operates from two different manners of approach. First, efficiency of operation is usually a question of proper management of a section of the organization which is utilizing a part of the facilities. The statistical control items result from data originating from charges incurred in the section.

The second approach is from a product viewpoint. The difference between the standard product cost of two models in the same line is represented by the basic difference in design and methods of producing the parts that are not common to both models. The comparison between the cost of the two models is not affected by the variables of cost, such as non-productive direct labor, and indirect manufacturing expense, as the same rates for these elements are included in both costs. As efficiency is a fluctuating factor its influence should generally be disregarded in product cost comparisons. Cost control, through study of the product, is guided toward design and methods.

Distribution of indirect manufacturing expenses is not complicated by the need for assessments to various production centers, some of which are often arbitrary in character.

As the business is primarily concerned in the manufacture and sale of completed product and sells parts only for repair and replacement, there is no advantage in distributing indirect expenses by a fine segregation.

Engineering and Special Tools Accounting

Expenses of designing, drafting and other engineering expenditures, including cost and maintenance of special tools, are segregated into a separate element of cost.

Engineering accounts are set up for each line of product. For example, the Heating Device Division will have a separate account for irons, another for roasters, etc.

A standard amount of engineering expense is included in the standard product cost of each item in the line.

Variations from the standard represent an increase or reduction in gross margin for the period.

Cost Variances

Both "Work in Process" and "Finished Stock" inventories are carried at standard cost.

Total expenditure for all elements of cost are first changed to "Work in Process" inventory but the standard value and variances are booked in separate sub-accounts.

The variances are transferred to "Cost of Sales" in the same month the charges are received, which results in a "wash" entry for variances in "Work in Process" inventory. Table 2 illustrates the result of these entries.

Finished stock is transferred from "Work in Process" inventory at standard cost.

When cost standards are changed a revaluation of both inventories is required. A corresponding adjustment to cost of sales results.

If variances result in an over-all credit, cost standards should be revised as the inventory investment will not meet the requirement of cost or market, whichever is lower.

Analysis for Supervisory Executives (Manufacturing Operations Report)

A monthly manufacturing operations report provides the detailed financial analysis of the complete manufacturing operation as carried on at each plant. This report is also used by management.

Table 2 illustrates a form of analysis report that provides the information in such a way that budget realization can readily be seen. The effect on profits of manufacturing performance is shown by the amount of variances over/under budget. Profit-and-loss reports are not distributed to the supervisory force. But the manufacturing operations report, which is designed for the supervisors and management, is distributed to the supervisors monthly. It shows the supervisors by what amount the profits are increased or decreased over the planned amount through the factory operations. Note that Table 4, profit-and-loss statement, in-

cludes the exact amount of variance as the manufacturing operations report. Costs are accounted for on an expenditure basis. The manufacturing operations report compares performance with expenditures and the profit and loss compares factory performance with sales billed.

Various other analyses are provided on a daily and weekly cycle but are designed to concentrate attention on individual sections of the organization and also on separate elements of costs, that is, statistics showing performance in spoilage, non-productive direct labor, indirect expense labor, etc. All manufacturing organization reports use the same standards and the same budget.

Profit-and-Loss Statement

The profit-and-loss statement, Table 4, is designed to concentrate attention on the gross margin at standard; to provide a means of measuring the long-range possibilities of the products; and also to bring out the result of "sales mix" on profit. Any change in the standard gross margin, during a period in which cost standards have remained unchanged, is caused by the actual sales consisting of a different mixture of products or models than planned; also, a change in selling prices will cause a change in standard gross margin. Either of the two reasons for change in standard gross margin is the responsibility of the sales organization.

As manufacturing cost variances are detailed on the profit-and-loss statement, the actual gross margin reflects the separate performance of the selling and manufacturing organizations.

Commercial and administrative expenses are detailed by major accounts and are part of gross margin.

Federal taxes are shown at the accrued rate and each division is regarded as a separate business as far as the division profit-and-loss is concerned. A reconciliation is required for the difference between Federal taxes, total for the business, and the combined total of the various divisions.

Investment and return on investment are given a prominent place on the profit-and-loss statement and performance to budget closely watched.

Classified Sales Report

The classified sales report, Table 5, serves to focus attention on the profit obtained on each product or wherever the variety is too great, the line of product.

Note: Each one of the control instruments described in this system is constructed from the same basic records. One operating plan for the complete organization is represented by the budget.

TABLE 1. STANDARD MANUFACTURING COST PER "M" OF PRODUCT "A"

Part No.	Material	Qty.	Price Per M	Material Amount	Labor Amount
1	4170413-2 Lower Casting Assembly	1		x	x
2	#6-32 × ¼ RD-HD-SD Screw Tapping (Shakeproof)	2	x	x	x
4	4174079-2 Unit Assembly	1		x	x
3	4176211-1 Base Assembly	1		x	x
5	4176214-1 Case Assembly	1		x	x
6	4171749 Cam Shaft Extension	1		x	x
7	1/16 × 3/8 Cotter Pin (Nickel)	1		x	
8	4173607-4 Lead	1		x	x
9	4173607-1 Lead	1		x	x
10	4173207-2 Lead Casting	1		x	
11	BPW-18 Cup Washer	2	x	x	x
12	4172505 Cup Washer	2	x	x	
13	4173059 Hex Nut	1		x	x
14	4199023-2 Spacer	1		x	
15	4174315-2 Base Rate Assembly	1		x	x
16	C-7 7 Watt Lamp	1		x	
17	4174219-4 Lid Assembly	1		x	x
18	4170423-2 Upper Casting	1		x	x
19	4171730-1 Groove Pin	1		x	
20	4174079-2 Unit Assembly	1		x	x
21	22X310 Cord Set	1		x	
22	4174643 Knob	1		x	
23	½ — 20 × 5/16 RR Screw (Nickel)	1		x	
24	4174079 Press. Plate—Upper	1		x	x
25	4172606 Shoulder Screw	2	x	x	
26	4172220 Press. Plate—Lower	1		x	x
27	4171676 Stud	1		x	
28	Hex Nut ¼" 0.20 Nickel Finish	2	x	x	
29	Pack SJ57515 Sec. 51			x	
	Assembly and Pack				x
	Test				x
	Total Productive			x	x

SUMMARY (COST EACH)

Total Direct Material Standards	$1.67
Total Productive D.L. Stds. (A)	0.47
Spoilage Standard (10% of A)	0.05
Non-productive D.L. (20% of A)	0.09
Indirect Mfg. Expense (125% of A) Std.	0.59
Engr. and Special Tools Standards	0.15
Total Standard Manufacturing Cost	$3.02

TABLE 2. MANUFACTURING OPERATIONS REPORT

	Current Month		
	Amount	A%	R%
Standard Productive Direct Labor	$ x	100%	x%
Standard Direct Material	x	x	x
Adjustment for Spoilage Included	–		
Total Net Direct Expenditures	x	x	x
Manufacturing Expenses:			
Non-productive Direct Labor	x	x	x
Direct Material Variance	x	x	x
Spoilage Losses	x	x	x
Indirect Manufacturing Expenses	x	x	x
Adjustment for Spoilage Included	–		
Engineering and Special Tools	x	x	x
Total Net Expenses	x	x	x
Total Charges to Inventory	$ x	x%	x%

		Over/Under Budget
Transfers to Warehouse at Standard	$ x	$ x
Cost Variances to Profit and Loss:		
Direct Labor	x	x
Direct Material	x	x
Spoilage Losses	x	x
Indirect Manufacturing Expense	x	x
Engineering and Special Tools	x	x
Total Variances	x	x
Total Credits to Inventory	x	x
Increase or Decrease in Inventory	x	x
Inventory Beginning Period	x	
Inventory Balance This Date	$ x	$ x

A%—Actual percentage rate to Standard Productive Direct Labor.
R%—Realization to budget.

TABLE 3. INDIRECT MANUFACTURING EXPENSE REPORT

Expense Accounts		Current Month Amount	A%	R%
1101	General Supervision			
1102	Salaried Foremen			
1103	Leaders			
1104	Inspectors			
1105	Production Clerks			
1106	Stock Clerks			
1107	Cost Clerks			
1108	Accounting Clerks			
1109	Payroll Clerks			
1110	Order Clerks			
1111	Planning			
1112	Wage Rate			
1201	Helpers and Laborers			
1202	Elevator and Crane Operators			
1203	Stockkeepers and Helpers			
1204	Tool Crib Attendants			
1205	Transportation Employees			
1206	Dispensary Attendants			
1207	Plant Protection			
1208	Power Plant Attendants			
1209	Personnel Employees			
1300	Overtime Premiums			
1301	Night Shift Bonus			
1401	Non-durable tools			
1402	Shop Supplies			
1403	Office Supplies			
1404	Telephone and Telegraph			
1405	Water Supply			
1406	Fuel and Power Purchased			
1407	Rearrangement of Equipment			
1408	Travel and Entertaining Expense			
1409	Accident Compensation			
1410	Taking Inventories			
1411	Suggestion Award Payments			
1501	Maint. Buildings and Structures			
1502	Maint. General Plant Facilities			
1503	Maint. Machinery			
1504	Maint. Ovens and Furnaces			
1601	Continuity of Service Expense			
1602	Vacation and Military Duty			
	Subtotal			
1700	Depreciation			
1701	Taxes			
1702	Insurance			
1703	Rentals			
	Sub-total			
TOTAL INDIRECT MANUFACTURING EXPENSE				
Memo—Standard Productive Direct Labor				

A%—Actual percentage to Standard Productive Direct Labor.
R%—Realization to budget.

PROFIT AND LOSS STATEMENT

	Current Month		
	Actual Amount	% to NSB	Budget
Net Sales Billed			
Std. Mfg. Cost of Sales			
Gross Margin at Std. Cost			
Variance From Standard:			
Direct Material			
Spoilage			
Direct Labor			
Indirect Mfg. Expense			
Engineering and Sp. Tools			
Total Mfg. Variance			
Gross Margin			
C. & A. Expenses:			
Operating Expense			
Direct Publicity Expense			
Other Direct Expense			
Total C. & A. Expenses			
Margin Before Federal Taxes			
Federal Taxes			
Margin After Federal Taxes			
Investment:			
Raw and Work-in-Process Inv.			
Warehouse Inventory			
Consignment Inventory			
Mfg. Plant, Rec. and Cash			
Total Capital Investment			
Return on Capital Investment (Annual Rate)			

Annual Forecast	Original	Revised
Net Sales Billed		
Margin After Federal Taxes		
Return on Capital Investment		

Table 4

Model or Product	Sales Billed		Gross Margin at Std. Costs		Cost Variances	Gross Margin after Cost Variances	
	Units	Amount	Amount	% S/B		Amount	% S/B
Product #1 Product #2 Product #3 Product #4							
Total Gross Sales							
Cash Discounts Transportation							
Total							

Table 5. Classified Sales Report.

COST ACCOUNTING IN THE ELECTROPLATING INDUSTRY

By
JULIUS E. FLINK *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

The products of the electroplating industry are, with few exceptions, essentially services performed. While materials are a significant cost factor, they are all absorbed in production in minute quantities for each unit. Characteristically, the basic material on which plating is done is generally the property of the customer and is not furnished or purchased by the electroplater. While very often, large quantities of articles are handled for each customer and in constant flow, the business is essentially of a job order character and the varieties of individual orders are generally of an unpredictable nature. It is, consequently, impossible to sharply define categorical groups of products. Some manufacturers, however, subdivide the business into base metal plating and precious metal plating although costing is consistently maintained for each job.

Although a great part of the work performed is in plating a baser metal with a more highly decorative coating and is known as ornamental plating, a field of no little importance is known as industrial plating which covers a multiplicity of products serving definite industrial functions. The latter consist generally of the "hard" metals, such as chromium, and are used for purposes where hard surfaces or edges are necessary for proper or improved function of the article or tool. In this group molds and cutting tools are an important group and are, in some cases, plated by specialists in that field.

Origin of the Product

The electroplating industry is essentially part of a whole manufacturing process. Never does it sell its product in itself as merchandise and, except for occasional sales, never does it sell to the ultimate consumer directly. In the "ornamental plating" field, electroplating is generally the finishing process of an article or part of an article. In the field of "industrial plating," its product is generally the finishing process of a part of a machine or tool. Hence, all of the products of the electroplating industry originate either directly or indirectly with process of manufacture.

Organization of the Plant

The electroplating plant is organized in accordance with the functions of each group of employees. The two main groupings of the personnel are non-productive and productive.

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Non-productive:

Plant Management
Estimating
Production Control
Purchasing
Personnel
Plant Maintenance and Tools
Engineering
Stores

Productive:

Rack Design and Production
Masking Operations
Tank Operation
Polishing
Inspection
Shipping and Receiving

While the foregoing represents the ultimate subdivisions of departmental operations, many of the functions are combined to form a single department. Similarly, while some functions are carried out by numbers of personnel, many others may be performed by a single individual, depending upon the extent and size of the operations. For example, in plants of smaller size, plant management, production control, estimating, and engineering may be performed by a single individual. On the other hand, in plants of greater size, further departmental subdivision exists, such as precious metals, hard chromium, special racks, etc.

II. How to Design the Cost System

What Information Is Required

In processing products of highly individual character and where the basic elements of continuous and uniform processes are absent, the cost system must be designed in such a manner as to give accurate results correlated to original estimates for the job. To accomplish this, it is necessary to determine:

1. The cost of operating each tank per hour (including materials which are absorbed at a uniform rate per ampere of current).
2. The cost of operating each grinding or polishing machine per hour.
3. The cost accumulation in fabricating special racks or in masking sections of the article which is to be left unplated.
4. Cost accumulations while in each stage of production correlated to the original estimates.
5. The resultant data for the preparation of analytical production reports and for the profit-and-loss statement and balance sheet.

The general purpose in accumulating such cost data is to test the accuracy of the methods of estimating which form the basis of pricing and to discover inefficiencies in the productive operations. Since estimating is undertaken by those who, by long experience in the field, are thoroughly familiar with production methods, or after test of a sample "run," the estimate sets the standard or normal for the job. The cost accumulations, therefore, reflect the variances from standard or normal

which represents a computation by experts. After final analysis, the experts critically re-examine those standards. The importance of the variances reflected in costs, therefore, exists in the close interrelation of estimates to actual costs and in the critical emphasis it places on each.

III. Description of the Cost System

The cost system is so designed as to make readily available actual costs at each stage of production and comparison with the corresponding estimates or standards. This objective is accomplished by the following steps:

1. Established standard costs per hours for material and overhead for each tank (Figure 1).
2. Design Departmental Time Cards (Figure 2).
3. Design Labor Waste Reports (Figure 3).
4. Design Job Cost Summary Card (Figure 4).
5. Design Tank Operation Card (Figure 5).
6. Design Production Report (Figure 6).
7. Design Completed Job Report (Figure 7).
8. Design Uncompleted Job Report (Figure 8).
9. Establish the necessary procedures for accomplishing the desired objectives.
10. Design all accessory forms such as requisition forms for materials, purchase orders, etc.

Standard Cost of Operating Per Tank Hour

Each tank in the plant operates with certain metallic salt solutions, the constituents are dissolved according to predetermined proportions. As a rule, such solutions are effective for electroplating at certain electrical currents for a definite length of time. Generally, each tank is used only for certain metals and none other. There are occasions, however, where solutions are changed, but this cannot be a frequent practice without seriously impairing the efficiency of operation in the plant as a whole, since there is loss in handling and in cleaning tanks. The identity of each tank, therefore, is maintained in relation to the particular solution with which it operates. In establishing the cost of operation per tank hour, therefore, it is first necessary to obtain the cost of the materials used in the solutions as disclosed in the established formulas. The cost of power is always a known factor and is related to the capacity of the tank and the kind of solution used. Overhead is determined by charging each tank with its proper proportion of fixed charges, supervision and general Tank Room supplies. This is generally done by a simple apportionment based on the normal average operating hours of each tank. Depreciation, repairs, and special anodes and maintenance are charged directly to each tank affected. In order to facilitate the work of establishing hourly tank rates and of reflecting permanent charges, an account is set up for each tank, summarizing the standard components (Figure 1).

Direct Labor

Labor is charged to jobs by time accumulations in each department. This is accomplished by the use of time cards (Figure 2) for each productive employee.

STANDARD HOURLY RATES

For the year 1946 Tank No. 5

Normal Average Hours Per Month 500

Solution Capacity 103 Gals.

Cadmium 5 Amps 210 Hrs.

Materials:			
25.7 lbs. Cadmium Oxide	@ 1.80	46.20	
64.4 lbs. Sodium Cyanide	@ 0.15	9.66	
12.9 lbs. Caustic Soda	@ 0.05	0.65	
Anodes 8 lbs.	@ 0.40	3.20	
Total Materials		59.71	
Power 16.5 Kwh.	@ .02½	0.42	
Total Materials and Power For 210 Hours		60.13	
Per Hour			.286
Overhead (per month):			
Fixed Charges		14.20	
Repairs		8.40	
Supervision		52.30	
Depreciation		21.00	
Factory Supplies		7.20	
Total for 500 Hours		103.10	
Per Hour			0.206
Total Hourly Rate			0.492
Idle Hourly Rate			0.206

Chromium
Etc.

Fig. 1.

Each employee in each department indicates the elapsed time of each operation which is then accumulated in the cost summary of each job. "Waiting time" or non-productive time is accumulated by departments in a "labor waste report" (Figure 3).

Cost Summary

Each job is controlled while in process by an individual job cost summary card wherein is accumulated the various costs as reported from each department. This is done by charging the labor time at the current rates paid each employee and charg-

ing plating time at tank hour rates. Provision is made for materials used in fabricating special racks or anodes (Figure 4).

Tank Operations

In order to be able to account for the performance of each tank, a tank operation card is maintained for the purpose of accumulating the actual hours of opera-

TIME CARD

Employee's Name _____

Employee's No. _____ Hrly. Rate _____

Department _____

Date _____ 19____

Job No.	Qty. Complete	Set-up Time		Waiting Time		Reason for Waiting
		Start	Finish	Start	Finish	

Fig. 2.

tion and consequently to determine what portion of overhead is actually absorbed in operations and what portion accumulated in idle time. Many tanks are equipped with punch clocks or other time recording devices whereby a mechanical operation indicates on the production tag the time elapsed while a job is in the tank. A card is maintained for each tank and the time for each job is posted thereon (Figure 5).

Production Reports

The production report is so designed as to quickly evaluate the actual use to which the productive capacity has been put during a month. The data for this

LABOR WASTE

Department _____

Month of _____ 19____

Date	Employee's No.	Time	Rate	Amount

Fig. 3.

JOB COST SUMMARY

Article _____ Customer's Name _____ Job No. _____

Quantity _____ Kind of Plate _____ Kind of Polish _____

Order No. _____ Price Quoted _____ Date completed _____

Estimate	Labor			Materials				Overhead		Plating				
	Date	Qty.	Amount	Date	Qty.	Price	Amount	Date	Amount	Date	Rate	Time	Amount	Qty.
Racks:														
Labor														
Material														
Overhead														
Total														
Special Anodes:														
Labor														
Material														
Overhead														
Total														
Masking:														
Labor														
Material														
Overhead														
Total														
Plating:														
Setup and Demount														
Tank Hours														
Rate														
Total														
Polishing:														
Barrel														
Other														
Total														
Other Finish:														
Labor														
Material														
Overhead														
Total														
Grand Total														

Fig. 4.

TANK OPERATION CARD

Tank No._____

Average Monthly Operation_____ Hours Year_____ Rate_____

JAN.			FEB.			MAR.			APR.			MAY			JUNE			JULY			AUG.			SEPT.			OCT.			NOV.			DEC.		
Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time	Date	Job #	Time

Fig. 5.

PRODUCTION REPORT

Month of_____ 19____

Tank No.	Standard Hours	Productive Time	Idle Time	Consumed Materials and Power	Overhead Absorbed	Idle Overhead	Total Standard Overhead	Actual Overhead	Variance Overhead

Fig. 6.

COMPLETED JOBS

Month of_____19____

Date	Job No.	Qty.	RACKS			ANODES			MASKING			PLATING			POLISHING, ETC.			TOTAL			Selling Price	Profit or Loss
			Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance		

Fig. 7.

UNCOMPLETED JOBS (WORK-IN-PROCESS)

As at_____19____

Job No.	RACKS			ANODES			MASKING			PLATING			POLISHING, ETC.			TOTAL		
	Estimated	Actual	Variance	Estimated	Actual	Variance	Estimated	Actual	Variance	Estimated	Actual	Variance	Estimated	Actual	Variance	Estimated	Actual	Variance

Fig. 8.

report are obtained from the totals reflected in the tank operation cards at the end of each month and is so delineated as to evaluate both the productive and idle time (Figure 6).

Completed Jobs

When a job is completed, the job cost summary card is ready for summarizing in the completed job report. This report is kept currently, all entries being made thereon as soon after delivery as is feasible. The purpose of this report is not only to arrive at the individual profit or loss on each job but to point out more than reasonable amounts in the original estimates. If billings are made for completed parts of a quantity order, such portion of the costs as is applicable to the completed quantity is reflected and the balances of costs are transferred to a continuation job cost summary card for the remaining portion of the job order. This must be done by reference to the quantities produced in each department (Figure 7).

Uncompleted Jobs

When jobs are in the plant in an unfinished state, much valuable information is still available to the plant management despite the fact that profit or loss cannot yet be determined. In making a report, therefore, of the state of uncompleted jobs two important purposes are served. First, management may examine variances while the job is still in the plant and when it is still possible to take corrective measures against excessive departmental costs. Second, the report itself summarizes the actual cost of work in process as of a given date. In making proper comparison with estimates, however, it is necessary to adjust the estimates of the latest incomplete stage of production so as to correspond proportionately to the actual work done (Figure 8).

General Ledger Control

The cost accounts in the general ledger are all departmentalized to conform with the main classifications in the job card summary as follows: Racks, anodes, masking, plating, and polishing.

Labor is proved for each department by accumulating:

Labor Waste	_____
Labor Completed Jobs	_____
Labor on Uncompleted Jobs at end of period	_____
Less: Labor on Uncompleted Jobs at beginning of period	_____
General Ledger Balances	_____

Materials consumed in each department may be proved by accumulating:

Materials consumed in completed jobs	_____
Materials consumed in uncompleted jobs at end of period	_____
Less: Materials consumed in uncompleted jobs at beginning of period	_____
General ledger balances	_____

COST ACCOUNTING IN THE FABRICATION AND ERECTION OF STRUCTURAL STEEL

By
C. L. TURNER *

I. DESCRIPTION OF THE INDUSTRY

Products

The Structural Steel Industry is divided into two types of operation, fabrication and erection. The products of structural steel fabrication are the steel structural members cut to the proper size, with necessary mounting pieces attached and necessary holes punched so that the steel framework of the entire building can be assembled therefrom on the site of erection without the necessity of any fitting or adjusting on the site. Steel for buildings and bridges of all types as well as for radio and electric transmission towers is fabricated. The erection of these members as the steel work of the structure, be it building, tower, or bridge, is the function of the erection operation. Since each structure is different, there is no standardization of products between orders. Although there may be multiple members in one order, it is only on very rare occasions that any two orders will produce identical members. This, then, militates against any production for stock. Everything is produced on a custom basis for each individual contract.

Raw Materials

The raw materials for fabrication are steel rolled in the various structural shapes such as angles, I-beams, channels, etc., all in mill lengths. Additional raw materials are rivets, bolts, paint, etc.

Organization of Plant

A structural steel plant consists of a fabricating shop, a storage yard, a template shop, and a maintenance shop. In some instances, there is a storage yard for finished work which is entirely separate from the storage yard for raw materials. The erection equipment is the plant of the erection department since all of their work is done at the site of the structure. No outline will fit every plant, but these are the units essential to any structural steel operation.

A very important part of the organization of every structural steel enterprise is the Engineering and Drafting Department. In this industry, each job is produced to specifications and individual architect's drawings. In every case, it is necessary to convert these specifications and drawings into working drawings which can be used by the shop. This department is also used extensively for the preparation of bills of material and cutting lists.

The equipment used in the fabrication of structural steel conists of machines

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designed for the cutting, punching, and joining of steel, such as plate shears, angle shears, burning and chipping equipment, automatic spacer punches, punch presses, radial drills, welding equipment, riveting machines, etc. Materials are moved from one location to another by means of cranes and hoists, and cranes and blocks are used extensively in the erection operations.

Segregation of operations into individual departments within the fabricating shop is counter-indicated because of the nature of operations. In general, the unprocessed structural shapes come in one end of the shop where the shears and first cutting tools are located and process through the various operations to be performed on them and wind up with the fastening of the mounting pieces at the other end of the shop. Because of the individual character of each job, no true production line is practicable, but the foregoing schematic route is followed and the machinery is so placed as to make this possible to as great a degree as possible.

Accountingwise, the following departments are found in the organization of a structural steel enterprise:

Administrative:
- Management
- Accounting
- Purchasing
- Personnel

Sales

Engineering and Drafting

Manufacturing:
- Production Control
- Maintenance
- Structural Shop
- Template Shop
- Erection Department

Further refinement will be indicated in larger organizations, but the above segregation is the minimum which should be employed for control purposes in any organization.

Production Order System

Production orders originate with the signing of a contract for the furnishing of structural steel for a specific structure. Upon the signing of such a contract, the sales department prepares Notice of Contract Award, Figure 1, in quintuplicate. The original accompanies a copy of the contract to the accounting department. The duplicate accompanies all pertinent drawings and blueprints to the engineering and drafting department. The triplicate notifies the production control department of the existence of the contract and requests the assignment of a Shop Order Number. From this point on, all references to the contract carry the Shop Order Number. The fourth copy is forwarded to the erection superintendent and the fifth copy remains in the files of the sales department.

As soon as possible, a Bill of Material is prepared by the engineering and drafting department and distributed to the production control department. From this, the production control department determines what pieces are to be fabricated from stock materials and which materials should be purchased specially for this contract. A purchase request is then drawn on the purchasing department for any nonstock materials, the inventory of stock materials to be used is checked, and a reservation put thereon for those items to be processed from stock materials.

Upon the completion of the preparation of a sufficient number of working drawings, they are released by the engineering and drafting department to the production control department. Immediately upon the receipt by the production control de-

partment of the working drawings, the job is scheduled and Shop Order forms, Figure 2, are prepared and released. The original copy of the Shop Order is forwarded to the accounting department, and one copy goes with the drawings to the Template Shop. The shop copy of the Shop Order follows the work throughout the shop, and cost entries are made on the accounting copy. A third copy of the Shop Order is transmitted to the erection superintendent, the fourth being retained by the production control department.

II. How to Design the Cost System

What Information Is Required

As with all cost systems, the maximum of managerial control derived from the least expenditure of money is the end to be achieved. Because of the individual character of each job, the chief value of a cost system in this industry is found in a comparison of actual to the estimated costs upon which the sales price was based, and a determination of the reasons for any serious discrepancies, with the collateral function of furnishing detailed operating statistics for future use in estimating. This comparison is applicable to direct costs only, since indirect costs are estimated as a percentage of direct labor and any variations from such a percentage are more important on an annual or other periodic basis than on an individual contract basis. Therefore, comparisons with estimates are for prime costs only.

Data presented to top management should be a summarized actual to estimate comparison broken down by jobs or contracts at the finest. In some cases, over-all profit and loss summaries will be sufficient for top management. Production superintendents will also want information as to the efficiency of each operation.

Considerations in Designing the System

In the structural steel industry, contracts are let on a competitive bid basis. It is therefore necessary that estimating be accurate and that the cost system provide information leading to accurate estimating and providing an adequate check on performance as against said estimating. Because of this basic consideration and the various data to be supplied by the cost system, the historical actual job cost system is clearly indicated.

III. Description of the Cost System

The most important steps in designing a job cost system for this industry are as follows:

1. Establish the necessary chart of accounts.
2. Provide the means for gathering the necessary data and feeding it into the cost system.
3. Design the Shop Order Cost Sheet (Figure 3).
4. Design the Summary Profit-and-Loss Statement for top management (Figure 4).
5. Design the reports for operating executives, such as:

   Direct Cost Comparison by Contract (Figure 5).
   Operational Cost Comparison (Figure 6).
   Monthly Overhead Analysis (Figure 7).

Summary Profit-and-Loss Statement Format

It will be noted that Figure 4 shows a simplified standard profit-and-loss form with the exception of the "Estimate" and "Variance" columns in the cost of sales section. With the addition of these two columns, all of the information immediately necessary to top management is presented, profit or loss for the period and the reasons for a variation from the anticipated profit or loss. When actual costs are running in line with estimates, there will be no reason for top management to concern itself with any more detailed analysis than this. When the situation demands that top management look into the more detailed aspects of costs, they will call upon their operating executives who will be supplied with the necessary detailed information as set forth below. The estimate and variance are shown for the various Overheads for the purpose of accounting for the entire variance only, since it is normally anticipated that there will be an over or under variance in this cost ingredient every month.

Shop Order Cost Sheet

From a study of the two forms, Figures 3 and 4, it will be noted that the profit-and-loss statement is merely a summary of the various cost sheets which have been closed out during the month with the addition of sales, selling and administrative expense, and nonoperating income or expense in order to produce a complete picture.

Immediately upon receipt from the production control department of the Shop Order, Figure 2, the accounting department carries the pertinent information to a Shop Order Cost Sheet form, Figure 3. The forms are so designed that the Shop Order and Cost Sheet are filed together, with only the information essential to positive identification being carried from the Shop Order to the Cost Sheet. Entries are made to the latter sheet from material and freight invoices and from payroll summaries for freight, direct material, and direct labor, respectively. Entries to the Cost Sheet for indirect expense are made from overhead distribution entries. The estimate is entered from the Shop Order and when all work is completed, the various money columns are totaled and the variance from the estimate is entered. Until such time as the work is completed, the entire cost accumulated on the shop order remains in "work in process" and does not become part of "cost of sales" until the entire order can be included.

Determination of Estimates

Since the estimates in this industry are the basis of the selling prices and therefore the primary determining factor in the obtaining of contracts, all estimating is usually done by the sales department. Also, because each job is completely different, historical data by jobs is of little or no signficance in the determination of estimates, although detailed operational costs are used in determining labor estimates. Therefore, an exposition of the exact methods of the determination of the estimates is without the scope of this treatise. However, it should be borne in mind that the primary function of the cost system is to provide a check of the actual against the estimate. For this reason, all copies of the Shop Order carry the estimate and it is entered on the Shop Order Cost Sheet. When the actual direct costs on any individual order vary greatly from the estimate, it is the responsibility of the Chief Accountant to call the attention of the chief estimator, the plant super-

intendent and the erection superintendent to this fact. All three of these individuals are involved since a variance in either direction could be the result of either faulty estimating or production errors or inefficiency.

Analyses for Operating Executives

As pointed out above, the chief accountant will notify the chief estimator and the plant superintendent in all cases wherein the actual varies greatly from the estimate. This procedure is, however, merely supplementary to the various reports issued routinely for the purpose of notifying all concerned of the relationship of actual to estimated costs. Two of the three examples included herewith, Figures 5 and 6, are routine monthly reports designed for this purpose. Figure 5, Direct Cost Comparison by Contract, is merely a summary of all of the shop orders closed out during the month and is an analysis of the Cost of Sales section of the Summary Profit-and-Loss Statement. Figure 6, Operational Cost Comparison, is prepared from special payroll summaries as outlined below and sets forth a comparison of actual to estimated labor costs by operation. Another periodic report which is of great importance is a listing of all shop order numbers on which the actual has equaled or exceeded the estimate before closing out. In the course of making the weekly labor postings to the Shop Order Cost Sheets, the total accumulated labor in each column is visually checked against the estimate appearing thereon. In every case in which the accumulated actual labor is found to equal or exceed the estimate, the shop order number is noted and all such numbers are incorporated in a list which is immediately circulated to operating and sales executives.

The monthly overhead analysis, Figure 7, is prepared for a dual purpose: First, to account for the variation between actual and estimated costs; and, second, to provide operating executives with some information as to the amounts of costs being accumulated in the various categories. At the bottom of this form it will be noted that provision is made for the entry of "Overhead at —% of Direct Labor." The percentage to be entered in this space is that used in the preparation of estimates for the purpose of setting sales prices. This percentage can well vary from time to time as circumstances dictate. If this report shows a consistent over or under absorption over a protracted period, this is a direct indication that the percentage should be changed.

If the management desires to go into the subject of manufacturing overhead more fully, flexible budgets can be set up for varying labor loads and the under- or over-absorption can then be traced to variance from the budget and labor load over or under average. Although this involves a slight amount of extra work on the part of the Accounting Department, it is usually well worth while due to the amounts of money involved. The use of such a flexible budget would only need to point out one type of expense getting out of line to more than pay for the cost of its installation and operation.

IV. How the Data for the Summary Profit-and-Loss Statement are Obtained

Sales

The sales figure as shown in this statement is not necessarily the same figure as would be shown on a normal profit-and-loss statement. Progress billings are not included since there is no accurate basis for determining the actual cost allocable

thereto. The entire amount of the sale and the entire amount of related actual cost are included upon the completion of the order. By the same token, sales and costs are entered on this statement immediately upon completion of the work, even though billing may be delayed for a considerable period. The value of this report would be greatly reduced if sales and costs were not included until the date of billing. Therefore, since this is an operating rather than a financial report it is aimed at promptly reporting the results of operations, which dictates the practice outlined above.

Deductions from Sales

Discounts on sales are of relatively minor importance, since trade discounts do not exist in this industry and cash discounts are rare. Because of the nature of the product, there are no returns, but occasionally allowances are made. Allowances cannot be anticipated, but in all cases where cash discounts are to be allowed, they should be anticipated for the purposes of this statement.

"Outbound freight" is deducted from sales, so that the operating profit is on the same basis regardless of FOB point. This situation occurs only where a different contractor is doing the erection work. Where fabrication and erection are done by the same contractor, freight from the fabrication shop to the erection site becomes part of the cost of the job. In cases where the material has not yet been shipped, this figure must be calculated as accurately as possible. Such calculation will be merely a check on the estimate, since the cost of outbound freight and hauling must necessarily be considered in any bid FOB delivery point.

Cost of Sales

As stated above, the cost of sales section of the Summary Profit-and-Loss Statement is merely a summary of the totals of the various columns of the Shop Order Cost Sheets on those orders closed during the month. For this reason, it is more important to discuss the method of collecting the charges to the Cost Sheets than on the Summary Profit-and-Loss Statement.

(1) *Direct Material.*—Most raw materials are purchased directly for a specific contract. Under these circumstances, the material is charged directly to the appropriate shop order on the voucher, and entered therefrom onto the Shop Order Cost Sheet. Any materials not purchased specially for the contract are withdrawn from stock on a requisition and posted to the Shop Order Cost Sheet from the requisition summaries.

(2) *Direct Labor.*—Both shop and drawing room direct labor are posted on the Shop Order Cost Sheets from payroll distribution summaries. The payroll summaries are prepared as follows. The Daily Operation Time Cards, Figure 8, are collected and extended daily. It will be noted that these cards are made up in several perforated sections. After the cards are extended and tied into the total, the sections are separated and sorted by shop order number. The charge to each shop order is then totaled and entered on the payroll distribution summary from which it is posted to the Shop Order Cost Sheet. This posting should be done weekly.

It will be noted that provision is made on the sections of the Daily Operation Time Card for information that is not carried to the distribution summary or the cost sheet. This is provided for purposes of analysis in the event that actual costs get far out of line, and also makes it possible to extend the detail in the record

keeping without altering the records originating in the shop. This is felt to be important, since the major difficulty in extending the amount of analytical detail available in any system is found in persuading the shop to make out more detailed records. In this system, the detail is present in the shop records in the beginning since it is necessary for any degree of analysis, and the modification of the office records to provide for the current recording of this additional detail is quite simple and normally can be accomplished without any difficulty.

The analytical information on the Daily Operational Time Card is used in the preparation of Operational Cost Comparison, Figure 6. After the completion of payroll distribution summaries used in the determination of direct labor to be posted to each shop order, the sections of the time cards are re-sorted by operation. From this, the actual cost by operation is obtained.

(3) *Manufacturing Overhead.*—After the last labor posting for the month is completed on the cost sheet, the overhead, both shop, drawing room and erection, is calculated and posted, as follows. The ratio of the total of each type of overhead to the respective direct labor is determined, and the overhead applicable to each shop order is calculated on the basis of this ratio to the direct labor accumulated thereon during that month.

The overhead accumulated on a shop order will, therefore, differ from the estimated overhead as the result of two entirely different factors. First, the overhead will vary from the estimate directly as the direct labor varies from the estimate. Second, the overhead will vary from the estimated overhead as the ratio of total overhead to total direct labor varies during each month from the average ratio used in the preparation of estimates. During some months, these variances may tend to cancel each other, and during other months, the variances may be cumulative. However, over a year's time, if the average has been accurately determined, the total overhead should be absorbed against all jobs.

BLANK STRUCTURAL STEEL COMPANY

NOTICE OF CONTRACT AWARD

Customer's Name _____

Customer's Address _____

_____

Customer's Contract Number _____

Erection Site _____

F.O.B. _____ Terms _____ Total Contract $_____

Description:

Issued:

_____ _____

Date Sales Department

Fig. 1.

BLANK STRUCTURAL STEEL COMPANY

SHOP ORDER

Customer's Name _____ No. _____

Customer's Address _____ Customer's Contract No. _____

_____ Notice of Contract Award No. _____

Description of Work to be Done:

Estimate			
Material			_____
Labor			
Drawing Room			_____
Shop			
Operation	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	_____
Erection			_____
Overhead			
Drawing Room		_____	
Shop		_____	
Erection		_____	_____
Total Estimate			_____

Approved: Issued by:

_____ _____

Production Control Department

Fig. 2.

Blank Structural Steel Company

SHOP ORDER COST SHEET

S. O. No. _____

Customer _____

_____

Description _____

ESTIMATE									
DATE	REF.	DIRECT MAT.	DIRECT LABOR			INDIRECT EXPENSE			REMARKS
			SHOP	DWG. ROOM	ERECTION	SHOP	DWG. ROOM	ERECTION	
TOTAL									
(OVER) OR UNDER ESTIMATE									

Fig. 3.

BLANK STRUCTURAL STEEL COMPANY
SUMMARY PROFIT-AND-LOSS STATEMENT
For Month of _____, 194 ____

Gross Sales				*
Less: Discounts on Sales			*	
Allowances			*	
Outbound Freight and Hauling			*	
Net Sales				–
	Variance	Estimate	Actual	
Cost of Sales				
Direct Material	–	–	*	
Direct Labor—Shop	–	–	*	
—Drawing Room	–	–	*	
—Erection	–	–	*	
Overhead—Shop	–	–	*	
—Drawing Room	–	–	*	
—Erection	–	–	*	–
Gross Profit				–
Selling Expense			*	
Administrative Expense			*	
Net Operating Profit				–
Other Income			–	
Other Expense			–	
Other Income or Expense (Net)				–
Net Profit for Month				–

* Denotes ledger accounts maintained.

Fig. 4.

Blank Structural Steel Company

DIRECT COST COMPARISON BY CONTRACT

For the Month of _____, 19____

CONTRACT NO	SHOP ORDER NO	FREIGHT TO ERECTION SITE			DIRECT MATERIAL			DIRECT LABOR-SHOP			DIRECT LABOR-DRAWING ROOM			ERECTION LABOR			TOTAL DIRECT COST		
		ACTUAL	ESTIMATE	VARIANCE	ACTUAL	ESTIMATE	VARIANCE	ACTUAL	ESTIMATE	VARIANCE	ACTUAL	ESTIMATE	VARIANCE	ACTUAL	ESTIMATE	VARIANCE	ACTUAL	ESTIMATE	VARIANCE
TOTAL PER COST STATEMENT																			

Fig. 5.

BLANK STRUCTURAL STEEL COMPANY
OPERATIONAL COST COMPARISON REPORT

For the Month of _____, 194 ____

Operation	Actual for Month	Estimate for Month	Variance for Month
Plate Shear			
Angle Shear			
Punch and Shear			
Spacer Punch			
Drill and Ream			
Burning and Chipping			
Blacksmithing			
Welding			
Riveting			
Painting			
Galvanizing			
Erection			
Total			

Fig. 6.

BLANK STRUCTURAL STEEL COMPANY
OVERHEAD ANALYSIS REPORT

For Month of _____, 194_____

	Fabricating Shop	Engineering	Total Shop	Drawing Room	Erection	Total Manufacturing Overhead
Salaries:						
Superintendence						
Purchasing						
Traffic						
Clerical						
Inspection						
Total Salaries						
Labor:						
Supervision						
Cranemen and Chainmen						
Repairs—Equipment						
Repairs—Buildings						
Correction of Errors						
Plant Housekeeping						
Material Handling						
Idle Time						
Overtime Premium						
Miscellaneous Indirect Labor						
Total Salaries and Labor						
Repair Materials—Buildings						
Repair Materials—Equipment						
Supplies						
Small Tools, Dies, Etc.						
Fuel						
Lumber						
Stationery and Printing						
Correction of Errors						
Freight and Hauling						
Traveling						
Power and Light						
Labor Safety and Welfare						
Public Liability and Property Damage Insurance						
Workmen's Compensation Insurance						
Social Security Taxes						
Depreciation—Buildings						
Depreciation—Equipment						
Miscellaneous						
Total Overhead						
Direct Labor						
Overhead in Estimates at ___% of Direct Labor						
Over or Under Absorption						

Fig. 7.

DAILY OPERATION TIME CARD

BLANK STRUCTURAL STEEL COMPANY

Name_____ No._____

Classification_____

Date_____

Time In_____ Out_____ Elapsed_____

Extra In_____ Out_____

Shop Order No._____ Start_____

Operation_____ Stop_____

Elapsed_____

Units_____ Cost_____

Shop Order No._____ Start_____

Operation_____ Stop_____

Elapsed_____

Units_____ Cost_____

Shop Order No._____ Start_____

Operation_____ Stop_____

Elapsed_____

Units_____ Cost_____

Fig. 8.

FARM COST ACCOUNTING

By
ARTHUR SHULTIS *

I. DESCRIPTION OF COMMERCIAL FARMING

Nature of the Business

Commercial farming is the production and sale of crops, livestock, and livestock products in the hope of earning a profit or at least a return on the capital and management employed. Farm products go into national or world markets where prices are beyond the control of the producer. The profit margin is small and difficult to obtain under the climatic and market price variations that prevail. Cost accounting can make a valuable contribution to management but it must be kept simple and low in cost.

Products

Large-scale farms usually produce from a few to many products with some change from year to year. Each crop or kind of livestock produced for sale or for use on the farm is an enterprise conducted for profit. Detailed inputs of labor and material as well as costs, returns, and profit should be learned and analyzed for each enterprise. Weak or unprofitable enterprises must be strengthened or abandoned, while strong ones are expanded and improved. Seldom will a year pass without some enterprises being unprofitable but the goal in farming is to concentrate on profitable ones in order to obtain a satisfactory return for the farm as a whole.

Cycle of Production

It takes from a few months to two years to produce a crop. Enterprises begin and end at different times of the year, some commencing in one fiscal year and closing in the next. But the fiscal year—usually the calendar year—will serve as the accounting period for most enterprises, particularly continuous ones like alfalfa, orchard, dairy, beef, and hog enterprises. Livestock enterprises require an inventory of stock and feed on hand at the beginning and end of the accounting period. Shorter accounting periods than the fiscal year are of little value in farming since costs and operations vary seasonally. It is well, however, to have most costs in enterprise accounts at the end of each month so management may watch these accumulating costs in light of market outlook and make any appropriate changes in production or marketing policy. At any time estimates of costs yet to come, based on previous experience, may be added to costs already incurred in order to estimate final costs.

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Inputs

Agricultural production requires a large investment in land and production facilities. Then it needs additional capital to hire labor, buy materials, and meet expenses for several months. The raw materials used are soil, labor, seed, feed, power, etc., and certainly weather, over which management has little control. In enterprise cost accounting, expenses may be grouped as follows: Labor, field power, materials, general overhead expense, management, and depreciation. With the investment varying widely between enterprises it is well to consider interest on the investment in a supplementary calculation or at least express profit in rate of return on capital.

Organization of the Business

Farms differ widely in size and products. They may be considered as of two parts—the productive enterprises and the service units or departments which furnish materials or perform work for the enterprises. Service units are not operated for a profit but merely to perform services for the enterprises as cheaply as possible. Also in farming the personal dwelling and affairs of one or more owners and administrative employees may require special handling in the interest of maintaining equity in the distribution of earnings. The following example illustrates a farm business which could well be served by cost accounting.

I. Enterprises Conducted for Profit—under 2 foremen
   - A. Range Land—7400 acres
   - B. Beef Cattle—stock—herd of 450 cows, 18 bulls, and about 280 head of young stock
   - C. Irrigated Pasture—200 acres
   - D. Alfalfa for Hay—60 acres
   - E. Thompson Seedless Grapes—120 acres
   - F. Young Grapes—40 acres, in process of development
   - G. Cotton—94 acres
   - H. Fattening Cattle—75 yearling feeders from "B" being finished for market

II. Service Units or Departments
   1. Management—manager, bookkeeper and office
   2. Housing and Board—5 cottages, bunkhouse, and messhall with cook
   3. Farm Machinery and Power—shop, 2 tractors, 2 trucks, 2 automobiles, farm machinery, with foreman in charge of power equipment and its maintenance
   4. Horses—2 draft and 4 saddle horses
   5. Irrigation System—2 pumping plants, pipe lines, etc.

III. Owner's dwelling and Personal Car

Administration

The manager of the above farm decides policy matters and administers the business from day to day through oral requests to three foremen, bookkeeper, cook, and other employees. A farm foreman looks after the crop enterprises and a cattle foreman, the range land, cattle, and horses. A farm machinery or tractor foreman is in charge of farming equipment. Each of these three foremen will account for his own time and the time of regular and seasonal employees in his charge and each

is in a position to report, if required, all the utilization of materials and equipment required for complete enterprise cost accounting.

III. Designing the Cost System

Information Required

For each *crop* enterprise the location, number of acres, the quantity produced, sold, and utilized, the labor required and cost for each major operation such as preparing land, thinning, and harvesting, the quantity and cost of each material such as seed, fertilizers, irrigation water, and the fair enterprise share of general overhead costs, management, and depreciation are required. For each *livestock* enterprise, opening and closing inventories by quantity and value, number of cows or other producing units, the number and weight of animals produced, the quantity and cost of labor, the quantity and cost of each major kind of feed, and the fair enterprise share of overhead and depreciation are required. In service departments the cost of services in detail should be made available for analysis and comparison. For example, the cost of board composed of food, supplies and fuel, cook hire, overhead, and depreciation should be shown per man day of board. The costs per hour and the fuel used per hour should be available for tractors and other major pieces of farm machinery. Quantities are necessary in all records as well as costs so efficiencies may be compared under changing price and wage conditions. Supplementary records of production, mortality, etc., are essential to form the basis for analysis and comparison of physical efficiency of production and to promote better production and to prevent losses and theft.

Important Considerations

In designing a farm cost system to meet the desired goals, simplicity and economy are required. A resident bookkeeper or accountant right on the farm working with manager and foremen constantly is essential for best results. Cost accounting in a city office off the farm is under a severe handicap in getting the detailed information needed for properly allocating costs to service units and enterprises. And the manager must be in close contact with the accountant from day to day in order to obtain and use the information needed for the many managerial decisions required throughout the year.

Actual Cost System

The costs charged to enterprises in so far as possible should be the actual costs as they are incurred. But in order that these enterprise cost accounts may be brought up to date at the end of each month, service unit charges, such as for tractor work, will be charged at an estimated average cost per hour or other unit for the entire year after all costs including depreciation and general expense are included. Standards for each operation and expense item may be developed in a few years and used for comparison but they are not made the basis of actual charges, because costs vary so from field to field and year to year. Costs in farming cannot be controlled with the exactness possible in a repetitive manufacturing process of short duration.

III. Description of a Cost System for Farming

The goal in farm cost accounting is the annual or crop cycle statement of profit or loss for each enterprise and a cost analysis for each service unit. The organization of farms as to enterprises, service units, and various administrative policies results in great differences in farm cost accounting systems. All costs must ultimately be properly allocated and charged to enterprises. Some expenses may be charged directly as they are incurred. But some must be accumulated by kind in temporary expense accounts for later charging to enterprises in a single item when the bases for allocation become available. Expenses for service units, such as tractors and trucks that serve several enterprises, are charged to those service units but the cost of operating these units is transferred to enterprises in the form of hourly or other rates for the work performed. Such cost accounting may be performed within the framework of any sound accounting system for the farm as a whole by the addition of certain accounts and procedures.

Enterprise Accounts

Each enterprise is covered by a group of two or more accounts—at least as income and an expense account and a stock inventory account for livestock enterprises. Every kind of crop or livestock produced on a commercial scale is an enterprise. Different fields or orchards of the same crop may be handled as separate enterprises. A certain kind of livestock may be divided into two phases, such as the raising of beef cattle to a certain point in one enterprise and the fattening of steers in the feed lot in another. Or a dairy selling milk wholesale might add a retail route, which would be a separate enterprise charged with the milk at wholesale value and credited with retail sales. An enterprise is frequently the production of a crop or product not sold at all but used entirely in feeding livestock in another enterprise. Enterprise cost accounting involves numerous charges and credits between enterprises based upon quantity and value per unit of product. These transfers of product should be at "farm value" at time of transfer. *Farm value is the net amount that would be received if the product were sold.* The use of cost of production would defeat the purpose of enterprise accounting by allowing an inefficient enterprise to pass its loss on to another. These inter-enterprise charges and credits should be based on carefully determined or estimated and recorded quantities entered and posted to enterprise accounts at the end of each month. It is the duty of management to maintain equity between enterprises and see that one foreman does not overcharge the enterprises of another.

Enterprise accounts may sometimes cover special undertakings with another farm or owner such as feeding a bunch of lambs or operating a combine or spray outfit in outside custom work. Where the farm business also operates for hire a number of farms for different owners, an enterprise account for each farm will form the basis for billing the owners for services performed. An enterprise account is also used in developing a young orchard or vineyard with accumulated costs at the end of each year being charged to an asset account. Everythting on the farm must be covered by an enterprise or service unit account, but small noncommercial enterprises, such as poultry or vegetables for use on the farm, may be combined in a miscellaneous group or with the operator's personal affairs or a service unit.

Enterprise accounts are kept in special analysis ledger forms so quantities and

costs for a number of items may be accumulated. A crop expense account should show the following separately: Man labor, tractor, truck, and each kind of material such as irrigation water, spray materials, fertilizers, etc. A livestock expense account should show the quantity and cost of each kind of feed.

Enterprise accounts are cleared to farm profit and loss at the end of the year after receiving all their direct and overhead costs. But an uncompleted enterprise is carried over. A crop planted in 1945 would receive its direct costs and its share of the 1945 overhead and then be carried over into 1946 where it would receive its further direct costs and share of 1946 overhead costs to be finally closed with the closing of books at the end of 1946.

Final enterprise statements are made at the end of the fiscal year when all costs and income are in the enterprise accounts. These statements should display each important income and cost item by price, quantity, and value and for the total enterprise, and per producing unit, such as the acre or cow, and per unit of product. Figures 1 and 2 show sample statements for alfalfa and beef enterprises. Enterprise statements should be studied and compared with those for similar enterprises in previous years and on other farms. There need be nothing secret or confidential about farming, so use can be made of outside comparisons.

Service Units

Expenses are charged directly to service units as incurred where possible. But an item, such as gasoline, is first charged to a perpetual inventory account from which it is charged to each tractor, truck, and automobile as used. Service or repair labor on a unit is charged to that unit. Whether the operator of a unit is charged to the unit for including in the charge for work done or whether his time is charged with other labor directly to the enterprise served is optional. Cost of employees' housing and board are charged to enterprises along with wages through the payroll record. It is recommended that all work by service units be charged to enterprises at the end of each month but at estimated annual average cost rates rather than actual costs for that month. Any over or under charge may be cleared at the end of the year and credited or charged to enterprises in proportion to charges already made. Management with the manager's and accountant's salaries and perquisites and office expense may be handled as a service unit but charged to enterprises in a lump sum at the end of the year on some appropriate basis, perhaps in proportion to total expense account debits. An owner's dwelling and car receiving labor and materials from the farm business may also be handled as service units but would be charged to the owner's personal drawing account rather than divided among enterprises.

At the end of the year a statement of costs for each service unit showing costs in detail for the unit and the cost per hour, mile, meal, or unit of work should be prepared for analysis and comparison. Valuable guidance in the selection of number and size or capacity of tractors, trucks and other large special machines is thereby made available. Many special cases occur with the performance of outside work and sometimes the joint ownership of a certain unit. Where considerable outside work is done by a service unit the profit occurring by charging more than cost should be credited to farm profit and loss rather than used to reduce the cost of service to the enterprises. Work horses kept mainly for service to enterprises might also produce some income if colts are raised. In the main, however, service units are

not operated for a profit so should be charged at costs to enterprises. A farm machinery and tractor foreman should not be permitted to show a profit on the operation of his department and its units by overcharging enterprises for the services performed.

General Expenses

General overhead expenses, such as taxes, insurance, interest, small equipment, general supplies, repairs, etc., may all be accumulated in temporary expense accounts or subaccount columns in a single general expense account. At the end of the year they will be allocated to enterprises and service units each on its own basis. A multicolumnar work sheet with columns for each enterprise and service unit is suggested and can be used as a special journal from which credits and debits to various accounts are posted. Taxes would be distributed in proportion to the value of the assets taxed, fire insurance according to the use of insured buildings and facilities, workmen's compensation insurance on direct labor charges, etc. Some smaller items may be arbitrarily distributed. The resulting totals of the enterprise and service unit columns are posted as single items called general expense.

Labor

Hired labor is usually a large item of expense and requires the best of records for proper administration and distribution of costs to enterprises. All wages paid are charged to a payroll account which is credited when charges are made to enterprises at the end of each month. The essential device is some form of farm worker's time card showing each day the hours worked by operation and enterprise. A monthly time card as illustrated in Figure 3 is recommended. On this same time card may be shown the employee's use of tractor, truck, or horses. The monthly time card is recommended even though workers are paid weekly or twice a month since it reduces considerably the number of separate calculations and entries in the payroll record. Where a large crew of temporary seasonal workers are employed on a single operation, such as picking peas, they may all be listed by name on a single time card. Time cards are kept by the foreman or straw boss in charge of the worker. If a foreman sends a worker to another crew he transfers the card to the other foreman. Each foreman also keeps a time card for himself showing his time distribution by enterprises. A working owner must also furnish a time card so his labor may be charged to the proper enterprises although the total amount is credited to his personal account rather than the payroll record. Where payment is by piece rate the same time cards are used but number of work units are shown rather than hours of work.

Whenever employees are paid, the foreman turns the time cards over to the accountant or manager who figures the amount due, makes the payment, and enters the amount on the time card. The monthly time card thus shows previous withdrawals and payments. At the end of the month the bookkeeper adds to the wages paid any cost of board and housing and distributes the total cost of that employee's services over the various jobs performed on the different enterprises in proportion to the time reported. Sick or vacation time with pay is shown separately for charging to a special account for later distribution to enterprises at the end of the year in proportion to labor previously charged. When the time card has been calculated, its summary is entered in the payroll record.

Payroll Record

A multicolumnar payroll record is essential for recording the name of each employee and a record of his wages, costs or charges for board or housing and the distribution of the cost of his services over jobs within each enterprise and service unit. Up to present writing (1948), collection by withholding for income tax, social security, and unemployment insurance does not apply to farm workers, but it may in the future. Hence any suitable commercial payroll record may be used by the addition of short sheets to provide sufficient columns for the distribution of costs to various accounts. This record is used as a special journal. After all employees have been entered for the month, totals of the columns are posted to the various accounts affected. Charges included for board and room are credited to the proper service unit account, and wages to the payroll account. The labor costs distributed are charged to enterprise and service units and an undistributed labor account. Labor within crop enterprises is segregated into from six to twelve operations; thus, for each enterprise, there will be a number of operation columns plus a total column. The operation columns are totaled but only the total column is posted to the enterprise account. The operation cost totals are picked up for the enterprise analysis at the end of the year.

Service Unit Record

A time card similar to the farm worker's monthly time card may be kept for each automobile, truck, and tractor, and any other service unit, such as an irrigation pump. These would be kept by the department foreman and could also show the fuel drawn from farm tank each day along with the total hours of work distributed over operations and enterprises. Another special journal similar to the payroll record would be used for recording the monthly summary charging the costs to enterprises and crediting the amount so charged to the proper service unit accounts. Tractor and farm truck work are best charged without driver on an hourly basis at rates that are expected to approximate the average annual cost per hour. After a year or two the accountant should be able to estimate the hourly cost of a tractor within a few cents. Automobiles and pickups used a few minutes now and then for a variety of errands present difficulties in charging exactly according to use. A foreman's car may be charged in proportion to his time. Other cars may be charged arbitrarily or in proportion to management or some other item at the end of the year.

Some large-scale farms are highly departmentalized with a farm machinery department staff. All farm machinery and tractor and truck expenses are charged to his department along with wages of foreman, mechanic and special tractor, truck, and other machine operators. This department may or may not keep separate cost accounts on the various machines. It does, however, charge for work furnished enterprises at a schedule of rates expected to pass on the entire department costs. This system has been observed to usually result in less efficient utilization of time and materials and higher costs than where the time of each worker must be shown and charged to enterprises and service units.

Depreciation

The large capital outlay for buildings, equipment, irrigation system, fruit trees, etc., should be recovered during the period of use by properly estimated deprecia-

tion charges based on the expected useful life of each item. Items are usually grouped in a depreciation record, each group being covered by an asset account. Sometimes depreciation for the entire group is chargeable to a single enterprise or service unit. In other groups depreciation may need to be distributed differently for each item. Depreciation on a special machine used only for one enterprise is usually charged to that enterprise. The problem may arise of what to do with depreciation on a bean harvester in a year when beans are not grown. After all, depreciation is usually a rough estimate and too much time and trouble should not be spent in getting just the right amount into each enterprise account. A multicolumnar work sheet for distributing depreciation to service unit and enterprise accounts by arbitrary estimates is recommended. By using judgment and knowledge of the use of each item, a better job could be done than by any mathematical formula. When distribution is complete, columns are totaled and depreciation is credited to the various depreciation reserve accounts and charged to enterprises and service units as a single item. Naturally not all depreciation will appear as such in the final enterprise accounts, some of it being included in other items such as charges from service units.

Depreciation is usually charged at the end of the fiscal year. Since there is only one cycle of production in a year in farm operations there is no advantage in dividing it and charging it monthly. It could, of course, be charged once for the year at any time except that additional entries for later additions of equipment would be necessary. It is not necessary to formally charge depreciation before estimating final costs for an enterprise. Depreciation can be estimated for most enterprises by knowing what was charged on the same or a similar enterprise for the previous year.

Inventories

At the beginning and ending of each fiscal year a careful inventory must be taken of all livestock, feed, supplies, prepaid expense, and unsold products on hand. The policy of valuation which best reflects the true profit earned for each year should be consistently followed. Livestock should be carefully counted by age and sex group and feed quantity should be measured and computed. Items produced for sale should be valued at farm value at inventory time. Feed or supplies should be valued at cost when acquired or at the value at which it was transferred from one enterprise to another. Breeding stock, like dairy and beef cows, should be carried at normal uniform values for stock of average age and quality. Each enterprise and each service unit is credited with its part of the inventory at the end of the year, the total inventory being charged to asset accounts. At the beginning of the year inventories are charged to the proper enterprises or service units for that year. A crop in marketing channels for which final payment is unknown at inventory time must be given a value in order to close the accounts at the end of the record year.

Order of Closing

At the end of the fiscal year when posting for the twelfth month has been completed and proved, it will be convenient to proceed with adjusting and clearing entries in the following order:

1. Allocate depreciation to enterprises and service units.
2. Enter inventories, crediting enterprises and service units.

3. Allocate general expense to enterprises and service units.
4. Clear any other temporary expense accounts to enterprises and service units.
5. Clear management service unit to enterprises and other service units.
6. Clear remaining service unit balances to enterprises.
7. Clear enterprise accounts to farm profit-and-loss.
8. Clear profit-and-loss and owners' personal accounts to capital.

Farm Profit-and-Loss Statement

A useful form of profit-and-loss statement shows farm totals and expenses and incomes by enterprises and service groups arrayed in a multicolumnar form. Expenses may be combined into a few major groups. The farm total for each item will be the total of that item for all enterprises and service units. Service units are included so that labor, depreciation, general expense, etc., may be included as such in farm totals even though duplicated in service charges to enterprises. Figure 4 shows the first few columns of such a statement. Where number of enterprises and service units is too large for such an array, a vertical listing of enterprises with their profits and losses will help visualize the sources of farm profit.

Enterprise Statements

Enterprise statements are prepared from the enterprise income and expense accounts plus additional information from supplemental records. Labor and field power costs for separate operations within any enterprise are obtained from the operation or job columns in the payroll and field power records. Figure 1 presents a sample alfalfa enterprise analysis, and Figure 2, one for beef cattle. These statements illustrate the considerable amount of useful information and comparison that are made available. For each important and continuing enterprise a comparison sheet should be carried forward adding each year the important items for that year on a unit basis, such as the acre and ton where they may be compared with foregoing years.

S. A. Ranch

(D) ALFALFA ENTERPRISE ANALYSIS, 1946

60 Acres

Yield and Income

Cutting	Disposition	Yield, Tons		Total Value	Per Acre	Per Ton
		Total	Per A.			
1 May	Stacked for Beef Ent. "D"	72	1.2	1152.00	19.20	16.00
2 June	Sold Ellis, in windrow	64	1.1	1120.00	18.67	17.50
3 July	Sold Ellis, in windrow	60	1.0	945.00	15.75	15.75
4 Aug.	Stacked for Feeders "E"	56	0.9	896.00	14.93	16.00
5 Sept.	Stacked for Beef "D"	59	1.0	944.00	15.73	16.00
6 Oct.	Stacked for Beef "D"	62	1.0	992.00	16.54	16.00
Total Hay		373	6.2	6049.00	100.82	16.22
Pasture	Horses, Beef, A.U. Mo.	64	1.1	96.00	1.60	0.25
				6145.00	102.42	16.47

Analysis of Income and Costs. 373 T. to windrow. 249 T. to stack.

	Man Labor		Horse		Tractor and Truck			Cost Per Acre	Cost Per Ton
	Hours Total	Total Cost	Hours	Cost	Hours Total	Total Cost	Total Cost		
Harrow	30	19.20			30	21.00	40.20	0.67	0.11
Fertilize	60	37.50	60	9.00	30	21.00	67.50	1.13	0.18
Irrig. 7x	490	342.00					342.00	5.70	0.92
Subtotal	580	398.70			60	42.00	449.70	7.50	1.21
Cut 6x	200	136.50			200	140.00	276.50	4.61	0.74
Rake 6x	180	126.00	360	54.00			180.00	3.00	0.48
Stack 4c.	312	232.80	200	30.00	120	90.00	352.80	5.87	1.42
Tot. Labor	1272	894.00	620	93.00	380	272.00	1259.00	20.98	3.38
Irrigation Water 3360 A. in. @ 18¢, 56 A. in. per A.							604.80	10.08	1.62
Gypsum 30 Tons @ $15, 1000 lb. per A.							450.00	7.50	1.21
Superphosphate 9 Tons @ $50, 300 lb. per A.							450.00	7.50	1.21
Miscel. Items and Repairs to Haying Equipment							136.40	2.27	0.36
General Ranch Expense, Taxes, Insurance							212.30	3.54	0.57
Management at 9% of All Other Costs							319.54	5.33	0.86
Depreciation on Stand							300.00	5.00	0.80
Depreciation on Haying Equipment							138.00	2.30	0.37
Total All Costs							3870.04	64.50	10.38
Value of 249 Tons Put in Stack for Farm Use							3984.00		16.00
Cost of 249 Tons Put in Stack							2633.63		10.58
Profit on Hay Transferred to Other Enterprises							1350.37		5.42
Income from 124 Tons Sold in Windrow to Ellis							2065.00		16.65
Cost of 124 Tons Sold in Windrow							1140.41		9.20
Profit on Hay Sold							924.59		7.45
Total Profit Alfalfa Enterprise							2274.96	37.92	6.09
Total Investment Involved Except Service Units							15,060.00	251.00	
% Profit of Investment—15.1%									

Cutting 0.55 hr. per acre each time, man and tractor #2.
Raking 0.5 hr. per acre each time, man and team.
Stacking 1.25 man-hour per ton, 3 men, 1 with horse buck, 1 with tractor buck.
Irrigation 8.1 hr. per acre ÷ 7 times = 1.15 hr. per irrigation.

Fig. 1.

S. A. Ranch

(B) BEEF ENTERPRISE ANALYSIS, 1946

450 Breeding Cows Nov. 1, 1945—800 Animal Units Annual Average.

Analysis of Sales

	No. Head	Total Weight	Total Value	Av. Wt.	Av. Val. per Hd.	Price per Cwt.
Breeding Bulls	0					
Beef Bulls	1	1,250	$ 138.00	1250	$138.00	$11.04
Cows	95	98,800	8,892.00	1040	93.60	9.00
Veal Calves	6	1,272	184.44	212	30.74	14.50
Weaner Calves	76	34,352	4,809.28	452	63.28	14.00
Yearling Heifers	50	31,900	3,828.00	638	76.56	12.00
Yearling Steers	172	130,720	16,993.60	760	98.80	13.00
2 year Steers	0					
Total	400	298,294	$34,845.32	746	$ 87.11	$11.68

Analysis of Production

	No. Head	Total Weight	Total Value	Per Cow	Per An. U.	Per Cwt.
Stock Sold	400	298,294	$34,845.32	77.43	43.56	11.68
Closing Inventory	751	574,600	45,720.00	101.60	57.15	7.96
Less—Stock Bought	2	1,400	500.00	1.11	.63	35.71
Less—Opening Inventory	753	575,000	45,500.00	101.11	56.87	7.91
Net Production	396	296,494	$34,565.32	76.81	43.21	11.66
Calves Raised to Sale or Closing Inventory			404	0.898	0.505	
Net Head Raised			396	0.880	0.495	
Head Died Other than Calves			8	0.018	0.010	
Pounds Produced			296,494	658.9	370.6	
Pounds Sold			298,294	662.9	372.9	

Analysis of Inputs and Costs

	Quantity		Total Value	Per Cow	Per Animal Unit	Per Cwt.
	Total	Per An. Unit				
Range, A.U. Mo. @ 1.25	7,000	9	8,750.00	19.44	10.94	2.95
Irrigated Pasture @ 2.50	2,100	3	5,250.00	11.67	6.56	1.77
Hay @ $16 per Ton, 200 Tons	400,000 #	500	3,200.00	7.11	4.00	1.08
Concentrates @ $80 a Ton	40,000 #	50	1,600.00	3.56	2.00	0.54
Salt and Minerals @ $30 a Ton	4,000	5	60.00	0.13	0.07	0.02
Total Feed Cost			18,860.00	41.91	23.57	6.36
Labor at 74¢ av. per hr.	5,800	7.3	4,292.00	9.54	5.37	1.45
Horse Work @ 13¢ an hr.	3,500	4.4	455.00	1.01	0.57	0.15
Truck and Automobile @ $1.00 hr.	112	.1	112.00	0.25	0.14	0.04
Vet. and Miscel. Supplies and Fees			469.65	1.04	0.59	0.16
General Ranch Overhead, taxes and insurance			1,643.20	3.65	2.05	0.55
Management at 9% of other costs			2,355.65	5.24	2.94	0.79
Depreciation Beef. Bldg. and Eqt.			342.00	0.76	0.43	0.12
Total Cost of Production			28,529.50	63.40	35.66	9.62
Value of Production, from above			34,565.32	76.81	43.21	11.66
Profit			6,035.82	13.41	7.55	2.04
Beef Enterprise Investment, Stock, Bldg., etc.			61,450.00	136.56	76.81	20.73
Per Cent Profit of Investment			9.8%			

Fig. 2.

FARM WORKER'S MONTHLY LABOR RECORD

Record of Work Done by RAYMOND A MILLER on Farm of S A RANCH for Month of MAY 1946

OPERATION OR WORK DONE	ENTERPRISE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL HOURS	RATE	AMOUNT
IRRIGATING PASTURE	C	12	8									12	12	12	4										8	8		8	8	8		8	108	.88	95 04
MOWING ALFALFA	D			8	8		8		4	4																							32		28 16
STACKING ALFALFA	D							9	4	4	8																						25		22 00
IRRIGATING ALFALFA	D														6	8	8	8															30		26 42
CULTIVATING COTTON	G																				8	8	8	8									32		28 16
HOLIDAY WITH PAY	UND. LABOR																													8			8		6 72
Miscellaneous or General Farm Work																																			
Home or Personal																																			
Total Hours Daily and for the Month		12	8	8	8	0	8	9	8	8	8	12	12	12	10	8	8	8	0	0	8	8	8	8	8	8	0	8	8	8	8	8	235		206 50

Fill in above the hours worked each day, using a separate line for each operation and enterprise and the column headed for the day of the month. Write in work done under operation and indicate enterprise in proper column by a letter according to code at bottom of this page. Fill in the hours of use of tractor, truck, horses or mules by this employee daily. A two-horse team for one hour equals two horse hours.

FIELD POWER USED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL	RATE	VALUE
Draft Horses and Mules																																		
Saddle Horses																																		
Tractor No. 2			8	8		8	9	8	8	8										8	8	8	8										70 ¢		
Truck No.																																		
Pump or Irrigation Water, No. 1	24	24									16	24	24	24	24	24	24	18						24	16		18	24	24					

ENTERPRISE CODE:

A RANGE B BEEF CATTLE C IRRIG. PASTURE D ALFALFA E THOMPSON GRAPES F YOUNG VINEYARDS G COTTON H FEEDERS-BEEF I

CHARLES R. HADLEY CO., PATHFINDERS, LOS ANGELES, SAN FRANCISCO, NEW YORK, NY 2469

PRINTED IN U. S. A. STANDARD FARM WORKER & LABOR RECORD FORM C724

Fig. 3.

S. A. Ranch

PROFIT AND LOSS BY ENTERPRISES, 1946

	Total Ranch	A Range 7400 A.	B Beef Cattle 800 An. U.	C Irrigated Pasture 200 A.	D Alfalfa 60 A.	E Thompson Grapes 120 A.
Investment Involved	$326,430.00	$85,000.00	$61,450.00	32,000	$15,060.00	$42,000.00
Production and Yield per Unit		7,000 0.95 per A. An. U. Mo.	296,494 # 370.6 # per An. U.	2,400 12 per A. An. U. Mo.	373 T. 6.2 per Acre	210.0 T. 1.75 per Acre
Income:						
Sales Off Farm	85,723.92		$27,708.92			$32,000.00
Transferred to Other Enterprises	25,966.40	$ 8,750.00	7,136.40	$6,000.00	$ 2,065.00 4,080.00	
Inventory Change	1,280.60		— 280.00			
Total Income	$112,970.92	$ 8,750.00	$34,565.32	$6,000.00	$ 6,145.00	$32,000.00
Expenses:						
Labor	26,914.88	648.20	4,292.00	2,136.40	894.00	11,341.28
Horse Work	968.60	87.00	455.00	120.00	93.00	153.60
Automobile and Truck Work	676.70	96.50	112.00	24.00	20.00	248.20
Tractor Work	1,314.00	24.20		70.00	252.00	427.80
Feed and Production Materials	32,140.07		18,860.00	2,160.30	1,504.80	1,446.80
Supplies and Miscellaneous	1,001.73	120.00	469.65	24.00	136.40	72.08
General Ranch Expense	8,231.24	3,640.00	1,643.20	708.20	212.30	1,230.54
Management	6,662.63	442.43	2,355.65	525.86	319.54	1,431.57
Depreciation (Direct)	2,782.00	300.00	342.00	600.00	438.00	986.00
Total Expense	80,691.85	5,358.33	28,529.50	6,368.76	3,870.04	17,337.87
Net Profit	32,279.07	3,391.67	6,035.82	— 368.76	2,274.96	14,662.13
Per Cent Profit of Invest.	9.9%	4.0%	9.8%	— 1.2%	15.1%	34.9%

Fig. 4

A COST SYSTEM FOR THE CHEMICAL FERTILIZER INDUSTRY

By
IRVING D. DAWES *

I. DESCRIPTION OF THE INDUSTRY

General Description

The chemical fertilizer industry is one of the most important and basic of all industries. The use of fertilizer is increasing nearly everywhere at a rapid rate and as the richer and other soils become depleted of their plant food, an even broader and more intensive use can be expected. Fertilizers were limited at first largely to the South and the Eastern seaboard. There poor soils or those exhausted from one-crop agriculture made fertilization absolutely essential to any sort of efficient production. Now, however, fertilizers are being used in almost every agricultural area. In some places, particularly the Middle West, good crops can still be raised without fertilizer, but farmers have found that its application will give large increase in yields and return several dollars in crop value for every dollar invested in plant food. There is also an increasing use of fertilizer on pastures by the dairy industry to produce more grass per acre and a longer grazing season.

The fertilizer industry operates nearly one thousand plants. Its greatest concentration is still in the South and along the Eastern seaboard but rapid expansion is now going on in the Middle West. Fertilizer is a heavy and relatively low-priced product. Its effective distribution is limited, therefore, to a rather small circle in the neighborhood of each plant, thus accounting for the large number of factories operated. In 1945 the industry had a capital investment of approximately four hundred million dollars, with from twenty thousand to thirty thousand employees and about fifty thousand dealers and agents.

As might be expected, the business is highly seasonal, the season varying with the climate, crop, and section of the country. In regions producing only one crop, such as tobacco or cotton, the shipping season is limited to a very short period in the early spring and larger facilities for pre-season storage are required. In places like the Middle West, having both winter wheat and summer crops, there are two seasons—one in the fall and the other in the spring. This permits greater turnover of inventory and so smaller storage facilities. In such areas as Florida, with many crops and an almost continuous growing season, business is fairly steady throughout the year, with only moderate seasonal variation. This enables quicker turnover and therefore a larger yearly tonnage out of the plant.

Types of Fertilizer and Component Elements

Fertilizers are of various types and grades, depending upon the requirements of the crops and soils and on the materials available. A "complete" fertilizer contains

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the three basic elements of plant food: Nitrogen, phosphorus, and potassium, with which may be combined certain minor elements, such as boron, calcium, magnesium, sulphur, and manganese.

The first major element, nitrogen, is of two general classes—organic and inorganic. Included in the former are such materials as packing house and process tankage, cottonseed and soybean meal, fish, processed sewage, tobacco stems, and many others. The inorganic group contains sulphate of ammonia, synthetic and natural nitrate of soda, ammonium nitrate, cyanamid, nitrogen solutions, and other chemical products.

The second principal element, phosphorus, is usually in the form of superphosphate, made by treating finely ground phosphate rock with sulphuric acid. The result is a product which contains from 18% to 21% available phosphoric acid (A.P.A.), the percentage depending on the analysis of the rock used, the mixing efficiency, and the time allowed for "curing." The A.P.A. is in the form of calcium phosphate which represents about one half of the superphosphate combination, with calcium sulphate being the remainder.

The third major element, potassium, comes in three forms—muriate of potash, sulphate of potash, and nitrate of potash. Muriates are of three kinds: Crude salts with 25% content of potash and two refined grades of 50% and 60%, respectively. Sulphate comes in two grades, the first having 48% to 52% content and the second, sulphate of magnesia, having 22%. Nitrate of potash is also of two grades, the Chilean containing 15% nitrogen and 15% potash and the German, 13% nitrate and 44% potash.

Mixed fertilizer grades are expressed in numbers representing the unit content of each major element in the order—nitrogen, superphosphate, potash. For example, Grade 4-8-6 means that 4% of the mixture is nitrogen, 8% available phosphoric acid, and 6% potash, giving a total of eighteen units or 18%. In a ton of fertilizer this would be 360 pounds of plant food. The balance of 1640 pounds represents the carriers or compounds in which these major elements occur, as well as minor elements, limestone, conditioners and, if necessary, a sufficient quantity of sand or other filler to bring the mixture up to 2000 pounds.

Sources of Raw Material

Most of the sulphur used in the manufacture of sulphuric acid comes from the Texas-Louisiana area. Before those deposits became developed sulphur was extracted from iron pyrites, either domestic or imported.

The principal sources of phosphate rock are Florida, Tennessee, and Idaho, with by far the largest proportion coming from the first.

Practically all the potash used by the industry now comes from domestic sources in California, New Mexico, and Utah. Until those deposits were developed a decade or two ago all potash was imported—chiefly from Germany and France.

Almost half of the nitrate of soda used comes normally from Chile, with synthetic nitrate manufactured in Virginia furnishing the remainder. Other sources of nitrogen are coke ovens for sulphate of ammonia, the packing houses, cottonseed oil and soybean oil mills, sewage disposal plants, ammonium nitrate plants, cyanamid plants, etc.

With very few exceptions and chiefly for phosphate rock, raw materials are supplied by others than those engaged in the manufacture of mixed fertilizers.

Manufacturing Methods

(1) *Sulphuric Acid*

Sulphuric acid is made by burning sulphur and spraying the resulting fumes with water in the presence of an oxidizing agent or catalyst.

There are two principal methods, the first being the "Chamber" process with the fumes and acid passing through a series of lead chambers and towers. Niter is used as the oxidizing agent.

The second is the so-called "Contact" process, which, because of the use of a system of cooling coils, does not require the large chambers used in the first process. Under this method the fumes and water come in contact with a catalyst (vanadium) to effect the chemical combination desired.

(2) *Superphosphate*

Superphosphate is usually made in mixing pans from which the mixture is developed into a "Den" where it is allowed to cool and "set" for twenty-four hours. It is then removed to storage piles for curing, preferably for a period of several months. This curing period not only furnishes a better-conditioned product but also enables a further combination of any free acid with rock particles, thus increasing the percentage of available phosphoric acid.

Incidentally it should be noted that superphosphate is the only part of the complete fertilizer that is actually manufactured by the industry, the other elements being simply mechanical mixtures without chemical combination being involved. Its manufacture, however, requires a heavy investment in sulphuric acid and so-called wet-mixing plants. As a result by far the greatest number of fertilizer plants are of the "dry mix" type. Many are operated by small concerns because of the relatively little capital required for the simple equipment needed for the mechanical mixing of superphosphate with the other ingredients and for storage facilities. Their superphosphate is obtained from the larger companies, which make this product both for sale to these dry mixers and for their own mixed fertilizers. In other cases there are "wet mixers" who manufacture superphosphate but purchase their sulphuric acid, and also conduct dry-mix operations.

A "complete" plant is one that makes sulphuric acid and superphosphate as well as operates a dry-mix department. A plant of this type has great flexibility as regards operations and capacities. For example, one ton of 50° sulphuric acid will enable the production of approximately two tons of superphosphate, whereas a ton of the latter will permit the mixing of about two tons of mixed fertilizer. A sulphuric acid plant with an annual capacity of, say, 20,000 tons will, therefore, enable the production of about 40,000 tons of superphosphate and 80,000 tons of mixed fertilizer. The last is the measure of the total capacity of the plant if all the acid and superphosphate are used in the production of mixed fertilizer. It usually happens, however, that a plant is not so perfectly balanced as to permit that, or the problems of storage make it impossible. If its storage facilities or the sales situation will not enable the handling of, say, more than 60,000 tons of mixed goods, obviously only 30,000 tons of superphosphate will be needed. Thus 10,000 tons will then be available for sale to dry mixers in bulk or to consumers in the form of bagged superphosphate. (A great deal of superphosphate is used as fertilizer by itself, and, without the other elements, for pasture fertilization and certain crops.) Correspondingly, the acid plant may produce more acid than is required for super-

phosphate. The surplus then becomes available for sale to wet mixers or other industrial users. Thus the capacity of a "complete" fertilizer plant is quite variable and flexible depending upon operating, storage and sales combinations, and conditions.

(3) *Mixed Base*

The mixing of fertilizers is done either in the dry-mix department of a Complete Plant or in separate dry-mix plants. The various ingredients, nitrogen, superphosphate, potash, etc., are taken from the storage piles and mixed thoroughly in Manipulating Machines. The mixture or grade is then stored in a pile, suitably marked with the grade analysis for curing and to await the shipping season. The pile may contain hundreds or even thousands of tons of one of the more common grades. Such materials are called "mixed base" and represent an intermediate stage, further processing being necessary before shipment.

(4) *Milling, Bagging and Shipping*

Mixed bases harden and lump in the storage piles so it is necessary that they be re-milled before bagging and shipping. Likewise bagged goods are subject to hardening and forming lumps if packaged too long before shipment. It is customary therefore to prepare and bag fertilizer just before shipment and at the most not more than a few days ahead.

This final grinding or re-milling is done in a Combination Milling and Bagging Machine. The base goods are dumped into a "boot" at the bottom of the machine. An elevator conveyer carries them to the grinding section of the apparatus from which they are dropped into bags under control of automatic weighing scales. The bags are then closed by sewing machine or by hand and transported to the loading platforms for shipment, either by truck or freight car.

(5) *Chemical Analysis and Control*

In order to determine the chemical content of raw materials, superphosphate and mixed fertilizers, and for proper control of formulation, frequent sampling and chemical analysis must be made. The factory is given the analysis of raw materials by the supplier and furnishes samples of its own products for chemical analysis. Most states have laws setting certain standards for fertilizer and employ inspectors who take frequent samples of fertilizer after it has left the factory. Usually each brand or grade sold must be registered with the state. Generally the unit content must also be shown on the bag for each principal ingredient. Most states require the affixing of a "Tax Tag" to each bag of fertilizer. The tax furnishes the revenue to pay for the state inspections and control. Penalties are imposed for deficiency in analysis beyond a specified tolerance.

Most of the larger plants maintain their own laboratories for analysis of the samples taken, also chemical control departments for the scientific preparation of formulas and the determination of the quantities and types of materials to be used for production of the desired grades.

(6) *Labor and Mechanization*

Work in a fertilizer factory is dusty, heavy, and disagreable. Because of this, and with the seasonal nature of the business calling for a large proportion of tran-

FLOW SHEET FOR THE MANUFACTURE OF MIXED FERTILIZERS

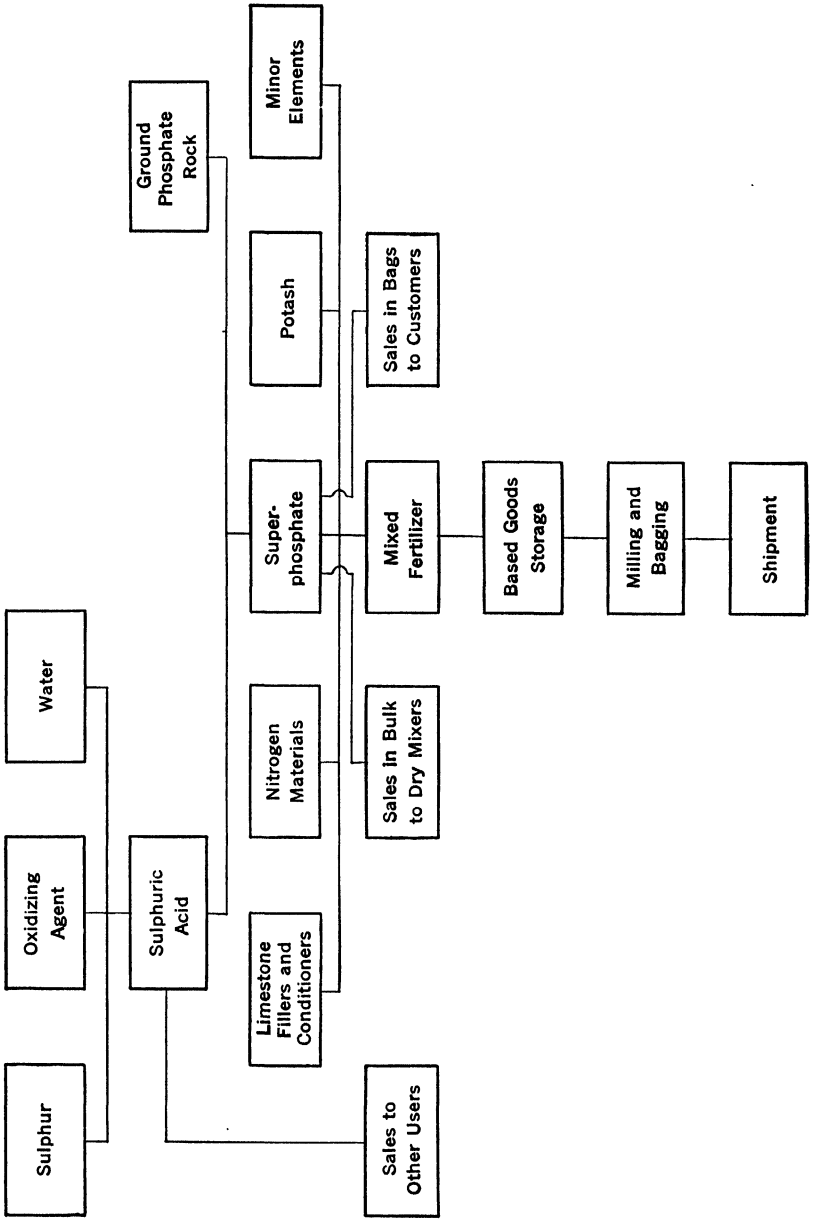

Fig. 1.

sient labor for a few months only, the industry can obtain only the type of common labor least in demand except for its year-round personnel. Until recent years the low wages at which this class of labor could be obtained in most areas made it uneconomical to substitute mechanical for manual work for many of the operations. Lately, however, the great increase in wage costs and the general scarcity of labor have forced the use of much more mechanical equipment than ever before and this mechanization is expected to continue. Labor has always represented a very small portion of the cost of fertilizer, running from 15% to 20%, with material being 70% to 80% of the total cost. As mechanization grows, the costs for repairs and depreciation can be expected to become proportionately larger and those for labor smaller. At present, aside from the milling and bagging machines, the chief items of mechanical equipment in a fertilizer mixing plant are tractor shovels and conveyers.

II. How to Design the Cost System

The cost system must be designed to produce accurate costs and yields for the operations involved in the production of sulphuric acid and superphosphate in a complete plant and for basing and mixing in the dry-mix department or separate plant. A second major objective should be the proper costing and the control of materials used in formulating. This is of especial importance because of the large portion of the total cost represented by materials. Only a slight amount of carelessness or wastefulness in their use can quite readily offset or wipe out hard-won gains from manufacturing economies or efficiencies.

The cost system must be simple in nature—first, because the small margin of profit at which fertilizer is sold does not warrant an expensive system; and second, the operations, because of the very large tonnages of heavy and variable materials and the type of labor employed, do not lend themselves by nature to a system involving many and detailed records and scientific accuracy.

III. Description of the Cost System

Sulphuric Acid Costs

(1) *General Comments*

The manufacture of sulphuric acid is a continuous process, the plant never being shut down except for repairs or lack of business. It is always run at approximately full capacity when running and if it produces, say, only 70% of its yearly capacity, it will run only 70% of the number of days in the year, and not at the rate of 70% for each day of operation.

Relatively little labor is required, although three shifts must be used for each of the seven days in the week. The feeding of sulphur, the regulation of valves and pumps, and the reading of instruments and measurements are the principal activities of labor. There is no reason, therefore, to get any segregation of operating labor for particular operations and the total for the entire acid plant is sufficient for cost purposes. It is important, however, to keep a separate record of labor used on repairs. The labor costs for the sulphuric acid department are obtained from the Payroll Analysis (Figure 2).

The costs of a sulphuric acid plant are divided into the two main divisions of "operating costs" and "material costs," each of which is discussed separately below.

(2) *Material Costs*

Since either the oxidizing agent or catalyst is charged to "supplies" as an operating cost, the only material involved is sulphur. Water, of course, is a major ingredient, but is likewise treated as an item of "supplies."

WEEKLY PAYROLL ANALYSIS

Pay Period Ended_____

Department		.1	.2	.3	.6				Total
No.	Name	Supervisory	Direct	Indirect	Repairs				
1	Acid								
2	Superphosphate								
3	Mixed Base								
4	Milling and Shipping								
5	General Factory								
6	Inventories								
	(Etc.)								
				NOTES:					
	1. Blank columns can be used for other accounts to which labor is charged.								
	2. Labor charges to inventories cover unloading and handling charges on in-bound materials.								
	Totals								

Fig. 2.

All materials being on a standard cost basis, the per pound cost of sulphur usually will not vary throughout the year. The quantity used per ton of acid produced, however, will change from month to month with operating conditions, efficiency, warm or cold weather, etc. Inasmuch as the cost of sulphur may be two thirds or more of the total cost of the acid, its cost, pounds used per ton of acid, and the differential or variance from the standard cost are all important information for the operating management.

The quantities of sulphur fed to the burners are listed on daily reports by the plant operators and totaled monthly to give the information required for cost purposes.

(3) *Operating Costs*

In common with the other departments of a complete fertilizer plant the acid department will have the usual direct and indirect operating and expense accounts, such as supervision, direct and indirect labor, repairs, depreciation, power, factory overhead, etc. A code of accounts should be prepared, with the same sub-numbers for the various accounts in whatever department applicable but with a prefix to designate the department. For example, if Account .6 is set up for repairs and the

"Acid Department" has the controlling prefix 1 and the "Superphosphate Department" 2, repairs for the respective departments will be coded as follows:

1.6 = Repairs—Sulphuric Acid Department
2.6 = Repairs—Superphosphate Department

By following the same method for all other accounts and departments, items are easily coded and classified. The schedule of "Sulphuric Acid Operating Costs" (Figure 3) shows the accounts generally applicable to that department.

There are many general items of expense pertaining to the complete plant but not directly applicable to the operating departments. This includes general office and supervisory expenses, fire protection, insurance, taxes, etc. These should be allocated to the respective operating departments on a predetermined percentage basis computed in proportion to the relative outputs of the departments.

The sulphuric acid department represents one of the major parts of the investment in a complete fertilizer plant. This makes it important to accurate cost-finding that its own depreciation be determined, and likewise for the other departments. Repairs, except for minor current upkeep, come at irregular times and in large amounts, with perhaps several years intervening between major jobs. Unless this condition is recognized and steps taken to "smooth off" its effects, the costs for some years will be entirely too low while others will have to pay for maintenance accumulated but not charged in previous years. An excellent way to prevent this is to charge all actual repairs to a "Deferred Repairs" account and to make a monthly charge to current operating costs on a per-ton basis with a corresponding credit to "Deferred Repairs." The rate used will be based on knowledge and experience and should have a margin of safety sufficient to insure that actual costs will be absorbed.

Having provided for repairs in this manner, the remaining operating costs of this department will be found to be quite steady and uniform from month to month. This makes the use of a "Standard Operating Cost" especially applicable. Not only will this enable the determination of monthly differentials and the measurements of operating efficiency, but also it will permit the setting of a fixed cost for acid delivered to the superphosphate department and for cost of sales when acid is sold as such.

(4) *Cost Statement*

A typical "Cost Statement" for a Sulphuric Acid Plant is presented on Figure 3. Comparisons for the respective single months and for the fiscal year to date are shown on either side of the form.

Superphosphate Costs

The compilation of the costs of manufacturing superphosphate is a quite simple matter as will be seen by reference to the "Superphosphate Cost Statement" (Figure 4).

The two items of material—namely, sulphuric acid and phosphate rock—are susceptible of accurate measurement as used and they will be priced at standard material costs so the only variance will result from the quantity used per ton of superphosphate. In order to make a ton of superphosphate it is necessary to use more than a ton of the two ingredients as there is always a shrinkage resulting from

Form AD 25

Month of_____ **OPERATIONS STATEMENT** _____ Months to_____ 19____

This Month		Last Month		Item	Months This Year		Months Last Year	
Amount	Per	Amount	Per	SULPHURIC ACID	Amount	Per	Amount	Per
				Production in Tons				
				Material Cost				
XXXXXXXXX	XXXX			Sulphur - Total Quantity - (lbs.)				
XXX	etc.			Sulphur - Pounds Per Ton of Acid				
XXX				Yield - (Ratio of Acid to Sulphur)				
XXXXXXX				Sulphur - Actual Cost				
XXXXXXX				Sulphur - Standard Cost				
XXXX				Differential - Favorable (Unfavorable)				
				Operating Costs				
				Labor - Supervisory				
				Labor - Direct				
				Labor - Indirect				
				Power				
				Supplies				
				Repairs (At Standard Rate Per Ton)				
				Depreciation				
				Share of General Expense				
				Miscellaneous				
XXXXXXX				Total Operating Costs				
XXXXXXX				Standard Cost				
XXXXXX				Differential - Favorable (Unfavorable)				
				Total Cost				
XXXXXXX				Material				
XXXXXXX				Operating				
XXXXXXX				Total Cost				
XXXXXXX				Standard Cost				
XXXXX				Differential - Favorable (Unfavorable)				

Schedule

Fig. 3. Sulphuric Acid Cost Statement.

Form AD 25

Month of _____ **OPERATIONS STATEMENT** _____ Months to _____ 19____

This Month		Last Month		Item	Months This Year		Months Last Year	
Amount	Per	Amount	Per	SUPERPHOSPHATE	Amount	Per	Amount	Per
XXXX				Production in Tons				
				Materials Used				
				Sulphuric Acid - Tons				
				Ground Phosphate Rock - Tons				
				Total - Tons				
				Production Tons				
				Shrinkage Tons				
				Shrinkage %				
				Material Costs				
XXXXXXX	XXXX			Sulphuric Acid				
XXXXXXX	XXXX			Ground Phosphate Rock				
XXXXXXX	etc.			Total Material Costs				
XXXXXXX				Standard Cost				
XXXX				Differential - Favorable (Unfavorable)				
				Operating Costs				
				Labor - Supervisory				
				Labor - Direct				
				Labor - Indirect				
				Power				
				Supplies				
				Repairs				
				Depreciation				
				Share of General Expense				
				Miscellaneous				
XXXXXXXX				Total Operating Costs				
XXXXXXXX				Standard Cost				
XXXXX				Differential - Favorable (Unfavorable)				
				Total Cost				
XXXXXXXX				Material				
XXXXXXXX				Operating				
XXXXXXXX				Total Cost				
XXXXXXXX				Standard Cost				
XXXXX				Differential - Favorable (Unfavorable)				
XXXXX				Average Units Per Ton				
XXXXX				Cost Per Unit of A P.A				
XXXXX				Standard Cost Per Unit				
XXX				Differential - Favorable (Unfavorable)				

Schedule

Fig. 4. Superphosphate Cost Statement.

loss of moisture, etc. The determination of this shrinkage is, therefore, important to the operating management, and is provided for on the "Cost Statement."

The cost of labor is also easy of determination, as the process is a repeating one and the labor crews remain fairly stable. Since the superphosphate department is separate and distinct, the other applicable costs are likewise quite easy of segregation. It is better for this department also that repairs be applied on a per-ton rate in the same manner as described for the sulphuric acid department.

The cost statement presents both a cost per ton and per unit of available phosphoric acid. The latter is helpful in computing the cost of mixed fertilizers and also in the determination of selling prices for bulk and bagged superphosphate where the tonnages involved may be of varying unit content.

Cost of Mixed Fertilizers

(1) *Operating Costs*

There are two separate operations in connection with the production of mixed fertilizers: First, the preparation of base goods and, second, the milling and bagging at time of shipment, both of which have been described.

The two operations mentioned, however, will be common to most grades. Their costs, therefore, should be determined on a total basis for all grades and allocated to the cost of the individual grades by use of uniform rates. In the cost system presented these rates will be considered as standards costs. The use of uniform rates is especially appropriate and desirable for those particular operations. It has already been stated that in normal times the shipping season is relatively short. Thus a large part of the year is used in preparing and storing fertilizers for later shipment. Costs, then, are really on an annual basis, except for sulphuric acid and superphosphate. What may be stored in the same pile in July or November will be shipped, perhaps, and without any possibility of differentiation, in the following March. Also certain costs will be incurred regularly throughout the year, and more often than not in those months when shipments may be very small or nothing at all. The rates, therefore, should be set on an annual basis, and operating costs allowed to accumulate in Deferred Charges until they can be applied to mixing and to shipments.

Two cost centers should be set up to cover these operations, one for mixed base and the other for milling, bagging, and shipping. The operating and applicable overhead costs will be determined from labor and other records just as for the acid and superphosphate departments. Knowing the total tonnage handled each month for each operation, the monthly costs and variances can be computed readily. It should be remembered, however, that, as already stated, these expenses should be applied to the grade costs only at uniform rates and not at the monthly fluctuating costs.

The cost statement (Figure 5) will illustrate the method used for both operations, although depicting only that for milling, bagging, and shipping. Incidentally it should be noted that the portion of general overhead remaining after the allocations to the acid and superphosphate departments is applied all to the final milling, bagging and shipping operation, with none going to mixed base.

The latter is only an intermediate operation and the result to the final product would be the same. Thus nothing is gained by trying to split this particular item.

Month of_____ OPERATIONS STATEMENT _____Months to_____194____

This Month		Last Month		Item	____Months This Year		____Months Last Year	
Amount	Per	Amount	Per	MILLING, BAGGING AND SHIPPING	Amount	Per	Amount	Per
				Tons				
				Operating Costs				
				Labor - Supervisory				
				Labor - Direct				
				Labor - Indirect				
				Power				
				Supplies				
				Repairs				
				Depreciation				
				Share of General Expense				
				Miscellaneous				
XXXXXXXXXXX	XXXX			Total Operating Cost				
XXXXXXXXXXX	XXXX			Standard Operating Cost				
XXXXXXXXXXX				Differential - Favorable (Unfavorable)				

Schedule

Fig. 5. Milling, Bagging and Shipping Cost Statement.

Attention is called also to the fact that these same operations and their costs apply to bagged superphosphate as well as to mixed fertilizers, so the treatment is identical.

(2) *Material and Total Costs*

Material cost is by far the largest portion of the total cost of mixed fertilizers, and of course will vary with every different formula.

Raw Materials.—In normal times most standard raw materials such as sulphur, phosphate rock, nitrogen materials, potash, etc., are usually bought on yearly contracts. Thus their costs are fixed for the year, except perhaps for supplementary lots or transfers from one factory to another to meet shortages, etc. This situation lends itself admirably to the setting-up of standard costs for purchased materials. These costs should cover the contract purchase price, inward transportation charges and unloading costs, together with an allowance for the excess cost of the small lots mentioned above.

Each material will then be entered on the stock records at its particular standard cost and carried through the cost records at the same value. All purchase invoices and transportation bills, also labor and other unloading costs, will be charged to a "Raw Material Purchase Account." At the same time an entry will be made charging "Factory Inventory Control Account" for the value of the purchase at its standard unit cost, with a corresponding credit to the "Raw Material Purchase Account." The balance in the latter account will, then, at all times represent the purchase differential or variance.

Grade Costing.—Each grade of fertilizer will have its own "Formula Cost Sheet" (Figure 6). The materials making up the formula will be priced at their respective standard costs, to which will be added the standard rates for basing, milling, and

GRADE FORMULA STANDARD COST SHEET

Grade *4-10-6*

Material	Inventory Acct. No.	Pounds	Price per Lb.	Cost	
Run of Pile Superphosphate					
Nitrogen Solution					
Sulphate of Ammonia					
50% Muriate of Potash					
Dry Limestone					
Gross Total		2050		XXXX	
Shrinkage		— 50		—	
Net - Materials		2000		XXXX	
Mixed Basing @ Standard Rate			XXX	XXX	
Total Cost Based " "			—	XXXX	
Milling and Shipping			XXX	XXX	
Total Cost Ex. Bags			—	XXXX	

Fig. 6.

shipping. Thus the entire cost is on a standard basis, the variances from actual costs having been handled at the various stages of production.

At the end of the accounting period the total tons for each grade shipped will be multiplied by the standard grade cost to give the charge to "Cost of Sales" and the credit to "Finished Goods Inventory." Up to this point no provision has been made in the grade costs for the important item of containers, which are either paper or textile bags. Since the same type and size of bag may be used for many different grades and correspondingly the same grade may be shipped in several different kinds of bags, it is preferable to apply bag costs all at one time. Hence at the end of the period the total tons shipped in, say, 100-pound burlap bags, regardless of grade, are multiplied by the standard cost of that type of bag. The result is charged to "Cost of Sales" and credited to the "Bag Inventory Account." Tax Tags are treated in the same manner.

Inventory and In-Process Accounts

In order to give proper accounting treatment to the various operations and to know the value of materials in the various classes of inventory, it is necessary to have certain work in process and other inventory accounts. For example, raw materials for the production of acid are credited to their respective inventory accounts and charged to sulphuric acid in process. The latter is credited and superphosphate in process charged with the acid delivered to that operation. Correspondingly, superphosphate is credited with transfers charged to "Mixed Base Inventory," and the latter in turn is credited with material transferred to the "Finished Inventory Account." All of these transfer entries will be made at standard costs, the variances being treated separately.

Standard Cost Variances

It has been shown that standard costs are used throughout the cost system, beginning with the purchase of raw materials. Thus variances or differentials from actual costs appear at each stage of the manufacturing process. These should be collected on a Standard Cost Variance Schedule similar to that presented in Figure 7, and each month the necessary entries should be made to clear the respective inventory accounts of these variances.

Since the fertilizer business is a highly seasonal one, with sales concentrated in a relatively short period but production continuing throughout the year, it is not practicable to handle the variances in each accounting period by charges or credits to profit or loss. As said before, this is primarily a yearly business and so the costs should be yearly ones. It is proper and logical, therefore, to hold these variances in a "Deferred Variance Account" and handle them through the "Profit-and-Loss Account" at the end of the year or perhaps during the shipping period. In the latter case the proper proportion to be allotted to each month can perhaps be determined best on a per-ton basis.

General Comments

In the description of this cost system no attempt has been made to cover all the details of cost procedure because of the limitation of space. It was felt that a general outline of the operations, principles and problems involved, supplemented by

OPERATIONS STATEMENT

Month of_____ _____Months to_____19____

This Month		Last Month		Item	____Months This Year		____Months Last Year	
Amount	Per	Amount	Per	SCHEDULE OF STANDARD COST VARIANCES	Amount	Per	Amount	Per
				Sulphuric Acid — Materials				
				" " — Operating				
				Superphosphate — Materials				
				" — Operating				
				Mixed Base — Materials				
				" " Operating				
				Milling, Bagging & Shipping — Materials				
				" " " — Operating				
				Total Manufacturing Variance				
				Purchasing Variance				
				Total Variances				

Schedule

Fig. 7. Standard Cost Variance Schedule.

the exhibits, would give a comprehensible and usable picture of a type of cost system fitted to the fertilizer industry. It is believed that enough information has been given so that a well-trained cost accountant can fill in the missing details and adapt the system readily to his particular plant and problems.

COST ACCOUNTING FOR THE FLOUR MILLING INDUSTRY

By
R. R. McCreight *

I. Description of the Industry

Classification of Products

1. The major food grains are wheat, rice, and corn; rye, barley, millet, and sorghum are used to some extent especially in some oriental countries.

The writer's work has been confined to milling of wheat, hence, this article will be written in terms of wheat.

Flour milling as practiced today is a gradual reduction process which means that wheat is ground in successive installments, and after each grinding the material is sifted and separated into several products of different sizes, which are re-ground and sifted again until they are of a size that permits passage through a sieve of specified mesh.

The wheat berry consists of (1) 84% endosperm or floury inside, 14.5% outside bran coat, and 1.5% germ. We shall use the terms flour and offal or feed.

There are two families of wheat—winter wheat and spring wheat. These are again divided according to the color of kernels into white, red, and amber. The red kernels are of three classes: (a) Hard red springs, (b) hard red winter, and (c) soft red winter.

2. Hard wheat flours are primarily bread flours whether used in the bake shop or home. Flour from soft red winter wheat excels in the making of fine cake, pastry, and biscuits. Flour from the amber kernels, or Durum wheat, is used primarily in the production of macaroni and other alimentary pastes.

Origin of Products

The origin of wheat is unknown. It was an important food crop in ancient Egypt and Palestine, Syria, and Mesopotamia. The protein found in wheat flour accounts for its universal appeal as a food.

The crude art of milling was probably learned almost as early as the cultivation of grain. Old legends relate that the goddess Ceres taught man the art of agriculture and also taught him how to grind the grains. Ancient literature tells of the excellence of sifted meal and bread made from this which was recognized as a food that belonged to the delicatessen class. Bread made from sifted wheat meal was considered a food fit to set before a goddess. The sifting of the outside of the grain from the inside is an art that antedates Greek and Roman civilization.

Sources of Raw Materials

Wheat is grown in some quantity in all states of our union. The four principal winter wheat states are Kansas, Nebraska, Oklahoma, and Texas. And the four

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principal spring wheat states are North Dakota, South Dakota, Montana, and Minnesota. These eight states produce more than 50% of the total production in the United States.

Organization of Plant

One of the important factors in the operations of a flour mill is the avoidance, so far as possible, of the speculative element which ordinarily follows the ownership of grain. Since most flour is sold for delivery within a period of 60 to 120 days, and usually is not made until date of shipment, the company must protect itself against market losses on future deliveries of flour by purchasing "cash" grain at the time such sales are made or by "hedging" with grain futures. All transactions relating to the purchase or sale of grain and "futures" are included in the operations of the grain department.

This article has been limited to a discussion of milling costs and profit-and-loss factors relating strictly to milling operations. Purchases and sales of grain and transactions relating to "hedging" have purposely been excluded from this paper.

An outline of plan to coordinate the functions of a milling company with the usual duties and functions of industrial plants.

- ADMINISTRATION
  - Grain Department
    - Country Station Operations
    - Car-lot Purchases and Sales
    - Options Bought and Sold
  - Milling Department
    - Production
    - Maintenance
  - Selling
  - Laboratory
  - Products Control
  - Laboratory

The operations of the production department of a flour mill naturally divide themselves into four major departments.

1. Elevator operations, consisting of receiving, weighing, unloading, and binning, using scales and belt-bucket elevators or other bulk moving equipment. This department does some cleaning, transferring to mill all wheat that is ground and loading out any that is to be shipped.

2. Milling consisting of (a) proper wheat conditioning, that is, cleaning, scouring, washing and tempering, using separators and other cleaning and washing machinery to eliminate all dirt or foreign material before being crushed by rollers; (b) grinding of the wheat berry by mill rolls, sifted over various sifting machines, elevated in belt bucket elevators, then re-rolled, re-sifted, and re-elevated until the particles pass through a specified mesh of the sieves from whence it is collected into bins.

3. Packing. From the bins it is drawn off into various size packages using packing and weighing equipment.

4. Warehouse and Loading. Most flour is loaded directly from packer to car by trucks or other conveying equipment. If no cars are available or no definite shipping instructions at hand, the flour is then stored in a warehouse.

All of the above operations are under the direct supervision of the plant superintendent.

The maintenance work affecting all of the above departments is under the direction of the master mechanic but approved by the plant superintendent.

Production Order System

The cooperation of the sales department must be secured before any planning procedure can be carried out. All orders for shipment should pass over the desk of the man doing the planning of production and shipments. He must know among other things the kinds of wheat used for various grades of flour, and available supply of each on hand or to arrive; packing material on hand, or on order; sales requirements of various customers.

The production program must harmonize with the deliveries to be made; hence, runs of similar grades of flour should be placed in consecutive order to facilitate the preparation of the wheat mix; and labor for loading, trucking, storing, piling, etc., should be budgeted daily according to standard hundred weight per man-hour required for the scheduled operations.

II. How to Design the Cost System

Considerations in Designing the System

Profits in flour milling arise from two general groups of factors:

1. Profits due to merchandising ability, reputation, and services.

2. Profits arising from intangible factors, such as distribution and quality of wheat crop, market movements of mill feeds and clears. Also market movements in the future's market, and protein premium over the current future's market.

In the operation and development of accounting methods we should endeavor to strengthen control over expense and attain such an analysis of operating results as will disclose the information necessary to an adequate exposition of the underlying causes of profits or losses.

A good chart of accounts, if accompanied by adequate instructions, is a great aid to better accounting. It makes for uniformity, saves time, gives clarity, promotes better understanding, and more effective use of accounting statistics in the internal affairs of the company.

The profit-and-loss statement has been designed to show comprehensive and complete current and cumulative data (for fiscal year period) as to the contributions by the various functions and factors inherent to the business toward the total net results.

The illustration, however, shows only the results of a single accounting period, being the first month of the year. At the end of any accounting period other than the first month, we get the accumulated results from which the previous results are subtracted to get the result of the current period's operation.

As actual or historical, cost accounting is statistical in plan, conventionalized in harmony with a formula that provides a simple partial proof of clerical accuracy by balancing, and refers primarily to movements of moneys or goods, translated into terms of money. It has some features which are indispensable.

Our budget covers the expense allowance for conversion costs at a selected normal level of operations. It is not a forecast of sales, as selling prices are relatively unimportant, but we are concerned with the gross recovery over material cost.

The gross recovery over material cost is calculated on each sale contract at the

Mill_____ Order No._____ Date_____ 19____

PRODUCTION				MILLING SPECIFICATIONS							
Customer or Destination	Leading Order No.	Cwt. Flour	Flour Grade No.	Wheat Mix	Ash	Moisture	Malt	Enrichment	Bleach 1	Bleach 2	Bleach 3

By_____
Shipping Foreman

Approved By_____
Products Control

Fig. 1.

time the booking of the sale is made, at standard price of the material items entering into the cost of the sale.

Our standard accounting procedure is composed of the ingredients of (a) "historical costs," (b) expense budget, and (c) standard material cost.

III. Description of the Cost System

The necessary steps in order to establish a standard cost system in this industry are as follows:

(1) Design the profit-and-loss report.
(2) Design the standard cost of material.
(3) Determine the budget of expenses.
(4) Set up instruction for carrying out the cost system and producing the desired result.
(5) Set up the chart of accounts.
(6) Trial balance and work sheet.

Profit-and-Loss Statement

	Month	Year To Date
Flour Shipments	$134,312.60	
Feed Shipments	25,165.66	
Total	$159,478.26	
Less Returns, Allowances and Freight	17,001.16	
Net Shipments	$142,477.10	
Cost of Shipments:		
Wheat Ground	116,429.65	
Packages Used	4,024.84	
Ingredients Used	679.89	
Total	$121,134.38	
Decrease in Flour and Feed Inventories	4,104.42	
Total Material Cost	$125,238.80	
Recovery Over Material Cost on Closed Transactions	17,238.30	
Open Transactions to Market (Wheat—Flour—Feed)	(765.61)	
Total Recovery and Adjustment to Market	$ 16,472.69	
Manufacturing Expense	8,935.04	
Gross Profit on Shipments	$ 7,537.65	
Operating Expense:		
Administration Expense	1,611.17	
Office Selling Expense	1,803.88	
Outside Selling Expense	2,180.53	
Total	$ 5,595.58	
NET GAIN FROM OPERATIONS	$ 1,942.07	

Fig. 2A.

Profit-and-Loss Statement

The profit-and-loss statement in a few figures tells the result of that period's operation. To explain the why and how of these results is the task of the cost accountant.

In order to bridge the gap between actual or historical entries and standard entries, we prepare our profit-and-loss statements on both the historical method and the standard method.

PROFIT-AND-LOSS STATEMENT

Mill Department:	Month	Year To Date
1. Gross Recovery on Flour Shipments	$11,300.83	
2. Manufacturing Expense Absorbed at Budget Rates	8,105.96	
3. Gross Profit on Flour	$ 3,194.87	
4. Administration and Selling Expense Absorbed at Budget Rates	5,745.00	
5. Net (Loss) on Flour	$(2,550.13)	
6. Expense Under Absorbed at Budget Rate	(1,131.62)	
7. Total	$(3,681.75)	
8. Realization of Discounts on Feed	2,758.71	
9. Feed Sales Under Cost Card Values	(473.37)	
10. Loss in Feed (Net) to be produced from Flour Bookings	(63.40)	
11. Net Gain Feed Department	$ 2,221.94	
12. Realization of Discount on Clears and Profit on Flour Bought	2,172.00	
13. Gain in Clears to be Produced from Flour Bookings	403.85	
14. (Loss) on Miscellaneous Grain Products Bought for Resale	(62.02)	
15. Wheat, Clears and Offal Variance	1,423.00	
16. Wheat Tempering Gain	2,019.22	
17. Freight Variance	(153.76)	
18. Package Variance	(690.84)	
19. Ingredients Variance	(64.52)	
20. Sales Allowance	(53.45)	
21. Insufficient Gross Recovery on Flour Bookings	(5,052.05)	
22. Excess Cost of Malt Flour	(127.38)	
23. Net (Loss) Mill Department	$(1,645.76)	
Grain Department:		
24. Profit on Wheat Sales to Mill and Inventory Variance	$ 843.64	
25. Gain/(Loss) on Hedging Trades	(1,201.80)	
26. Wheat Gain in Unfilled Flour Bookings	3,945.99	
27. Net Gain Grain Department	$ 3,587.83	
28. NET PROFIT MILL AND GRAIN DEPARTMENTS	$ 1,942.07	

Fig. 2B.

Figure 2A is the historical or conventional profit-and-loss statement showing shipments and cost of material, and the resulting recovery over material cost adjusted by loss on open transaction less the totals of the various expense division. It is used in preparing state and Federal reports.

Figure 2B is the standard cost profit-and-loss statement. Most of these items are self-explanatory, but some require explanation as follows:

Line 8. Realization of discount on feed. This represents the movements in feed values at date of flour order and milling date. It is also affected by opening and closing inventory value of feed.

Line 9. Feed sales in excess of cost card value represents the difference between the sale price of feed and the cost card value on booking date of feed sale.

Line 10. Loss in feed (net) to be produced from flour bookings. This is difference between cost card value of feed at time of bookings and at inventory date.

Line 12. Realizations of discount on clears and profit on flour bought. This is similar to line 8, except it applies to clear flour and includes gain or loss on flour bought for mixing purposes.

Line 13. Similar to Line 10.

Line 15. Wheat clear and offal variance represents the difference between the standard and actual yield of flour and feed from the wheat berry.

Line 16. Wheat tempering gain represents the added ingredients to condition the wheat berry.

Lines 17, 18, and 19 represent the difference between values used in costing sale and the actual disappearance; packages and ingredients are always affected by an erroneous inventory.

Line 21. "Insufficient Gross Recovery on Flour Bookings" represents the amount by which our open flour contracts were insufficient to meet the sum of standard material cost at inventory date, plus budgeted expense.

Line 22. "Excess Cost of Malt Flour" represents the value between the cost of malted wheat flour added in excess of regular flour displaced.

Line 24. "Profit on Wheat Sales to Mill and Inventory Variance" represents the movement of wheat price between date of booking flour sale and cost of wheat. It is also affected by the value of opening and closing inventory date.

Line 26. "Wheat Gain on Unfilled Flour Bookings" being the difference between the value of the required number of bushels to fill all open orders at inventory date as compared to value of booking date.

Procedure to follow to get information on Figure 2B.

In order to arrive at the gross recovery on flour shipments, we make daily cost cards using current wheat and offal price and a standard number of bushels to arrive at bulk f.o.b mill cost of each percentage of patent flour. The sale price is also reduced to a bulk f.o.b. mill price, and the difference between the two amounts is the gross recovery which is entered on the booking contract carried as follows to the invoice when shipment has been made:

	COST						
Sales Price	Wheat	Clears	Offal	Package	Ingredients	Freight	Gross Recovery

The amounts to be inserted in the above spaces are those shown on the booking orders, provided the shipments are in exact conformity with the basis on which the orders were booked. When the shipments differ from the booking basis, the sales prices inserted in the stamp are those shown by the invoices, and the amounts for wheat, clears, offal, and package are revised to conform to the actual basis of shipment, and a new gross recovery is calculated.

The various factors inserted on sales invoices are extended by quantities and accumulated into monthly totals by grades of flour or feed; also as to class of shipments, that is, customer, inter-mill, jobbing departments, or samples.

Each month these accumulations are entered on "Standard Material Cost of Shipments and Inventories" (Figure 3), together with the opening and closing inventories. This sheet is recapped by grades on Figure 4, and from this sheet the following journal entries are made. (The illustrations used are actual for one plant for a period of one month.)

From our expense tabulation and budget we prepare JV 1813 as follows:

JV	Account No.	Dr.	Cr.
No. 1813 EXPENSE ABSORBED			
Manufacturing Expense Applied to Shipments	2052	$ 7,654.00	
Manufacturing Expense Absorbed	2445		$ 7,654.00
Administration Expense Applied to Shipments	2054	5,745.00	5,745.00
Manufacturing Expense Over or Under Absorbed	2446	149.42	1,281.04
Expense Under Absorbed	9989	1,131.62	

From our Inventory Summary we make JV's No. 1814, 1815, and 1816:

No. 1814 TO RECORD OPENING AND CLOSING INVENTORIES			
Wheat Inventory	2060	$51,362.52	$53,188.07
Wheat Purchases	2061	53,188.07	51,362.52
Miscl. Flour, Feed, and Meal Inventory	2041	357.60	247.05
Miscl. Flour, Feed, and Meal Purchases and Sales	2042	247.05	357.60
Package Inventory	2045	14,261.55	12,285.10
Package Variance	2046	12,285.10	14,261.55
Ingredients Inventory	2047	624.75	1,020.80
Ingredients Variance	2048	1,020.80	624.75
No. 1815 TO RECORD EXPENSE IN OPENING AND CLOSING INVENTORY			
Flour Inventory at Mill	2001	$ 488.46	$ 940.42
Manufacturing Expense Applied to Shipments	2052	940.42	488.46
No. 1816 TO RECORD PROFIT AND LOSS IN OPEN CONTRACTS			
Wheat Purchase, Contracts to Market	2069	$ 1,288.32	
Wheat Gain or Loss Unfilled Flour Bookings	2067		$ 5,234.31
Gain or Loss Unfilled Clear Bookings	2057		403.85
Gain or Loss Unfilled Feed Bookings	22057	63.40	
Insufficient Gross Profit in Unfilled Flour Bookings	2058	5,052.05	
Open Transaction to Market	2090		765.61

No. 1818 Standard Material Cost for the Current Month	Account No.	Dr.	Cr.
Std. Material Cost Flour Shipments, Customers	2007	$99,397.38	
Std. Material Cost Flour Shipments, Inter-Mill	2009	4,578.92	
Std. Material Cost Flour Shipments, Jobbing Dept.	2010	4,357.19	
Blended Flour Produced	22014	510.51	
Flour Inventory at Mill	2001	5,198.55	$ 12,013.83
Std. Material Cost Feed Shipments, Customers	2037	7,885.71	
Std. Material Cost Feed Shipments, Jobbing Dept.	2040	15,810.22	
Feed Inventory at Mills	2031	1,851.59	1,116.99
Wheat Sales to Mills	2062		116,750.93
Clears Produced	2014	3,859.09	
Offal Produced	2019	18,203.15	
Clears Purchased Flour Transfers	2015		4,139.79
Clears Purchased Flour Transfers	2015		1,866.79
Feed Transfers	2020		21,941.99
Package Credit	22046		3,334.00
Ingredient Credits	22048		487.99
No. 1820 Freight on Flour and Feed			
Flour Sales—Freight	2006	$14,850.85	
Feed Sales—Freight	2036	1,943.10	
Freight Credit	22044		$16,793.95

From the quantities of flour, clears and feed produced, and the values of wheat, clears and feed sold, we are able to make the following entry:

No. 1821 Wheat, Clears, and Offal Variance			
Wheat Sales to Mills	2062	$ 543.82	
Blended Flour Produced	22014		$ 505.62
Feed Yield	22019	1,384.80	
Wheat, Clears and Offal Variance	2021		1,423.00

These illustrations are no hypothetical figures, but are from actual experience, and in order to tie them up with all papers we have an adjusting entry to correct errors of the previous month.

Flour Inventory at Mill	2001	$2,274.06	
Clears Produced	2014		$ 29.40
Offal Produced	2019		63.70
Feed Yield	22019		297.36
Wheat Sales to Mill	2062		1,883.60

Posting Standard Entries

Standard entries are entered on ledger sheets so marked as to distinguish them from historical entries which enables a trial balance to be separated as to standard entries and others, thus eliminating the reversing of many standard entries to get the historical record.

In our plan, the balancing figure for standard entries is always the sum of the

	HISTORICAL ENTRIES DR	HISTORICAL ENTRIES CR	STANDARD ENTRIES DR	STANDARD ENTRIES CR	PROFIT [LOSS]	SALES	PURCHASES	OTHER COSTS
2001 Flour Inventory at Mill	(10 680 19)			(4 993 18)				
2002 Flour Shipments to Customers		106 209 74						
2003 Flour Shipments Subsidy		19 669 07						
2004 Flour Shipments Inter-Mill		4 578 92						
2005 Flour Shipments Jobbing Dept.		4 027 44						
2006 Flour Shipments Freight			14 850 85					
2007 Standard Material Cost: Flour shipments to Customers			99 397 38					
2009 Standard Material Cost: Flour shipments Inter-Mill			4 578 92					
2010 Standard Material Cost: Flour shipments Jobbing Dept.			4 357 19		11 300 83	134 485 17		
12								
2014 Clears Produced			3 829 69					
22014 Blended Flour Purchased			4 89					
2015 Clears, Blends Purchased Flour Transfers				6 006 58	2 172 00			
16								
2016 Wheat Tempering Gain				2 019 22	2 019 22			
8								
2019 Offal Produced			18 139 45					
22019 Feed Yield			1 087 44					
2020 Feed Transfers				21 985 60	2 758 71			
6								
2021 Wheat, Clears, and Offal Variance				1 423 00	1 423 00			
20								
2022 Flour Sales Allowance Customers		72 68						
2025 Marine Insurance on Export Flour Shipments	18 18							
2026 Feed Sales Allowance Customers	47 95				53 45	53 45		
9								
2031 Feed Inventory at Mill	(1 073 38)		(778 21)					
2032 Feed Shipments to Customers		9 755 31						
2035 Feed Shipments to Jobbing Dept.		15 410 35						
2036 Feed Shipments - Freight			1 943 10					
2037 Standard Material Cost: Feed Shipments to Customers			7 885 71					
2040 Standard Material Cost: Feed Shipments to Jobbing Dept.			15 810 22		473 37	25 165 66		
14								
2041 Miscellaneous Grain Products Inventory	(247 05)		(110 55)					
2042 Miscellaneous Grain Products - Purchases and Resale	172 57			110 55	62 02	172 57		

Fig. 5. Trial Balance.

	HISTORICAL ENTRIES DR	HISTORICAL ENTRIES CR	STANDARD ENTRIES DR	STANDARD ENTRIES CR	PROFIT [LOSS]	SALES	PURCHASES	OTHER COSTS
17								
2044 Freight Variance	16 947 71					16 947 71		
22044 Freight Credits				16 793 95	153 76			
18								
2045 Package Inventory	(12 285 10)		(1 976 45)					1 976 45
2046 Package Variance	6 001 29			1 976 45				6 001 29
22046 Package Credits				3 334 00	[690 84]			
19								
2047 Ingredients Inventory	(1 020 80)			(396 05)				396 05
2048 Ingredients Variance	156 46		396 05					156 46
22048 Ingredients Credits				487 99	[64 52]			
2049 Fuel Inventory	1 128 74							
2099 Malted Flour Inventory	299 70							
2098 Novadel Inventory	341 25							
2								
2052 Manufacturing Expense Applied to Flour Shipments			8 105 96		[8 105 96]			
4								
2054 Administration Expense Applied to Flour Shipments			5 745 00		[5 745 00]			
13								
2057 Gain or Loss in Clears to be Produced from Flour Bookings				403 85	403 85			
10								
22057 Gain or Loss in Feed to be Produced from Flour Bookings			63 40		[63 40]			
21								
2058 Insufficient Gross Recovery in Flour Bookings			5 052 05		[5 052 05]			
2090 Open Transactions to Market	(5 651 52)			(765 61)				
2059 Excess Cost of Malt Flour Over Wheat Flour	127 38				[127 38]			127 38
GRAIN DEPARTMENT								
24								
2060 Wheat Inventory	(53 188 07)			(1 825 55)			1 825 55	
2061 Wheat Purchases	113 402 30		1 825 55				113 402 30	
2062 Wheat Sales to Mills				116 071 49	843 64			
25								
2065 Closed Futures	1 201 80				[1 201 80]		1 201 80	
26								
2067 Wheat Gain or Loss in Unfilled Flour Bookings				5 234 31				
2069 Gain or Loss in Wheat Purchase Contracts			1 288 32		3 945 99			
2070 Milling in Transit Billing	(2 014 98)							
BALANCE		66 342 91		(13 399 -)				
TOTAL	226 006 42	226 006 42	197 226 38	197 226 38	3 073 69	142 477 10	116 429 65	4 704 73

Fig. 6.

first two debit entries on JV 1813 cumulated for each period. (The manufacturing and administration expenses absorbed.)

Trial balance for month under review is shown in Figures 5 and 6.

The inventories are circled; those in the historical column representing the opening inventory; those in the standard column the changes at the close of the period.

The items appearing in the profit-and-loss column can readily be checked with profit-and-loss statement—Figure 2B.

To get the conventional profit-and-loss statement, all items of sales are entered in the "sales" column totaling $142,477.10. All grain and grain products purchased are entered in the "purchase" column. "Other cost" include packages and other improving ingredients.

		Total of Sales Column		$142,477.10
		Purchase Column	$116,429.65	
		Other Costs	4,704.73	
Acct.	2001	Decrease in Flour Inventory	4,993.18	
Acct.	2031	Increase in Feed Inventory	(778.21)	
Acct.	2041	Increase in Miscl. Flour, Etc., Inventory	(110.55)	125,238.80
		Recovery Over Material Costs		$ 17,238.30
Acct.	2090	Open Transactions to Market		(765.61)
		Total Recovery and Market Adjustment		$ 16,472.69

For verification the closing inventories total $82,815.60, the balance figure in the historical column is $66,342.91; the difference being $16,472.69.

COST ACCOUNTING FOR FOOD SERVICE ORGANIZATIONS

By
NEVA HENRIETTA RADELL *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Food service organizations serve meals or individual menu dishes for consumption of the guest in dining rooms or at counters provided. The types of service are waiter or waitress, cafeteria or buffet, and counter. Occasionally lunches are packed to be sent out, and hotels take care of food service in private rooms.

The food service industry is one of the great businesses of this country. It is fourth in size among retail lines and is important for the health and well-being of millions of people who eat away from home. Also, much of the social life of the country is centered in dining out. For some time there has been an increase in the use of public eating places including hotels, restaurants, cafeterias, train and airplane diners, clubs, schools and colleges, and others. The school food service programs with their Federal and state aid are tending to influence our future adult population in the appreciation of good food served in public places.

Origin of the Products

Menu items originate from food knowledge in the preparation and service of meats, fish, poultry, vegetables, fruits, and other single item dishes. For many foods served, recipes are used for standardization of the product.

A complete knowledge and background of experience are essential regarding foods, their preparation, service, and place in the menu. This function of menu making, besides knowledge and experience, requires time, thought, study, imagination, and ingenuity.

Sources of Materials

As few foods come to the kitchen in a completely raw state, most of them being partially if not entirely processed, materials will be referred to as food, not raw food or raw materials. Another reason is that the term raw food has an entirely different use.

Sources of food may be gardens, orchards, poultry or stock farms owned by the organization or by local gardeners and farmers. In every case, however, the main sources for fresh foods are wholesale and retail meat, poultry, fish, fruit, and vegetable markets. Processed foods—canned, frozen, dried, or dehydrated—are purchased from wholesale or retail grocers or specialized business firms. Dairy, ice cream, and bakery products are purchased from special firms.

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Organization of the Plant

From the standpoint of the personnel

Owner, manager, head of department
Supervisors
Cooks and assistants
Baker and assistants
Storeroom man
Counter people
Waiters and waitresses
Bus people
Dishwashers, potwashers, and cleaners
Cashier and checker
Accountant and office assistants

From the standpoint of function

Menu making, purchasing, and job assignments
Hiring and supervising personnel
Receiving, storing, and requisitioning of food
Preparing food for service
  Kitchen, bakeshop, salad preparation unit, pantry or counter
Serving
  Table, cafeteria, counter, or outgoing deliveries
Dishwashing and cleaning
Cashiering and checking
Accounting

Production Order System

Production orders are made out daily for each individual item on the menu. These are posted in the kitchen or in the various departments. The orders usually cover the amount of food to be prepared for a meal and for a day. In some instances, there may be an order for some item for the following day or for a special function. See "Production Record" in Section III of this chapter.

II. How to Design the Cost System

What Information Is Required

A food cost system must be set up to fit the size of the organization, both as to sales volume and number of personnel. Usually the larger the organization the greater the need for a cost control system.

A *daily* cost control system is the ideal for the food service business, as all processes of buying, producing or manufacturing, marketing or merchandizing, and collecting take place in the short period of one day. Also the system must be set up to give the information regarding the cost of a day's meals not later than the next day following the service. This is essential for analysis of the day's operation in time to make any changes effective the following day or for notations on menu items which caused too high or too low a cost for the day. Changes may be made in size of portion, sales price, better training of servers, better supervision of the cooks, better buying, change of equipment for handling the preparation and service of food, closer inspection of deliveries, or better control of all materials from time of delivery or storage to the time the customer is served and all the food is sold.

The relation to sales of the total cost of food used for the day is the most important one figure for control. See daily food cost report or profit-and-loss statement for the month.

Considerations in Designing the System

All steps must be carried out so as to get a reliable result. If food is to be requisitioned for a storeroom or refrigerator, this policy requires a locked storeroom and refrigerator. If there are no locks, they must be provided and used. If space has to be partitioned off in order to keep food and supplies under lock and key, this must be done. All personnel must be instructed to carry out their assigned duties with reference to the control system. This means teaching new employees, reminding others, and supervising and checking constantly.

Watching for possible leaks in the system and avoiding situations where employees are tempted to take food home or to destroy it by some means is important. A control system should avoid unpleasant situations between employees and create an harmonious atmosphere in the organization. No employee wants to be blamed for what someone else does, and a food control system must help to place the responsibility on employees and give little chance for petty pilfering.

Records supplementary to the daily cost report should be set up before the end result of a cost system is attained. For these records refer to Section III of this chapter where the system is described in detail.

The "Standard" Cost System Is NOT Favored

The standard cost system cannot be used to advantage in food service. The detail of pricing every unit of sale every time that item is served is too detailed and costly. Recipes for many items served are priced as a guide only, but unless the prices are current, they do not show a true picture. Also the size of sales portion cannot be controlled as easily as in the manufacturing of staple items and this keeps the recipes from being an accurate and effective cost control.

A food cost system uses the unit of purchase or the food used in a given division of the production unit as a basis instead of the finished product as in the standard cost system. For example, 100 pounds of top or bottom round of beef is purchased and it is the plan to serve a portion of the size three to the pound. If on a check of sales it is found that there were 300 portions sold and there was none left over, the portions selling for thirty cents would yield ninety dollars. If the cost were forty dollars, the relation of cost to sales in terms of percentage is at the rate of 44%. If only 250 portions at thirty cents were obtained, the rate per cent of food cost would be 53%. In like manner single items of purchases are controlled and the divisions within the production unit as the range, bakeshop, salad, and pantry are controlled. Then, in many instances, a cost for all items grouped together for the day is related to total sales for the day to get the over-all picture for the day as a whole. See Figure 10 in Section III of this chapter.

III. Description of the Cost System

Profit-and-Loss Statement

Since in commercial and institutional food service, all processes of buying, producing or manufacturing, marketing or merchandizing, and collecting take place in a short period of time—usually a day, the monthly profit-and-loss statement derived from the regular accounting system presents the picture of operation as a guide, but it is too late to be used for maximum and effective control.

_____ Food Service

Profit-and-Loss Statement for the Month of _____, 19__

				Per Cent of Sales
Income:				
Sales			$2,000	100
Food Cost:				
Inventory at Beginning	$ 200			
Purchases for the Month	850			
Total	$1,050			
Less Final Inventory	150			
	900			
Less Cost of Employees' Meals	40			
Cost of Food Sold			860	43
Gross Profit or Margin			$1,140	57
Management and Labor Cost:				
Salaries and Wages	600			
Cost of Employees' Meals	40			
Total		640		32%
Operating Expenses:				
Rent	$ 140			7.0
Laundry and Linen	20			1.0
Paper and Cleaning Supplies	20			1.0
Utilities and Water Tax	60			3.0
Replacements, Repair, and Maintenance	40			2.0
Depreciation	40			2.0
Advertising	10			0.5
Taxes and Insurance	40			2.0
Miscellaneous	30			1.5
Total		400		20.0
Total Management and Labor Cost and Operating Expense			$1,040	52
Net Profit			$ 100	5%

Variances

A food service budget may be set up as in the profit-and-loss statement illustrated for the operation of the organization to indicate that the amounts to be spent for food should yield a ratio to sales of from 35% to 50% or, in other words, 35 to 50 cents will be spent for food for every dollar sale. A pattern of service is set up accordingly in the form of a menu, with policies as to grades of food to be used, sales prices, size of portions, and other policies of various kinds. This service plan once set up does not insure that costs will remain in line continuously without a cost accounting system. Food is a "constant variable," not stable in price, quality, quantity, or availability. Menu combinations yield unpredictable returns. Also the impossibility of standardization of the human element which enters into the prepa-

ration and service of the menu items is ever present, and the same standards cannot be adhered to as in other manufacturing.

Also selling must take place within a short period of time after preparation, and patronage may be irregular. These cause loss in waste of food prepared that may not be served later. Thus close and immediate control of costs is vital in any food service operation.

Food service departments need food cost accounting systems to enable the head to exercise efficient control. If this department is within a larger organization as in a hotel, hospital, residence hall, and public or private school cafeteria, the central accounting office may be interested in records only from the standpoint of historical information, while the department needs records and statements for control. In these instances, the accounting office seldom submits an operating statement to the department until the end of the year.

The Cost Control Records

Menu Sheet or Menu Book

The menu is the core of any food service organization and the menu sheet or menu book becomes the blueprint from which the food is purchased and requisitioned, produced, and sold. Therefore it is important that the food planner set up a menu pattern covering a period of at least one week, so that he can add or adjust with ease and with the whole effect always in view. Large sheets may be used for menu making with the days of the week heading the columns, and the menus for the different meals served listed in the columns. The sheets should have ample space for the recording without crowding and individual items on the menu. Or a notebook may be used with a page for each day.

A definite menu form is emphasized for the following reasons:

1. A working plan is in action at all times, flexible yet directive.
2. An emergency can be met easily by a glance at the menu and a reach for the telephone.
3. The manager by this means knows not only where he is going but where he has been, which is necessary information in the food service business.

Recipe

A card file of recipes may be in vertical form or in a visible record book or cabinet. After a recipe has been tried out and is found to be satisfactory for use in the organization, it is priced and the cost per portion obtained. Two copies are typed, one to be used in the production department or kitchen, and the second copy to remain permanently in the file. Colored cards may be used for the second set. Many forms are in use for the recipe, and they are available in quantity recipe books. Recipes should be used for the following reasons:

1. Essential for smooth functioning in the kitchen.
2. Of value in menu making and ordering.
3. Guide in cost control.
4. When there is a change in cooks, the same products continue to be served.
5. Standard menu items tend to build a satisfied clientele.

A suggested classification for the file of recipes follows:

Recipe Classification

Desserts (alphabetically arranged)

Entrees
- Batter
- Cereal—Macaroni
  - Noodles
  - Rice
  - Spaghetti
- Cheese
- Egg
- Fish
- Fruit
- Meat— Bacon
  - Beef
  - Ham
  - Lamb
  - Pork
  - Variety
  - Veal
- Mixed Grill
- Vegetable
- Miscellaneous

Salads
- Cold Plate Combinations
- Egg
- Fish
- Fruit
- Gelatin, all types
- Meat
- Relish
- Vegetable

Salad Dressings (alphabetically arranged)

Sandwiches
- Cheese
- Egg
- Fish
- Fruit
- Meat
- Nut
- Vegetable
- Miscellaneous

Sauces (alphabetically arranged)

Soups
- Cream
- Fish
- Stock
- Vegetable

Vegetables (alphabetically arranged)

Yeast products, muffins, and biscuits

Request for Price Quotations

In placing large orders for canned and staple foods, prices are obtained from the various vendors using convenient records. To make up the order, if the business is a small one, an inspection of food supplies is made directly, whether these supplies are kept on shelves in a cupboard in one section of the kitchen or in a separate storeroom. If a perpetual inventory is kept, the cards may be consulted, or the last physical inventory may be used.

When this list of goods to be bought is put in order, it is written on a sheet with several columns for the names of the vendors. If salesmen call in person they will quote prices directly, and, if not, the list is sent to the vendors in a form letter requesting prices. In the case of each item on the list, there is a description as to amount desired, size of can or package, quality, and date needed.

As the letters are received in answer to the request for prices, the sheet previously prepared with the list is used to enter the vendor's prices in the proper column opposite the food item. When all of the replies are in, the prices are examined and the purchase orders made up. Factors in deciding with which company to place

the order are price including discounts, quality by test or previous orders, reliability of vendor, dependability of delivery, agreeableness in trading with the vendors, and others peculiar to a given situation.

If meats, fresh fruits and vegetables, eggs, and other perishables are purchased locally, a market list is made up before telephoning or going out to shop, and the prices are filled in upon purchase. The same procedure is followed if the buyer goes to large markets early in the morning. However, if buying perishables on a larger scale, the purchasing is done more like that for staple foods. With these, instead of writing, provided the firms are in the same or nearby city, the vendors are reached by telephoning for prices. Or, in some cases, the vendors call the buyer, quote prices, and take the order. Careful buyers compare prices daily on perishables placing quoted prices on a sheet similar to that for staples and circle or check the price and firm with which the order is placed.

Requesting price quotations accomplishes the following:

1. It is a good business policy to get the lowest price in buying which is obvious from a financial standpoint and a psychological one as well. Competition gives value for the money and attention from the tradesmen.
2. Careful buying means equal opportunities in the competitive field.

City, State
June 10, 19—

The G. & M. Company
City

Gentlemen:

Inclosed is a list of foods for which I should like to receive your prices. The date for delivery is July 1, and the prices should include delivery to our storeroom, 000 Broadway.

Item	Size	Description	Amount
Peas	No. 10	No. 4 Early June	10 doz.

Fig. 1. Request for Price Quotations for Staples.

			Firms			
Item	Size	Description	M & G	C & B	G & J	J C R
Peas	No. 10	No. 4 Early June	$9.00	9.00	8.75	9.00

Fig. 2. Quotations on Staple Foods.

Purchase Order

After telephone quotations are received and the orders placed, the list of goods bought is written in the purchase order book. For a small business this is an ordinary day book. With the date at the top, each vendor's complete order follows

City, State
June 20, 19—

The G. & J. Co.
City

Gentlemen:

Your price quotations have been received, and we wish to place the following order with you:

Item	Size	Description	Amount	Unit	Price
Peas	No. 10	No. 4 Early June	10	doz.	$8.75

Fig. 3. Purchase Order.

giving the quantity, unit of purchase, food item, description, and price. A carbon copy is made of part of the information for the convenience of the person who receives and checks in the goods (Figure 6).

In large organizations, the sending of a written purchase order to each vendor is the correct procedure in placing any order, for it confirms the telephone conversation and prevents misunderstandings between buyer and seller.

Food Requisitions

The food requisition is a list of all goods needed for the day from storeroom and refrigerator. Made up from menus and recipes, it is on either a specially printed form or a pad of sheets 5 by 8 inches, at the top of which are listed the date, day, destination and time of delivery, and the source of supply. The food order includes quantity, unit, article, and description. A column for checking the filled order, or, in case of a shortage, the quantity of the partially completed order, is used by the person issuing. The column headings, unit cost and total cost are filled in by the food manager or an assistant when the extensions and totals are made on the requisition sheets.

Those ordering food items should be specific as to the description and size of box, package, or can, and the person filling the order should be just as accurate. Both initial or sign their completed requisitions. Manager as well as employees profit from this system of food handling because:

1. Knowing what, when, and by whom foods are removed from the storeroom and refrigerators is a control in itself.
2. It furnishes an accurate and convenient food list to be used in a daily food cost report.
3. It avoids waste of time and loss of food.

Meat Tag

Because meat is the most expensive item on the menu, a tag system is used to control its delivery, storage, and utilization. When meat is delivered, it is checked and weighed and a tag attached by means of a pin. The meat purchased may have

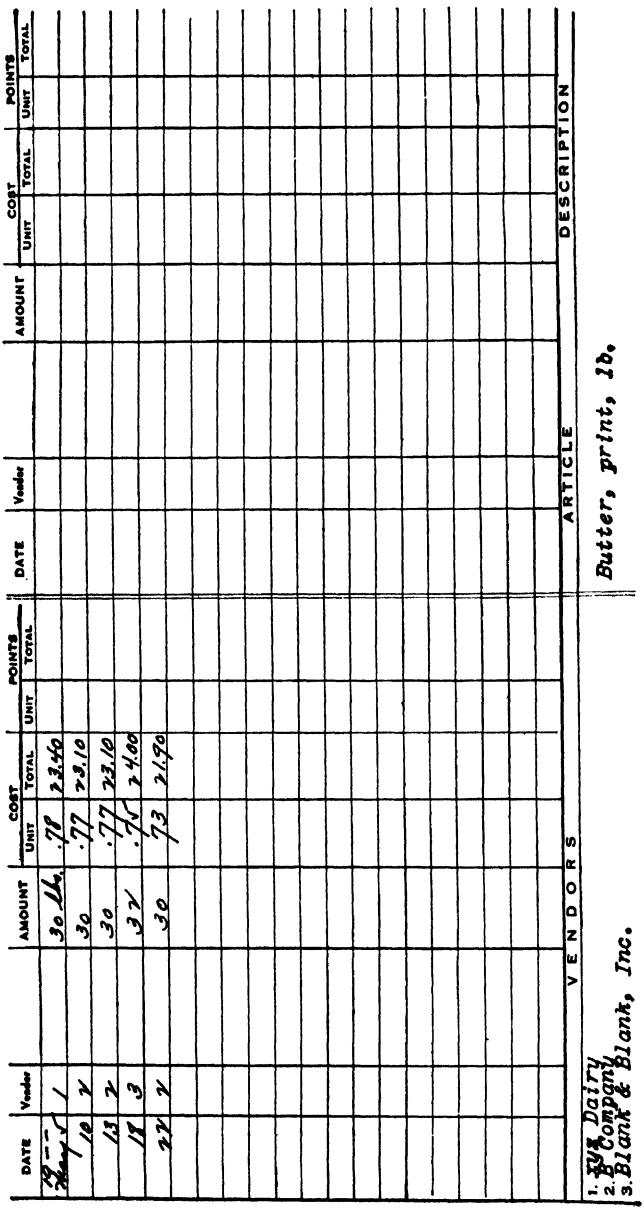

Fig. 4. Purchase Record of Perishable Food.

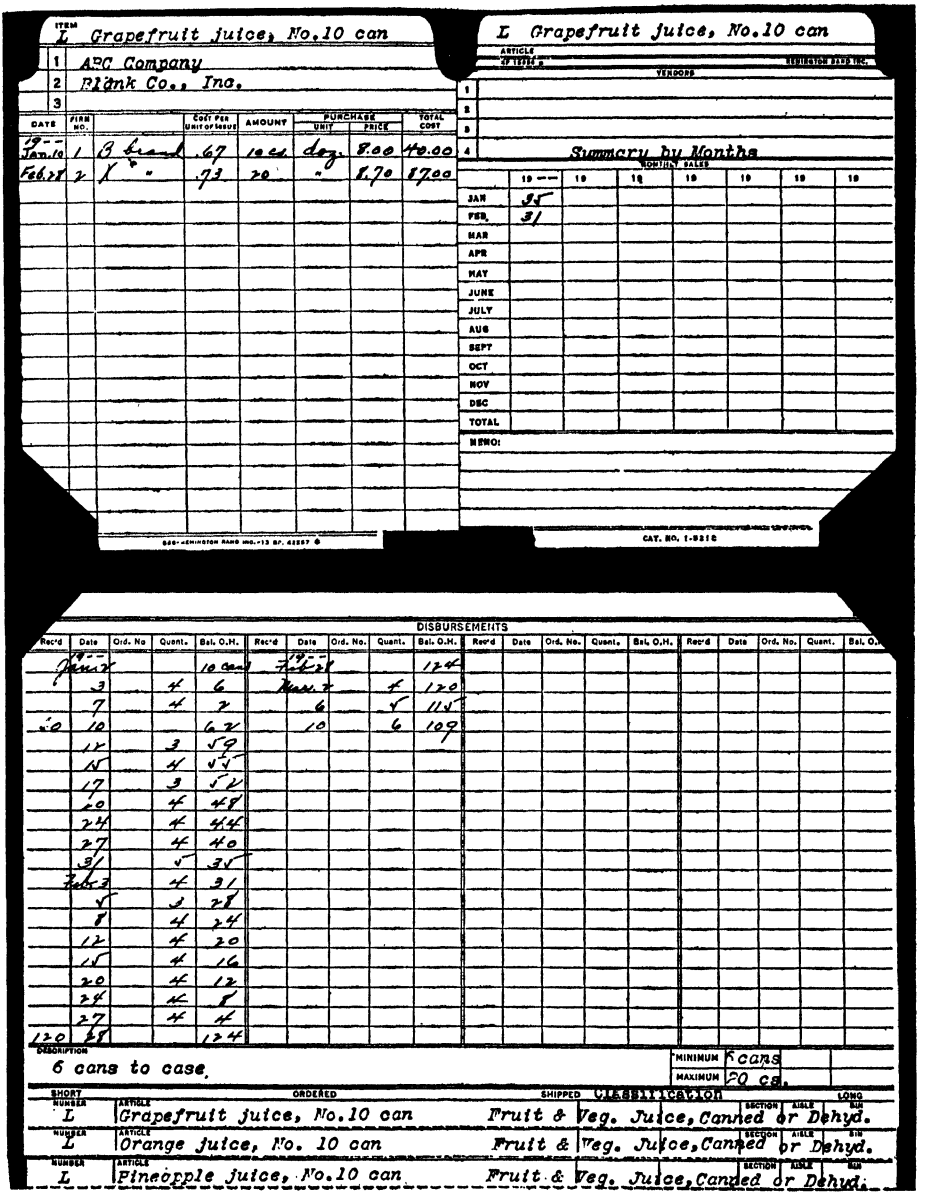
ITEM L Grapefruit juice, No.10 can
1 ABC Company
2 Blank Co., Inc.
3
DATE | FIRM NO. | | COST PER UNIT OF SERVICE | AMOUNT | PURCHASE UNIT | PURCHASE PRICE | TOTAL COST
19-- Jan.10 | 1 | B brand | .67 | 10 cs | doz. | 8.00 | 40.00
Feb.28 | 2 | X " | .73 | 20 | " | 8.70 | 17.00
L Grapefruit juice, No.10 can
ARTICLE
VENDORS
1
2
3
4
Summary by Months
MONTHLY SALES
19 -- | 19 | 19 | 19 | 19 | 19 | 19
JAN 35
FEB. 31
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
TOTAL
MEMO:
CAT. NO. 1-9216
DISBURSEMENTS
Rec'd | Date | Ord. No | Quant. | Bal. O.H.
19-- Jan 1 | 10 cases | 124
3 | 4 | 6 | 120
7 | 4 | 2 | 116
10 | 6 | 10 | 6 | 109
12 | 3 | 9
14 | 4 | 5
17 | 3 | 2
20 | 4 | 48
24 | 4 | 44
27 | 4 | 40
31 | 5 | 35
Feb 3 | 4 | 31
5 | 3 | 28
8 | 4 | 24
12 | 4 | 20
15 | 4 | 16
20 | 4 | 12
24 | 4 | 8
27 | 4 | 4
120 28 | 124
DESCRIPTION
6 cans to case.
MINIMUM 5 cans
MAXIMUM 20 cs.
SHORT NUMBER | ARTICLE | ORDERED | SHIPPED | CLASSIFICATION | LONG
L | Grapefruit juice, No.10 can | Fruit & Veg. Juice, Canned or Dehyd.
L | Orange juice, No. 10 can | Fruit & Veg. Juice, Canned or Dehyd.
L | Pineapple juice, No.10 can | Fruit & Veg. Juice, Canned or Dehyd.

Fig. 5.

ORDERS FOR MAY 10, 19—

Milk Company:
12 cases individual milk
40 qts. bulk
10 qts. cream

Bread Company:
14 2-lb. white
3 3-lb. white
5 3-lb. rye
5 3-lb. wholewheat
7 doz. doughnuts—plain

Bakery:
10 doz. small rolls
10 doz. dinner rolls
8 doz. cinnamon rolls

Meat Company:
35 lbs. chopped chuck
90 lbs. pork loin
90 lbs. corned beef
30 lbs. boned lamb. Bones separate.
1 case butter
3 lbs. cream cheese

Ice Cream Company:
1 2½-gal. vanilla
2 2½-gal. chocolate
1 2½-gal. tutti fruiti
1 2½-gal. lemon and lime ice

Fig. 6. Copy of Purchase Order for Receiving Clerk.

FOOD REQUISITION

To Bakeshop Date June 20, 19—

From Refrigerator Day and Time Thursday 7 a.m.

Quantity	Unit	Article	No. Units Issued	Unit Price	Total Cost
1	40 qt.	Milk			
10	lb.	Butter			
		(Before completing)			
1	40 qt.	Milk	1	$0.15	$6.00
10	lb.	Butter	10	0.65	6.50

(After completing)

Fig. 7. Food Requisition.

to be broken down further by the meat man who in turn weighs each separate piece and attaches a descriptive tag. On the tag, which may be a 3 by 5 inch card cut in

thirds, is written the date of receipt, name of cut, and weight. A blank space is provided for writing in the date the piece of meat or container of cut meat is actually used. When the person in charge of issues removes the meat from the refrigerator for filling the requisition, the tag is removed and attached to the

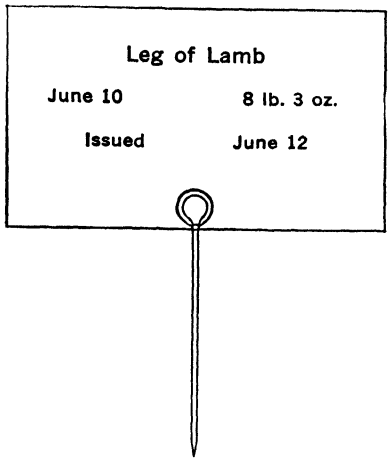

Fig. 8.

requisition sheet which goes to the individual making out the food cost report. If meat is bought by retail cut and used the same day, the tag system would not be used. The value of the tag system is contained in the following:

1. It gives the accurate weight of the meat used.
2. It saves time formerly involved in weighing meat for issue.
3. It accounts for the entire weight of meat bought and paid for.

Purchase Record

A record of purchases by item is called a purchase record. A separate purchase record file may be used for staple foods, another for perishable foods, and still another for small equipment, china, glass, silver, and linen, or they may be combined in one file. The cards are arranged for filing under subject classification headings and thereafter in alphabetical order within the groups. Subject headings for staple food and for perishable foods are illustrated on pages following.

CLASSIFICATION OF PERISHABLE FOOD

Bread, Rolls, Other
Cheese
Eggs—Fresh, Frozen, and Dried
Fats
Ice Cream, Ices, and Sherbet
Milk and Cream
Fish—Fresh, Frozen, and Smoked
Shell Fish
Fruits and Fruit Juices—Fresh
Fruits and Fruit Juices—Frozen
Meats—Beef
Lamb
Pork, Ham, and Bacon
Veal
Variety Meats
Poultry—Fresh and Frozen
Vegetables—Fresh
Vegetables—Frozen
Miscellaneous
Yeast

FOOD STORES INDEX

A. Beverages
B. Cereals, Prepared
C. Cereals and Flour
D. Crackers and Cookies
E. Chocolate and Cocoa
F. Condiments, Seasonings, and Spices
G. Extracts and Colorings
H. Fats and Oils
I. Fish, Canned
J. Fruits, Canned
K. Fruits, Dried or Dehydrated
L. Fruit and Vegetable Juices, Canned or Dehydrated
M. Gelatin and Prepared Desserts
N. Leavening Agents
O. Meats and Chicken, Canned
P. Milk Products
Q. Nuts and Nut Products
R. Pickles, Olives, Relishes, Sauces, and Salad Dressings
S. Preserves, Jams, and Jelly
T. Soups, Canned and Dehydrated
U. Sugar, Syrup, and Candy
V. Vegetables, Canned
W. Vegetables, Dried, Dehydrated, or Stored

Food items within a classification of staples and of perishables may be found as follows:

Fish—Canned

Bonita, 13 oz.
Lobster, 8 oz.
Salmon, small, 5½ oz.
Salmon, large, 4 lb.
Sardines, 3¼ oz.
Shrimp, 7 oz.
Tuna fish, 13 oz.

Poultry—Fresh or Frozen

Broilers, 1½—2 lbs.
Capons, 4 lbs. and over
Chickens, Roasting, 3—3½ lbs.
Duck
Fowl, 4½—5 lbs.
Fryers, 2—2½ lbs.
Game
Geese
Turkey, Hen
Turkey, Tom

In setting up the cards in the file, it is important to have an individual one for each food item and for each size of can, package, or other container, but different brands are indicated on the one card for that food and size.

Entries are made in the purchase record from the invoices after they are approved for payment. An entry consists of the date, vendor number, brand or description, amount purchased, unit cost, and total cost. In addition, the cost per unit of issue is desired.

Advantages of keeping a purchase record are:

1. It makes foods prices available for completing requisitions and costing recipes.
2. In menu making it gives control of consumption of any article.
3. By inspection the manager or owner can keep abreast of price fluctuations.
4. During the war it furnished ration point values for menu items and combinations.

Perpetual Inventory

Each food item in the purchase record of storeroom food may have a corresponding perpetual inventory card, or there may be a combination of the purchase record and perpetual inventory on one card. As each item received is entered in detail on the purchase record, an entry of the total units received is made on the perpetual inventory card. The units received are added to the balance-on-hand column and the units issued as per the requisitions are subtracted to show the balance on hand at all times. This card is a running summary of the food consump-

tion and does not end until the food item is completely used and the owner decides not to reorder. When this occurs the card is removed from the active file.

Other information valuable to the manager is displayed on each card, such as maximum and minimum amounts to be carried, colored signals denoting the supply on hand or ration points required, and the unit of issue. Users of the perpetual inventory system have found it useful for the following purposes:

1. It serves as a reference for future ordering, as signals correctly placed will denote the danger points for stock on hand.
2. It is a check or control on what is or what should be on hand in the storeroom.
3. It may be used at the end of a fiscal period instead of taking a physical inventory.
4. It aids in menu making because it is suggestive of what is on hand.

Physical Inventory

A physical inventory is a count of stock taken monthly or periodically in order to find the cost of food sold. It is an actual count of stock on hand at the end of a fiscal period. It is convenient to use a standard form on which the names and description of the food items carried are typed in advance. Two people take the inventory, one calling and the other writing in the count and units. Each item is priced from the purchase record or from invoices if a purchase record is not kept. In addition to its value in preparing the profit-and-loss statement, this inventory creates an opportunity to check on the physical conditions of the storeroom, for example, temperature, cleanliness, arrangement of storing facilities, and the items on hand in quantity.

In taking a physical inventory there are techniques involved that overcome problems which often occur due to the variety of items and prices. Some of these problems and their solutions follow:

1. The count of canned goods may be expressed in terms of cases, dozens, cans, or gallon jars. In the first instance it is necessary to know the number of cans to the case as six No. 10's; twelve No. 5's; twenty-four No. 2's, 2½'s, and 3's; forty-eight No. 1's; and four one-gallon jars. These must be converted to purchase price units as dozens or cans in order to figure values. Fifty cans or eight cases plus 2 cans at $4.75 per dozen would be figured as four dozen and 2 cans, the price per dozen and price per can being on the purchase record. Four times $4.75 equals $19.00 plus two times $.40 or $.80 gives a total value of $19.80.
2. When there is more than one price for an article, it is assumed that the older is used first following the principle of "First in, first out."
3. If two brands differ widely in price, each brand is listed on the inventory and figured separately.
4. When two firms deliver a food at the same time but at different prices, it is assumed that the higher priced item is used first.
5. An inventory should be figured by one person and checked by another for correctness of extensions and additions.

Production Record

The owner, manager, or other person responsible for the menu makes out a production record. It consists of the day's menu, amounts to be prepared, and, in some instances, size of portion to be served as well as number of portions, as with juices per can. The last column is left free for a later entry of the amount actually prepared. The production record is posted in the kitchen where the personnel con-

cerned can see and follow it. This plan of production simplifies the multiple factors of food service for the following reasons:

1. The manager has close control over the production department or kitchen.
2. The responsibility for the preparation of food is carried by the person trained for it and not left to the judgment of the employees.
3. It is the vital mid-point correlating proper purchasing and requisitioning with the ultimate service of food.

Luncheon	Production Record	Thursday, July 6, 19—
Menu	*Amount to be Prepared*	*Amount Prepared*
Prune plums	1 No. 10 can (3 to Portion)	
Tomato juice	1 No. 10 can (30 glasses)	
Apple juice	6 qts. (60 glasses)	
Chicken noodle soup	16 qts.	
Chop suey	24 qts.	
Baked hash	112 portions (8-oz.)	
Scalloped corn	38 casseroles	
Steamed rice	8 qts.	
Braised celery	5 qts.	
Salads: Fruit	30 qts.	
Asparagus	15 qts.	
Sandwiches:		
Bacon and Tomato		
On white	2 2-lb. loaves	
On whole wheat	2 3-lb. loaves	
On rye	6 3-lb. loaves	

Catering or Special Function Order and Cost Sheet

The cost of each special function or banquet is figured separately on a banquet or catering cost sheet. When the reservation is made the form is started with the name of the organization, the name and address of the person responsible for payment, the name of the function, reservation number, date, day, hour of service, selling price per person, and deposit. An arrangement is made between the manager and the organization concerning any difference between the number of reservations and number served.

The menu is entered with space between food items for listing all food components used in the preparation of each dish, followed by the direct expense items. Next the menu is taken off, orders are placed, and directions are given to the kitchen on a production record. After the function takes place the cost is figured from invoice prices and the purchase record cards. The function cost is completed by taking the following steps:

1. Enter the number of reservations and the number of persons served.
2. Enter the total cost.
3. Enter the total income.
4. Figure the cost per person served by dividing the total cost by the number served.
5. Figure the food cost per cent by dividing the cost of food by the total income.
6. Figure the total cost per cent by dividing the total cost by the total income.

The financial summary of the banquet reflects the manager's ability to plan, execute, and control large-scale functions.

CATERING OR SPECIAL FUNCTION ORDER

Organization: XYZ Club — Date: June 1, 19—

Person Responsible: Mr. B. — Day: Thursday

Address: 00 Blank Street — Hour: 7:30 P.M.

Name of Function: Father & Son Banquet — Price per Cover: $ 1.75

Reservation: 280 — Deposit: $50.00

Menu:	Description	Quantity	Unit	Price	Cost
Tomato Juice Cocktail with sliced lemon and cocktail crackers	Tomato Juice	11	#10	.333	3.67
	Lemons	2	doz.	.33	.33
	Onions	2	lb.	.08	.16
	Celery	3	stk.	.26	.78
	Sugar	1	lb.	.06	.06
	Condiment Sauce	1½	pt.	.18	.27
	Crackers	3	lb.	.21	.63
	Cream Cheese	4	lb.	.40	1.60
	Paprika	⅛	lb.	.54	.09
	Lemons	3	doz.	.33	.99
	Salt	½	lb.	.04	.02
Celery, Olives, Radishes, Carrot slices	Celery	4	doz.	3.10	12.40
	Radishes	16	bch.	.16	.96
	Stuffed Olives	1	gal.	3.19	3.19
	Carrots	6	bch.	.08	.48
	Whole Olives	¾	gal.	2.15	1.60

Total Food Cost $_____

Flowers _____

Ice _____

Labor _____

Laundry _____

Total Direct Expenses $_____

Total Food Cost and Direct Expenses $_____

Reservation: _____

Number Served: _____

Cost per Person Served: _____

Total Cost: $_____

Total Income: $_____

Food Cost: $_____ %

Total Cost: _____ %

Fig. 9. Catering or Special Function Order.

Daily Food Cost Report

The daily food cost report is a summary of the cost of food items used for the day. After the total is found, the cost is expressed in relation to the amount of sales. If the sales equal $100, the cost of food would have to fall in a given range, for example, $40 to $50, so that out of every one hundred dollars of sales, $40 or

$50 would be spent for food. Or, in terms of percentage, the cost of food (percentage) is divided by sales (base) to give the ratio (rate) which is illustrated by 40% to 50%. This control guides the owner or manager from day to day, so that the food cost may be compared with that which is budgeted or anticipated. If the budget calls for a 40% food cost and each day the ratio in terms of percentage is considerably above 40, the menu items, size of portions, or the purchasing must be investigated.

There are different methods used in preparing a daily food cost report. The simplest one is made up from the storeroom and refrigerator requisitions and direct purchases for the day. Storeroom items issued on requisition are priced, extended, and totaled. Refrigerator requisitions are handled in the same manner. The bills for the purchases of the day's fresh fruits and vegetables, milk, ice cream, bread and bakery goods, and others are also used. When all these are totaled, the cost of food for the day is obtained. The cash register report gives the sales which are entered on the cost sheet, and the food cost is shown in relation to the sales for the day, and this ratio is called the food cost per cent.

In addition to the day's food cost per cent, the ratio is also found for the food cost to date or cumulated for the month. This cumulated ratio gives the average cost over the period, where one day's cost might be high or low for specific reasons, such as lower sales, large amount of leftovers, or a high-cost meat item.

Another form of food cost report is to classify all foods used for the day and report the total of each group so that the cost of meats, fish, fowl, fruits, vegetables, etc., are known and can be compared from day to day (Figure 8). With this the manager may establish by inspection a systematic relationship between each item.

FOOD COST REPORT

Number of Customers 400 Date June 10, 19

Average Check $0.43 Day Friday

Weather Rainy

	Amount
Storeroom Issues	$18.50
Refrigerator Issues	9.50
Direct Purchases	
Meat	20.00
Fish	4.50
Produce	8.00
Milk and Cream	10.00
Bread and Rolls	2.50
Ice Cream	3.00
Total	$76.00

	TODAY		TO-DATE	
	Amount	Per Cent	Amount	Per Cent
Sales	$170.00	100.0	$1900.00	100.0
Food Cost	76.00	44.7	803.70	42.3

Fig. 10. Simple Food Cost Report.

DAILY FOOD COST SUMMARY

Sales for the Day $900.00
Today's Food Cost 49%
To-date Food Cost 51%

Date May, 3, 19
Day Monday

Foods		Amount	
Meats		37	71
Fish		18	50
Fowl		66	55
Cheese		9	55
Eggs		33	57
Fats and Oils		16	42
Milk, Cream, and Ice Cream		59	55
Cereals and Cereal Products		3	58
Bread, Rolls (Purchased)		7	68
Sugar		4	01
Fruits and Juices	Fresh	30	85
	Frozen	18	75
	Canned	5	25
	Dried	7	39
Vegetables and Juices	Fresh	51	88
	Frozen	22	00
	Canned	2	34
	Dried	3	00
Groceries		40	09
TOTAL		$438	67

Department Summary	
Kitchen	$218.53
Bakeshop	96.34
Salad Unit	42.19
Counter or Pantry	56.93
Special Function	19.62
Ice Cream	5.06
Total Food Cost	$438.67

Fig. 11.

and the total cost, and between separate items as meats and vegetables, and fruits and desserts. This becomes basic information for the next menu planned and will affect accordingly menu items, prices, and combinations.

The department summary gives the total cost of each unit in the operation. The figures are obtained from storeroom and refrigerator requisitions to each unit. In this case issues are also made to a special function, and the only direct purchase is ice cream. The two grand totals are the same, one being a check on the other.

Advantages of a daily food control system are:

1. The daily and to-date food cost per cent can be watched and compared with the budgeted rate per cent, for close control avoids the necessity of running low-cost food items day after day toward the end of the month or fiscal period.
2. Daily control is a conscious effort to maintain certain standards of service which is impossible when an operation is allowed to run unchecked.
3. The daily food cost report is the final and most informative step in the meal service cycle from menu planning through sales. It embodies those factors of the cycle

which alone are obscure and seemingly uncontrollable, producing a picture that reflects policies, purchases, portions, and sales.

4. The uncertain owner or manager will gain new confidence if he sets up a food cost system with a daily report, for it has the mechanics and basic information to substitute intelligent interpretation for guesswork which is imperative when acting on new ideas and policies.

Sales Analysis

Sales analysis or portion count may be done regularly on all sales or on only some menu items as the meats and vegetables, the highest priced items on the menu. Or a count may be made occasionally on all or some items.

A portion count may be obtained in several ways. The manner depends on the size of the organization, the need for the information, the reliability and dependability of the workers, and the closeness of supervision.

For sales portions on sandwiches, salads, first-course cocktails, milk, pies, cakes and any other items portioned in advance of service, the count may be taken from the production record. This method may have its weak points from the standpoint of control, but it works well in some places. If portions of meat are made up in the kitchen, a given count to a service pan, the kitchen supervisor may count the number of pans used. This is particularly applicable to cafeteria service. In some cases where there is sufficient china and glassware for a complete meal service, dishes may be counted and a record kept by some worker other than the food handler.

The ideal method of obtaining a count on sales portions is to have a check made by tally count or on a portion machine as the waiter or waitress goes into the dining room with the service, or at the end of a cafeteria counter. This method entails the employment of at least one employee for checking during the service hours.

After the portion count figures are obtained, they may be matched with costs to see if an item is profitable to sell at a given price according to the size of portion used.

Advantages of a detailed sales analysis are:

1. Gives accurate information to menu planner of popularity in making up production record.
2. Checks high cost food for too large, too small, or irregular portions.
3. Checks against "leaks" due to pilfering.

Management and Labor Cost

Management and labor cost cannot be broken down per item as in the regular cost accounting systems because the work of the kitchen employees is too varied and time on one product overlaps that on another with several menu items being prepared or cooked at the same time. Therefore costs of management and labor must be determined on the percentage basis in terms of sales with the labor costs averaged for the day or the actual amounts figured for the month.

Variable factors in labor cost are layout, personnel, equipment, flow of work, and supervision. Under layout, there are several considerations: (1) Arrangement within units and between units of preparation, the hot or range unit, salad and vegetable preparation unit, bakeshop, and others; (2) storeroom facilities including

cold storage rooms and refrigerators; (3) dining room location; and (4) cafeteria counters or service pantry arrangement. Experience, training, and turnover are considerations under personnel. Equipment is a major consideration in labor cost: namely labor saving devices, adequate refrigerator space, proper size of equipment for the number being served, sufficient small equipment, dishes, glassware, etc., and dish washing machine location. Flow of work can never be perfect, but food can be at the place when and where it is needed, carried there by runners or an employee lower paid than the cook. Adequate but not excessive supervision and management should be a goal in controlling management and labor costs.

Other Employee Compensation

Employees' meals may be checked in detail or the record may include only the name of the meal received by the employee. State workmen's compensation insurance laws, Federal and state social security laws, and Federal and state income tax laws must be complied with, with reference to amounts to be charged for the meals. As yet, there is no complete uniformity in these for the different states or sections of the country, nor for each in the same state.

Rooms, laundry and any other maintenance are included in the personnel record for certain tax purposes. The handling of tips as applied to the above laws are tending to become more uniform. The amount to be used in the tax report should be checked for the time and place of operation.

COST ACCOUNTING IN FURNITURE MANUFACTURING

By

CLINTON W. BENNETT *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

The furniture industry is composed of a wide range of manufacturers from the small shirt sleeves manager type of business to the large company with public ownership. The diversity of products manufactured is also great. Some companies specialize in specific types of furniture, for example, chairs or tables. Some may confine their efforts to classes of products, such as dining room or bedroom furniture. Others may produce any of these classes, plus specialties. But singularly enough, the fundamental cost accounting requirements are relatively uniform, and sound basic procedures can usually be used universally if proper care and attention are devoted at the time of installation to the peculiarities of the specific plant.

Because of the diversity it has been deemed desirable to refer to products as Class A, Class B, and Class C.

All methods described in this section are intended for manufacturers of wood products.

Although there is considerable uniformity in manufacturing methods, distribution and selling procedures differ widely.

Kinds of Raw Material

Obviously lumber is the most important raw material. It is usually purchased green and rough cut; as a result drying and yard operations are extensive. If all lumber used is treated uniformly in drying and handling, the cost of these operations may be included in factory burden. If, however, there is substantial variation, particularly in kiln drying, these costs should be considered as an additional material cost of the lumber or by providing an appropriate separate cost center, preferably the latter.

Other materials—upholstery, finishing, hardware, etc., can usually be obtained through normal channels. Consequently lumber is the only material which causes a serious storage problem.

Organization of Plant

A typical list of operating departments and cost centers for a furniture plant follows:

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Production Centers:	*Service and Indirect Centers:*
Dry Kiln	Power and Steam Plant
Mill Room	Maintenance
Machine and Cabinet	Building Service
Finishing	General Factory
Upholstering	
Plating	
Packing	

In large plants the production centers will be subdivided into kindred operating divisions to meet local conditions. Additions may also be made to the list of service and indirect centers to include such departments as research, personnel, purchasing, production control, and similar activities. The centers tabulated herewith are essential in organizing the cost work in even the smallest plant and will serve as the basis for expanding to any extent dictated by the problems of the specific situation.

Efficient storerooms are important necessities for all material excepting lumber and that should be under strict yard and kiln control. Each day a definite part of the inventory should be counted and reported to the perpetual inventory clerk so that all stock will be counted at least once each year and preferably oftener. Lumber used should be reported daily. Other material delivered to in process should be reported on requisitions or daily bills of material delivered. If the quantities carried of any class of material are small and deliveries frequent, monthly inventories may provide the best way to obtain the quantities used.

Production Order System

An effective production order and control system is a condition precedent to a successful cost system in a furniture plant. No manufacturing business can afford not to have this simple control tool and the very nature of the furniture manufacturing problems increases the need for it. This is because there is a very real assembly problem. A piece of furniture is the result of assembling and subassembling parts and if the work is properly organized, assembly lines can frequently be used to splendid advantages.

All production orders should originate from the production control department. This department may consist of from one person up to a large aggregation, depending upon the size and ramifications of the business. The production control department should maintain perpetual inventories in quantities (not money values) for all parts, subassemblies, stock in the white (unfinished), and finished, also for other major materials. These records should show the actual quantities on hand, quantities on order and available balances after providing for appropriated stock. All production orders will issue from this department and production will be planned and scheduled at this point. All delivery dates will be set by the production department.

II. How to Design the Cost System

Information to Be Furnished

The cost system should provide top management with the following data promptly at the end of each month.

1. The operating results for each class of products.
2. Analyses of the reasons for any differences between planned and actual performances.
3. The cost and ratio to normal of each department or center.
4. The effectiveness of material, labor, burden, and production capacity utilization.

Promptly at the end of each week department heads should receive analyses of any differences between planned and actual performances in their departments.

Considerations in Designing the System

This phase of the work consists primarily of three steps: (1) Determining upon the type of system, (2) devising the control structure, and (3) determining the cost of individual products. These steps are particularly important in this industry because, while costs may be used as a guide in setting selling prices, they are essential elements in keeping the operating results within the price structure which may have been dictated by competition. So the cost system must be thought of as (1) an instrument of cost reduction and cost control, (2) the means of providing monthly profit and loss statements, and (3) the basis for checking or revising selling prices.

Type of System

A so-called standard cost system is usually the most satisfactory in a furniture factory. Most companies issue catalogs showing the line of products offered. Sales and resulting manufacturing will be limited to these goods. The term "standard" cost is intended to reflect the normal costs of specific products over a period of several years if the line is a standard one, and the anticipated cost of products having a considerable style factor. Even in very small plants the use of standard costs should be favored unless the products are of such a special nature that standards will not be feasible. If scientific standards are not available then reasonable estimates should be set up and controlled in accordance with the procedure outlined subsequently herein.

III. Description of the Cost System

Pattern of Development

The development and installation of a standard cost system in the furniture industry may be said to follow the pattern outlined below:

1. Prepare the chart of accounts.
2. Determine the cost standards for material, labor, and burden.
3. Set up the standard costs for specific products.
4. Establish the accounting control procedure.
5. Prepare the profit and loss statement and supporting control data.

Chart of Accounts

The accounting control involves as a first step a revision of the chart of accounts to provide, in a simple and practical way, the tie-in between the cost of operations as reflected by the cost data and the actual results recorded on the books of account. The basic arrangement indicated below that divides the general ledger

accounts into three major divisions and nine classifications will usually be found adaptable.

A. Assets:

1. Current Assets
2. Fixed Assets, Other Assets and Deferred Charges

B. Liabilities:

3. Current Liabilities
4. Reserves
5. Fixed Liabilities, Capital Stock and Surplus

C. Income and Expense:

6. Sales, Deduction from Sales, Cost of Sales, Cost Variances
7. Factory Burden
8. Commercial Burden
9. Other Income and Charges

Accounts required in the specific business should be inserted in each of these classifications.

Three groups require special mention as indicated below:

Inventories (classification 1) will usually consist of the following control accounts:

Lumber
Upholstering Material
Finishing Material
Hardware
Other Direct Materials
Supplies
Work in Process
Finished Goods at Plant
Finished Goods Elsewhere

The minimum number of cost variances accounts are as follows:

Material—Quantity
—Price
—Waste
Labor
Factory Burden
Unused Production Capacity
Commercial Burden

Clearing accounts to transfer actual burden from the burden accumulation accounts to the burden cost variances accounts without closing the accumulation accounts prior to the end of the fiscal year are:

Factory Burden Clearing Account
Commercial Burden Clearing Account

Determining Upon the Cost Standards

Material quantity standards for each product will be obtained from the product specification sheets. Lumber standards will be based on the size of the dimension stock leaving the cut off and rip operations. Waste standards will be established to

provide for loss up to the dimension stock stage. As the cost of dimension stock, plus waste to that point will be used in calculating product costs, spoilage will be the only other lumber waste to be provided for. Waste standards for the other direct materials also will be determined.

Material price standards will be based usually on a combination of experience and anticipation.

Labor cost standards should be based on time studies by elements (not of motions). This type of study, if made properly, will provide the best possible basis for setting up the standard labor costs by products, but in addition it will supply the necessary information to determine upon the most efficient way of doing the job. If time studies cannot be made available, daily work report cards may be put in use and the results tabulated for a period of time. However, this procedure is a poor substitute for time studies.

Factory burden cost standards should be based on a factory burden operating budget. The first step in the preparation of this budget is to list at the left-hand side of a columnar sheet the name of each account in the factory burden classification of the chart of accounts. Columns should be provided at the right for each of the production centers and the service and indirect centers, also for the total amount. The budgeted amount for each account or burden class will be inserted on the appropriate line in the total column and distributed to the centers on a predetermined basis. The service and indirect centers will then be redistributed to the production centers on the following bases:

Center	*Bases of Distribution*
Power and Steam Plant:	
Power	Horsepower hours
Steam	Pounds of steam used
Maintenance	Direct by requisition
Building Service	Square feet of adjusted floor space
General Factory	Total payroll dollars

By adding the amounts in the columns for the production centers, the burden budgeted to each one will be obtained. Next, determine the number of production units to use in absorbing the burden and applying it to costs. These units will usually be either direct labor dollars or machine hours, perhaps both in a single plant, depending upon local conditions. Direct labor dollars should be used when possible for ease in application, and control. When standard direct labor dollars are used as the basis, many of the major objections to the percentage on labor method of burden application evaporate.

The factory burden cost standards will be obtained by dividing the production units into the budgeted dollars of each production center. These rates will be used to obtain the factory burden cost of the product for the cost card, Figure 1.

Commercial burden cost standards, costs beyond the factory door, are usually obtained in this industry by dividing the budgeted commercial burden by the budgeted factory cost of sales for the same period. Therefore the commercial expense of the product will be obtained on the cost card, Figure 1, by multiplying the total factory cost by this percentage.

If feasible, the commercial expenses may be analyzed by classes of products and standard burden cost rates developed for each class.

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COST CARD

Style No._____

Description _____ Cost Per _____

Order No.								
Date								
Material	**Quan.**	**Price**	**Amount**		**Quan.**	**Price**	**Amount**	
Lumber								
Finishing Material								
Upholstering Material								
Hardware								
Total Material								
Labor and Burden	**Labor**	**%**	**Burden**		**Labor**	**%**	**Burden**	
Mill Room								
Machine and Cabinet								
Finishing								
Upholstering								
Plating								
Packing								
Total Labor and Burden								
Summary Material								
Labor								
Burden								
Total Factory Costs								
Commercial Expense								
Rate								
Amount								
Total Cost								
Add in Deductions								
Total Cost and Sales Deductions								
Selling Price								
Profit								

Fig. 1.

Determining the Cost of Specific Products

A cost card as illustrated in Figure 1 will be prepared for each specific product in the line. This card will reflect the standard or antictipated costs determined in accordance with the procedure outlined in the preceding paragraphs.

The cost card is of prime value in a standard cost plan. As a matter of course, it should show the standard cost of each product. But it also provides the standard cost figures to use as the basis for crediting the cost variances accounts and debiting work in process. Also from these cards will come the data for pricing sales to obtain the standard cost of shipments with which to credit finished goods and debit cost of sales.

Cost Control Procedure

Material Quantity Variances.—Raw material used during the month will be priced at actual cost and transferred from the inventory accounts to the material quantity variances account. Production orders entered in process during the month will be priced from the appropriate cost card at the standard cost of the material element and the resulting amount, the standard cost of material used, transferred from material quantity variances account to work in process account.

Differences which may be located between the physical quantities of raw materials and the perpetual inventory records will be priced at cost, charged or credited to the appropriate raw material inventory accounts with offsetting entry to material quantity variances account.

Material Price Variances.—Summarize the material used during the month by classifications and price at standard cost prices as used on the cost cards. Transfer the difference between this total and the actual cost from the material quantity variances account to the price variances account.

Material Waste Variances.—This refers to the waste in lumber between the stage of rough lumber and the dimension stock. The extent to which the cut and rip waste varies from the standards set for this cost element will be set out in the material waste variances account.

Waste of other raw materials will be automatically absorbed in the material quantity variances, but not of parts or products spoiled after having been placed in process. These should be reported on a spoilage report, priced at standard cost and transferred from work in process account to an appropriate factory burden account.

Labor Cost Variances.—Direct labor will be charged to the labor cost variances account from the payroll analysis. The units of production will be priced at standard labor cost and transferred from the labor cost variances account to the work in process account.

Factory Burden Cost Variances.—The aggregate of the actual factory burden of the month will be debited to factory burden cost variances account and credited to factory burden clearing account. Burden absorbed at standard rates will be transferred from this cost variances account to work in process account.

Unused Production Capacity Variances.—Each month the cost of unused or credit for overabsorbed production capacity will be calculated by reference to the bases used in setting up the burden budget and transferred from factory burden cost variances account to unused production capacity variances account, to remove the effect of volume from the burden cost variances account.

Commercial Burden Cost Variances.—The total of the actual commercial burden for the month will be debited to this account and credited to commercial burden clearing account. Absorbed burden, obtained by applying the standard rate to the factory cost of sales, will be transferred from the commercial burden variances account to the commercial cost of sales accounts.

Cost Variances General.—The importance of the cost variances accounts as instruments of management control can hardly be overemphasized. They serve as filters between the actual costs put into the plant in the form of material, labor, and expense and results obtained in the form of profitably produced products. They act as signal lights to the management and should be watched carefully not only for the reasons why certain results may have occurred, but also for trends of unfavorable factors which may as a result be corrected before they develop dangerously.

Revision of Standard Costs

The standard costs should be revised only if and when changes take place in important fundamentals. Frequent or unnecessary changes will destroy much of the real value of the standards as yardsticks of measurement with the result that the costs will be neither standards nor actuals—simply figures. In general, there are four basic situations which may be cause for considering revisions of the standard costs. These are:

1. Material specifications change.
2. Methods of manufacturing change.
3. Material costs change substantially and with reasonable permanence.
4. Basic wage rates change materially.

Revisions of standards should always be the result of decision by important management.

Work in Process and Finished Goods

Inventories of work in process and finished goods will be carried at standard cost and both classes may well be handled in a single account. Credits will be made from the monthly cost of sales summary.

If separate finished goods accounts are handled, transfers between the accounts will be at standard cost. Inventory differences will be carried to the appropriate cost of sales accounts.

Cost of Sales

Shipments will be priced at standard cost from the cost card and the total figure for the month credited to work in process (or finished goods) and debited to the appropriate cost of sales accounts.

Profit and Loss Statement

The profit-and-loss statement, Figure 2, is a fundamental cornerstone of the cost and operating control structure. This monthly statement can be prepared readily from the books of account if the procedure outlined has been followed. It shows by classes of products the profit that should have been made, the profit actually made and the reasons for any differences. If these differences are of sizable proportions, they should be traced through the underlying cost variance rec-

ords. If desired by management, detailed analytical cost variance reports can be prepared monthly in support of the profit and loss statement.

It will be noted that the cost variances are not allocated to classes of products on Figure 2. This is intentional. The standard costs are considered to be the real costs and the variances simply reflect the extent of departure from the planned performance. Allocation of variances to product classes, either as a separate item or in cost of sales, would confuse instead of enlighten.

PROFIT AND LOSS STATEMENT
(Furniture Manufacturing)

		Product		
	Total	Class A	Class B	Class C
Sales	—	—	—	—
Less: Returns and Allowances	—	—	—	—
Transportation Out	—	—	—	—
Commissions to Agents	—	—	—	—
Cash Discounts	—	—	—	—
Total Deductions	—	—	—	—
Net Sales	—	—	—	—
Cost of Sales—Factory	—	—	—	—
Gross Profit—Anticipated	—	—	—	—
Cost of Sales—Commercial	—	—	—	—
Operating Profit—Anticipated	—	—	—	—
Cost Variances:				
Material—Quantity	—			
—Price	—			
—Waste	—			
Labor	—			
Factory Burden	—			
Unused Production Capacity	—			
Commercial Burden	—			
Total Variances	—			
Operating Profit—Actual	—			
Other Income	—			
	—			
Other Charges	—			
Net Profit—This Month	—			
—To Date	—			

Fig. 2

Other Periodic Reports

Monthly balance sheets and burden statements—both factory and commercial —should be prepared for top management and such operating reports as may be found valuable in the circumstances should be provided. What these may be will depend largely on the requirements of the local management.

COST ACCOUNTING FOR GARAGES

By

JOHN BURNIS ALLRED *

I. DESCRIPTION OF THE INDUSTRY

The word "garage" is a French word meaning: "a shed for automobiles." It came into use shortly after the automobile made its entry into the affairs of busy men who drove cars beyond the stamina built into them, and because the blacksmith, however capable with carriages and horses, was unable to meet the need in this class of repairs.

At first the garages made small repairs, stored automobiles, and sold gasoline, oil, and air pumps (free air was not furnished then). But this was not enough. Factory trained mechanics were needed to rejuvenate worn motors and repair, adjust, and re-build automobiles, wrecked in collisions, etc.

Presently it became a business—this running a garage—of great importance. Repairs became only a side line, giving way largely to the selling of accessories, gasoline, oil, tires, and automobiles themselves. Many large garages now not only stock these articles, but do body and fender repairs and painting, sell seat covers, small hardware, tools, and even radios. Some have installed children's toys, holiday goods, and furniture.

All these operations entail costs and, consequently cost accounting. But since many of these items would be classed as merchandise with easily known costs, the main reason for this article is to direct attention to operations where costs are difficult to get, but necessary to have, and leave the ordinary merchandising to others.

Classification of Services

The garage which we intend to describe here may be termed a large operation, employing more than fifty persons. Besides, of course, the repair of automobiles, it sells tires, gasoline and oil, batteries, generators, etc., as well as making repairs of tires and tubes and conducting a storage department for cars belonging to customers. To this might well be included departments for other services, such, for instance, as repairs and servicing of farm tractors. The writer knows of one such shop which takes nothing but heavy trucks.

Origin of Service

The patronage of the garage is primarily due to wear and tear of the ever-increasing number of automobiles, trucks, etc., in use.

Storage of automobiles is provided in many garages because of the scarcity of parking space on streets; storage space is also provided for gas and oil.

Greasing and oiling of cars and trucks is becoming an important part of the garage's business.

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Source of Materials, Parts, Etc.

The supplies used in automobile repairs are either parts produced by the parent factories and shipped in or are produced by the mechanics of the garage. However, most parts are factory built and identical to those originally built into the automobile now needing repairs. Different models of the same make of car, however, frequently have different kinds of parts from models of other years.

Such other materials as are needed in making repairs may be classified as welding materials, graphite, cup grease, emery wheels, small tools, etc. Gasoline, oil, and grease may be added as used in practically all garages.

Organization of Plant

The plant should be so organized that men working will have ample room to function properly, but will be near enough to workbenches, cranes, etc. to eliminate needless steps.

Lighting should be the best. Every mechanic should be provided with a movable cord light with guards over the bulb to prevent breaking, and hooks should be available for hanging the light where needed so that the mechanic's hands may be free for full operation.

The work "stall" of each mechanic should be provided with a means of hoisting either end or all of a car or truck so that free access can be had to the under side. This is particularly advantageous in working on lower crankcase bearings, on clutch work, and in adjusting or re-lining of brakes.

The parts department should be supervised by a thoroughly reliable person who is well versed in his stock so that he will know from memory the models of cars on which certain parts will work. This department should be accessible to the mechanical department, but no part should be available to a mechanic or any one else without proper requisition signed by a competent authority. By this is meant that the stockkeeper must be held responsible for his department. This precludes the possibility of promiscuously taking out parts, etc., without the proper record having been made.

Production Order System

All work should be done on authority of a work card signed by the customer, a "hard" copy of which stays with the automobile being repaired at all times (Figure 1). Every operation involving cost of labor, parts, materials, and supplies is entered on this copy for eventual inclusion upon the original and other copies by competent authority. The back side of the order is prepared with lines for entering all pertinent information which cannot be detailed on the face.

When the job is finished the card is turned in to a person qualified as to costs to calculate the dollars and cents cost of the job. He may but he is not always required to place the sales prices on the ticket. Oftentimes this important operation is left to others in higher authority who include additional overhead costs before setting the selling price which of course, must include the profits.

For obvious reasons, the cost section appears only on the copies retained. The customer receives only the copy wherein the selling price is detailed. The selling price figures are real. Those on costs are partly real and partly estimated. As such they are preserved for comparisons with actual cost figures and with the standard for the industry for correction and further study.

Orders should carry information as to when the job will be completed so that customers will not be disappointed when they call for their cars. This is a small detail, but it can build good will for any shop. If, after preliminary investigation, the shop finds it cannot produce the job in the time specified it is well to report such information to the customer. That suggests that a space should be provided on all order forms for the telephone number of the customer for such emergencies as this.

II. Designing the Cost System

Information Required

Records of labor are important. If such labor is by skilled mechanics rather than by apprentices, that information is certainly of value. The reason, of course, is in ability and pay cost. The customer would not object to paying well for skilled workmanship, but it is doubtful if he would be satisfied in paying the same rate for an apprentice.

Material and supplies used, of course, should be noted so that all charges may be included in the cost of the job. Particular attention should be given here to parts furnished on exchange of new-for-old-parts-price basis where that is the case.

Considerations in Designing the System

The objective sought in designing the cost system is to find the costs as near as possible to the standard for the industry and put such information into practice. If costs appear to exceed the standard in appreciable extent these costs so found must be continually revised and corrected.

Materials—Usage	Standard and actual quantities used, including exchanged parts, scrap recoverable, etc.
Overhead—Cost	Amount budgeted and actual for operations.
Overhead—Capacity	Amount budget and actual results for operations
Adjustments—Inventory	Ledger accounts and audited amounts based upon count and actual values

How Variances are Allocated.—Immediately after variances are determined they are usually cleared to the variance account applicable thereto. They are apportioned in the same ratio that each is responsible. When a particular job or service is definitely responsible, the charge is made direct; but when the cause cannot be definitely placed, the variance is apportioned to all operations that could have been involved.

Fair apportionment of variances is, of course, desirable, and for this reason charges against one operation or service are subject to review. This does not mean that such review should be resorted to often because a high degree of care used in the original transactions should prevent errors of consequence.

Individual Service—Costing.—Every service rendered bears its portion of the cost of the operation as a whole. The costs of operations which have been established by past experience are based upon that standard. This is true also of those which have not yet been established by past experience.

Revision of Standard Costs.—If standard costs cannot be matched for local or other reasons, revisions may be made. Such reasons might well include wage rates,

operating methods, material costs, etc. Reviews toward this end should be conducted at least once a year to promulgate any changes needed, but revisions should be infrequent, and should be limited to changes of more or less permanent nature.

Operation Analyses for Supervisors.—Daily, weekly, or monthly reports should be prepared for supervisors giving detailed information as to the effectiveness of operations. Superior management should also receive this information if operations are not profitable. These reports should explain any variances by causes and circumstances. Armed with this information supervisors will be prepared to steer a course toward success based upon day-to-day results.

Standards—How Created.—These are based upon efficient operating activities. These standards are developed from the following:

Materials and Parts—Quantities. Materials and parts necessary for efficient operation of plant should be provided and maintained so that unnecessary delays may be avoided.

Care should be exercised to apply time to the job in process only. True costs cannot be had if accurate labor time records are not religiously applied to the one job in progress. The same is true as to materials, parts, etc., used.

Standard Cost System Favored

Actual cost system can be used, but should be so only while efforts are being made to reach the standard set for the industry. If, as rarely happens, actual costs are developed which are lower than the standard, they should, of course, be used. The difference will be reflected favorably in the final operating results.

The standard should be applied in all cases in preparing budgets for future operations. If this is done, any variance will show in the final result. By doing this the following results may be expected:

1. Any variances, even very small ones, will be detected which, if ignored, might result in very large amounts if a number of operations are conducted.
2. The degree of attainment in elimination of variances is readily apparent.
3. More perfect control of costs will be attained that will tend to assure success in the industry's operation.
4. Weaknesses will be apparent in the buying of supplies and employment of personnel.

III. Cost System Described

In establishing a cost system, the following are important:

1. Costs must be reasonable. To be reasonable they must be comparable to the standard for the same operation, as developed from actual practice in other operations of similar nature.
2. The system must be workable. No theory, however popular, should be depended upon until it has been tried and proved superior by the industry as a whole.
3. The system must be carried out to the fullest detail. Any deviation from the standard set by the industry as to procedure should not be permitted.
4. Charts of accounts should be set up with every cost in its place and, where possible, the dollars and cents costs produced by the standard for the individual operation should be shown. In these charts accounts for operations should be numbered and both the number and the account title should be used in describing the operations.

Profit-and-Loss Information

This is one of the most important statements which can be provided from the standpoint of management. By this is not meant the ordinary profit-and-loss statement showing simply incomes, expenses, and net gain or net loss, but one which gives all this information plus that which could be expected from the standard costs and the over and under variances for a period. The budgeted expenses estimated for the same period could very well be included in parallel columns to advantage. Needless to state, if the budgeting is done properly, there should not be a great deal of difference between that and the standard form.

These control data enable the management to know—

Why profits and losses occur.
Whether the budget plans as represented by figures originally estimated are proving successful.
What variations are turning up and why.

Thus, as the period progresses, management knows what he is doing, thereby lessening the element of surprise which he otherwise might encounter. It also gives him assurance for adequate pricing of his services, and allows him to meet competition without the fear of a loss.

Variances Used

Variances in this industry are applied as follows:

Name of Variance	*For Accumulating the Difference Between*
Labor—Rate	Standard and actual rates of pay, plus bonuses, vacation pay, night shift allowances, overtime, etc.
Labor—Efficiency	Standard and actual labor cost due any kind of inefficiency of personnel without reference to rates of pay.
Materials—Price	Standard and actual costs of materials, parts, and supplies.

Materials and Parts—Prices. The purchasing department should be able to estimate the unit prices at which material and parts may be bought under normal conditions. Attention should be paid to cash discounts, freight charges, etc. These features will of course affect the standards to a relative extent.

Labor—Rates. Every operation should have an established standard wage rate for performing each operation. Labor should be classified as to type required and this be included in such standard.

Labor—Efficiency. A standard hourly production rate established for each operation should be in use, and every operation should be time-studied to ascertain if efficiency is attained by workers. Waste labor reports should be prepared monthly to record lost time for any reason. (see Figure 3).

Overhead Rates. Overhead rates should be established for operating each department to normal capacity. This could be based upon estimated number of hours yearly, or by any other standard which will prorate the total overhead cost over all the operations for the hours involved.

Data for Cost Summary—How Obtained

Finding Cost of Job.—It is difficult to state any amount as a cost of a job, because all jobs require different amounts of material, labor, etc. It therefore be-

REPAIR ORDER

_____
Name of Garage

Ticket No._____
Job No._____

_____ _____
Make and Model of Car Mechanic on Work

Name of Customer_____
License No._____ Tele. No._____ Address_____

Parts and Materials Furnished	*Cost*	*Selling Price*	*Date Promised*

Labor

Date Delivered

Lubrication			*Delivered To*
Change Oil			
Flush Transmission			
Wash			
Polish			
Other			

Total Labor___

Gasoline, Oil and Grease		*Accessories*		Total Parts ___
Gals. Gas @ _____	_____	_____	_____	Gas, Oil, and Grease___
Qts. Oil @ _____	_____	_____	_____	Accessories ___
Lbs. Grease @ _____	_____	_____	_____	Tires, Tubes___
Total	_____	Total	_____	Other ___
				Total Amt. ___

Services Required

_____
_____
_____

Service Authorized By: Posting Record

_____ _____
Signature Date Posted

_____
Bookkeeper

Fig. 1.

comes necessary to apply the cost to the component items going into the job for comparative costs.

Material and Labor Variances.—Material costs variances are seen immediately

when prices are compared with standard costs covering the same operation. Labor variances, likewise, are seen when the standard for a certain operation is compared with workers' time cards for the same operation. If excess time is revealed from this record, some of it could doubtless be laid to extraneous causes such as waiting for material, parts, etc. If this is not so then adjustment is due. If the difference is very great and the variance cannot be reduced by subsequent tests, a revision should be made.

Overhead Variances.—Every service department accumulates overhead. Variances are distributed to productive centers on proper ratios by book entries to absorb accumulations periodically.

Inventory Variance Adjustments.—These are necessary in this industry because of poor record keeping on perpetual inventory record and other records. Purchasing and receiving records are also frequently at fault. Adjustments are usually made to inventory adjustments account regardless of what caused the variance.

CHART OF ACCOUNTS OF GARAGES

Department	How Classified
General Office:	
General Manager	Classified generally as overhead
Office Manager	
Purchasing Department	
Office Personnel—Other	
Service Department:	
Parts Manager	Classified as overhead or as cost of parts if cost of this service has been added to invoice price
Inventory Clerks	
Stock Keepers	
Mechanical Department:	
Foreman of Mechanics	Classified as overhead on job unit costs chargeable to direct cost of jobs
Floor Manager	
Mechanical Staff	
Cranemen and Hoisters	
Storage Department:	
Storage Manager	Location on floor
Cashiers	Issuance and Collection of tags
Record Keepers	Daily record
In-take Men (in)	
Delivery Men (out)	
Automobile Sales:	
Manager of Sales—New Cars	Purchase and Sale—new Cars
Manager of Sales—Used Cars	Purchase, reconditioning and sale of used cars
Purchase Manager	
Appraisers	
Repair Mechanics	
Office Personnel	

Fig. 2.

LABOR WASTE_____DEPT. MONTH OF_____19___

PAYROLL

Day	Total	Direct	Indirect	% of Indirect To Direct	Rates	Total
1						
2						
3						
4						
30						
31						
Mo.						

MANAGEMENT RESPONSIBILITIES

Day	% of Standard Direct	Machine Breakdown	Waiting Materials	Waiting Orders	Other	Total
1						
2						
3						
4						
30						
31						
Mo.						

LABOR RESPONSIBILITIES

Day	% of Standard Direct	Slow Worker	New Worker	Poor Worker	Other	Total
1						
2						
3						
4						
30						
31						
Mo.						

Fig. 3.

NEW CAR RECORD

_____
Name of Garage

Our Number_____ Style or Model_____
Date Received_____ Motor Number_____ Body Number_____

COST:

Factory Price	$_____
Transportation Cost	_____
Accessories Added	_____
_____	_____
_____	_____
_____	_____
Overhead_____	_____
Floor space usage	_____
Other Overhead	_____
State License Cost	_____
Total Costs	_____

SALES RECORD

_____
Salesman

Sold to_____
_____

Commission paid
to salesman_____

Cash Received $_____
Trade Allowance _____
Other _____
Total Sales $_____

Trade-In Car: Make_____
Motor Number_____
Body Number_____
Condition_____

Fig. 4.

Explanation of Figure 4

This form is for use in records of new cars handled. One sheet is used for each car. It should be started as soon as the new car is received and, as subsequent events occur, additional information is added. It is closed when the car is sold and the trade-in is transferred to the used car record, Figure 5.

The form is practically self-explanatory. It is intended to accumulate the original cost, added accessories, cost of gasoline and oil, license cost, and any other amounts making up the costs to date of sale.

It also records the final sale including the salesman and the amount of commission paid him. The trade-in car allowance is recorded in a manner that ties the two transactions together, both in this and in the used car record.

USED CAR RECORD

_____
Name of Garage

Our Number_____ Style, Make and Model_____
Previous Owner_____ Address_____

Motor Number_____ Body Number_____ Cost $_____
Cash $_____Or Trade-In

Value when received $_____ $_____
Accessories added Trade-In Record

_____ _____ On New Car__Our No.__
_____ _____ On Used Car__Our No.__
_____ _____

Materials and Parts (List)

_____ _____
_____ _____
_____ _____
_____ _____

Services:

Greasing _____
Washing and Polishing _____
Fender and Body Work _____
Other Services _____

Supplies Furnished:

Gasoline and Oil _____
Grease _____
Total Cost $_____

SELLING RECORD

Sold To_____
_____

Selling Price: Cash $_____ Trade-In $_____ Total $_____
Salesman _____ Commission Paid $_____
Cost of Sale, Other:
Advertising _____
Overhead _____
Other Costs _____ _____ _____
Net Sales Price $_____
Net Profit or (Loss) $_____

Fig. 5.

Explanation of Figure 5

This form is for use on all used cars taken in trades on new or other used cars or purchased outright. It also records all costs of any nature, purchase price, and additions for reconditioning, accessories, supplies, and services, as well as overhead.

It records when and how the unit was obtained, and the profit-and-loss record in the final disposition.

COST ACCOUNTING FOR RETAIL GROCERY STORES

By

JOHN R. BROMELL *

I. DESCRIPTION OF THE INDUSTRY

Types of Stores

With reference to ownership there are two general types of retail grocery stores: Chains and independents. A chain is a group of four or more stores owned and operated by a person or by a business entity. An independent is a store, the owner of which controls not more than three units.

The majority of independent stores offer credit and delivery service. The large chains seldom offer these services, while the very small ones sometimes do.

With reference to goods carried, grocery stores are divided into two general classes: Those with meat departments, and those without meat departments. Those with meat departments are called combination stores.

Products Carried

A grocery store may carry few or many lines, depending on the desire of the owner to grow and the requirements of the market served. Medium-sized and large combination stores usually carry most of the following lines, which may be called departments:

Canned foods: Fruits, vegetables, beans, spaghetti, meats, seafood, soup, milk, etc.

Farinaceous foods, packaged: Cereals, flour, coffee substitutes, macaroni, popcorn, etc.

Farinaceous foods, bulk: Cornmeal, rice, hominy, macaroni, peas, beans, etc.

Bakery products: Bread, rolls, cakes, pastries, pies, doughnuts, cookies, crackers, etc.

Meat products: Fresh meats, smoked meats, cured meats, poultry, seafood, lard, butter substitutes, etc.

Dairy products: Milk, butter, eggs, cheese, etc.

Confectionery products: Candies, chewing gum, candied fruit peel, etc.

Soft drinks: Bottle beverages.

Tobacco products: Cigarettes, cigars, chewing tobacco, smoking tobacco, etc.

Soaps and cleansers: Laundry soap, toilet soap, soap powders, cleansers, etc.

Coffee: All types of coffees.

Fresh fruits and vegetables: All types of fresh fruits and vegetables.

Miscellaneous edibles: Sugar, baking powder, salt, soda, extracts, condiments, syrups, salad dressing, salad oils, jams, jellies, desserts, cocoa, tea, dried fruits and nuts, etc.

Miscellaneous non-edibles: Housekeeping products, medicines, notions, dry goods, etc.

Frozen foods: Fruits, vegetables, meats, poultry, fish, etc.

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Sources of Supply

In order to procure his merchandise the retail grocer has to trade with many producing and wholesaling sources. Below are shown the sources from which the goods for each department are usually purchased.

Departments	*Sources*
Canned Foods	Grocery wholesalers
Farinaceous Foods, Packaged	Grocery wholesalers
Farinaceous Foods, Bulk	Grocery wholesalers
Bakery Products	Local Bakeries
	Grocery wholesalers for cookies and crackers
Meat Products	Meat packers' branch houses
	Meat wholesalers
	Poultry wholesalers
	Seafood wholesalers
	Grocery wholesalers for lard and vegetable shortenings
	Specialty wholesalers for butter substitutes
Dairy Products	Dairies for milk, cream, butter, eggs, cottage cheese, etc.
	Meat packers for butter, eggs, cheese
	Poultry products wholesalers for eggs
Confectionery Products	Grocery wholesalers
	Confectionery wholesalers
	Direct from manufacturers
Soft Drinks	Bottlers
	Beverage wholesalers
Tobacco Products	Grocery wholesalers
	Tobacco wholesalers
Soaps and Cleansers	Grocery wholesalers
	Manufacturers
Coffee	Grocery wholesalers
	Coffee roasters
Fresh Fruits and Vegetables	Fruit and vegetable wholesalers
	Grocery wholesalers
	Wagon wholesalers
	Commission houses
	Farmers
Miscellaneous Edibles	Grocery wholesalers
	Manufacturers
Miscellaneous Non-edibles	Grocery wholesalers
	Drug wholesalers
	Manufacturers
Frozen Foods	Grocery wholesalers
	Manufacturers
	Frozen food wholesalers

Buying Organizations

In order to get their merchandise more cheaply, or to get the privilege of stocking certain brands of merchandise, retail grocers sometimes join or form a "voluntary" or a "cooperative" wholesale house. A voluntary wholesaler is a service wholesaler who controls a brand or brands of food and who permits the retailer to be the exclusive agent in his immediate community for the branded goods

in return for a pledge that the retailer will buy all the merchandise he can from the wholesaler. A cooperative wholesale house is one which is owned by the retail customers. It, also, often has controlled brands to offer the retailer.

II. How to Design the Cost System

Prerequisites of the Cost System

The profits from most single store units do not warrant the luxury of a special employee for cost work. The system therefore must be as simple and as inexpensive to operate as is consistent with the desired results. It must also yield results within a reasonable tolerance.

What Information Is Required

The cost system must be designed to produce the maximum of managerial control data. It should be able to yield:

1. The cost of each function.
2. The cost and net profit for each department.
3. The cost and net profit for each important item.
4. A profit-and-loss statement and a balance sheet for the business as a whole.

The above will enable the merchant to (1) see the items and departments on which he is losing or making money; (2) cull from his stock the "losers" and replace them with items that have greater profit possibilities; and (3) know the items and departments on which advertising and sales effort will yield the greatest results.

Costing Items

The pages which follow deal with allocating cost to departments only. The method of costing commodity items is the same as that outlined for departments or groups, except that the department takes the place of the store and the item substitutes for the department. However, if it is desired to cost all items, this may be done by ignoring departments and applying the cost to each item in the first place. The only disadvantage of this system is that there will be 1500 or more items, instead of some 15 departments, to cost.

III. Description of the Cost System

Costing Technique

Each expense item should be charged to departments on the factor or factors to which it bears the closest relationship. For example, occupancy cost is more closely related to floor space than to anything else. It should therefore be charged to departments in proportion to the floor space used. Again, advertising is done for the purpose of bringing people into the store so that sales may be made. This item, therefore, should be charged to departments on the basis of sales dollars regardless of the goods actually advertised.

But some expenses are incurred for one or few items only. For example, a special license is required to carry some butter substitutes. The cost of this license should be thrown against the butter substitutes that occasioned the expense. Again, if the

coffee grinder has to be repaired, the cost thereof should be placed against the coffees which are ground in the store. In other words, each item of cost which can be traced to a department or group of departments should be charged direct to such department or group of departments.

However, no department should be charged with an expense from which it derives no benefit. For example, meats should not be charged with any of the cost incurred in repairing or maintaining fixtures for non-meat items. Likewise, fresh fruits and vegetables should not be charged with the cost of refrigerating such perishables as butter, milk, eggs, and meat.

WORKSHEET 1. FACTORS ON WHICH EXPENSE ITEMS ARE ALLOCATED

Expenses	Floor Space Occupied	Sales Volume	No. of Sales	Average Inventory	No. of Purchases	Clerk Time Spent	Direct	Total
Occupancy	$1,200							$ 1,200
Cleaning, Decorating, Repairs	300							300
Light and Heat	300							300
Printing and Stationery		$ 50						50
Collections		50						50
Advertising		350						350
Bad Debts		250						250
Legal		50						50
Telephone			$ 200		$ 50			250
Delivery			2,250					2,250
Bookkeeping			1,000		200			1,200
Licenses and Taxes	100			$ 50			$ 50	200
Insurance, Inventory				50				50
Interest				50				50
Purchasing					200		200	400
Clerk Salaries						$6,100		6,100
Free Goods							50	50
Manufacturing							50	50
Spoilage							100	100
Telegraph							50	50
Insurance, Furn. and Fix.								50
Depreciation, Furn., and Fix.				50 50				50
Manager's Salary		1,500			500			2,000
Cashier's Salary			1,600					1,600
Total	$1,900	$2,250	$5,050	$250	$950	$6,100	$500	$17,000

The first step in costing departments is to analyze each expense item in order to determine what factor or factors should be used in the distribution, and then group the expense items on a work sheet on which all expenses to be distributed on a given factor are placed in one column. These factors will be: Floor space, dollar sales, number of sales, average inventory, and number of purchases (see Worksheet 1).

Under floor space will come all items of expense incurred in housing the business in a manner that sales can be made. This will include occupancy (rent, if not owned; taxes, insurance, repairs, and the like, if owned), cleaning, decorating, repairs, heat, light, and a general license to do business.

To determine the floor space to be charged to each department actual measurements should be taken of both the store and the storage room at least twice during the period covered. This should be done at opposite seasons of the year to correct for seasonal variations.

Where goods occupy shelving, the floor space covered by the shelving should be prorated to the goods kept thereon on the basis of space occupied on the shelves. For example, if the shelving involved has three shelves, and Department A uses one shelf, Department A should be charged with one third of the space charged to the shelving.

WORKSHEET 2. PERCENTAGE OF EACH COST GROUP THAT IS CHARGEABLE TO EACH DEPARTMENT

Department	Floor Space Occupied	Sales Volume	No. of Sales	Average Inventory	No. of Purchases
Canned Foods	24	8	10	25	2
Farinaceous Foods, Packaged	3	2	2	3	5
Farinaceous Foods, Bulk	5	3	4	5	2
Bakery Products	4	9	15	4	13
Meat Products	12	33	18	11	14
Dairy Products	5	18	16	4	22
Confectionery Products	2	2	2	2	2
Soft Drinks	1	1	1	1	2
Tobacco Products	1	2	1	1	5
Soaps and Cleansers	9	3	6	11	2
Fresh Fruits and Vegetables	4	10	12	4	12
Coffee	2	3	1	2	5
Miscellaneous Edibles	15	3	8	14	2
Miscellaneous Non-edibles	12	2	3	12	2
Frozen Foods	1	1	1	1	10
Total	100	100	100	100	100

Only the floor space actually "covered" should be considered in the computation.

When the measuring is completed the percentage of actual space covered by each department should be placed in the first column of Worksheet 2. This will automatically charge aisles, space used by the cashier and checkout stations, and that used for sales-promotion purposes, to departments in the proportion of actual coverage.

The conventional accounting system should show the expenses for the period in like groups, such as are given in the last column of Worksheet 1.

Under sales will fall all items that either promote sales or aid in collecting for sales made. Some authorities believe that advertising of specific items should be charged to those items. However, since regardless of the items mentioned, most advertising is done to get customers in the store so that they will buy more than the items named, it is felt that all advertising affects the sale of all goods and therefore should be charged to all departments in the proportion of sales made.

If dollar sales for each department are not determined regularly for management

purposes, they may be determined by adding purchases to opening inventory, subtracting closing inventory, and then adding gross profit.

In most departments a few items account for the major portion of the sales volume. Therefore, the gross profit for a department can be closely approximated by subtracting the purchase price (as determined by a review of purchase invoices) from the selling price (as determined by examining shelf price tags or the price marked on the goods) on the big-selling items, and then applying the result to the cost of goods for the entire department. The result will be slightly conservative since large volume items usually carry shorter gross margins than do slow moving items. But the error will be very small since the slow movers will represent little volume.

Under number of sales should come the items most closely related to that factor. These cost items are telephone, delivery, bookkeeping, manager's salary, and the like.

The number of sales may be determined by establishing the average sale for each department and then dividing the sales for the period by the average sale. The average sale can best be determined by a sample tabulation of sales transactions.

Under average inventory should come all items which tend to fluctuate with inventory, such as taxes on inventory, insurance on inventory, and interest on money borrowed with which to buy goods. Some authorities think interest should be charged to the specific item for which the borrowed money is paid out. However, where the incidence of borrowing falls is usually accidental. Had the cash available not been used to buy other products it would not be necessary to borrow in order to buy the "victim" item.

The average inventory for each department can be determined by taking inventory several times each year, adding the several inventories for each department, and then dividing by the number of times taken. However, the inventory counts should be made at different seasons of the year in order to take into account seasonal flutuations.

The items which should be charged on the number of purchases made are those incurred either directly or indirectly in performing the purchasing function. Some of these are portions of the salaries of the manager and other employees for time spent in buying. Also, an appropriate portion of the bookkeeping and telephone costs should be charged to purchasing.

The number of purchases may be determined by a tabulation of purchases either on the total period, or a sample basis.

The second step in costing departments is to make a worksheet with columns which show the percentage of each of the five cost groups to be charged to each department. Worksheet 2 is such an instrument. It shows, for example, that the Canned Foods Department uses 24% of all floor space (determined by actual measurement) and is therefore to bear 24% of all costs distributed on the basis of floor space occupied; that it accounted for 8% of all sales and is therefore to bear 8% of all costs assigned on the basis of sales, etc.

The third step is to multiply the columnar totals in Worksheet 1 by the individual department percentages in the corresponding columns of Worksheet 2 and record the results in the appropriate columns and opposite the appropriate departments in a third worksheet—Worksheet 3.

WORKSHEET 3. ALLOCATION OF COST TO DEPARTMENTS

Department	Floor Space Occupied	Sales Volume	No. of Sales	Average Inventory	No. of Purchases	Clerk Time Spent	Direct	Total
Canned Foods	$ 456.00	$ 180.00	$ 505.00	$ 62.50	$ 19.00	$ 365.60		$ 1,588.10
Farinaceous Foods, Packaged	57.00	45.00	101.00	7.50	47.50	158.40		416.40
Farinaceous Foods, Bulk	95.00	67.50	202.00	12.50	19.00	93.40		489.40
Bakery Products	76.00	202.50	757.50	10.00	123.50	1,015.20		2,184.70
Meat Products	228.00	742.50	909.00	27.50	133.00	2,080.00	$250.00	4,370.00
Dairy Products	95.00	405.00	808.00	10.00	209.00	1,235.00	50.00	2,812.00
Confectionery Products	38.00	45.00	101.00	5.00	19.00	65.00		273.00
Soft Drinks	19.00	22.50	50.50	2.50	19.00	42.60		156.10
Tobacco Products	19.00	45.00	50.50	2.50	47.50	85.20		249.70
Soaps and Cleansers	171.00	67.50	303.00	27.50	19.00	127.80		715.80
Fresh Fruits and Vegetables	76.00	225.00	606.00	10.00	114.00	426.00	100.00	1,557.00
Coffee	38.00	67.50	50.50	5.00	47.50	127.80	50.00	386.30
Miscellaneous Edibles	285.00	67.50	404.00	35.00	19.00	127.80		938.30
Miscellaneous Non-edibles	228.00	45.00	151.50	30.00	19.00	85.20	50.00	608.70
Frozen Foods	19.00	22.50	50.50	2.50	95.00	65.00		254.50
Total	$1,900.00	$2,250.00	$5,050.00	$250.00	$950.00	$6,100.00	$500.00	$17,000.00

This procedure allocates all cost which is shared in common by all departments and which can be distributed to all departments on common factors.

The fourth step is to distribute items of joint cost which cannot be distributed to departments on a common factor. Clerks' salaries are of this nature. They must be distributed on the basis of actual benefits to each department. This means that, since all employees do not get the same rate of pay, each employee's salary must be distributed separately.

Worksheet 4 shows the distribution of each clerk's *time* to departments as determined by a time study. Worksheet 5 shows the distribution of each clerk's *salary*, as shown in Column 6 of Worksheet 1, to each department on the basis of the percentages shown in Worksheet 4. The last column of Worksheet 5 should then be transferred to the sixth column of Worksheet 3.

The fifth step is to distribute items of expense which are incurred for the benefit of one department (Column 7, Worksheet 1). Oleomargarine tax, free goods, repair of coffee grinder, spoilage, and telegrams used in ordering meat are examples of such expense items.

These items are assembled, as in Worksheet 6, and the total of each column is transferred to the appropriate department in Column 7 of Worksheet 3.

The sixth step is to add Worksheet 3 across and place the totals in the final column. These totals represent the cost to be charged to the respective departments for the period. When they are subtracted from the gross profit of the appropriate departments, the result will be the net profit for the several departments.

WORKSHEET 4. PERCENTAGE OF EACH CLERK'S SALARY THAT IS CHARGEABLE TO EACH DEPARTMENT

Department	Brown	Jones	Smith	Cox
Canned Foods	23	3		
Farinaceous Foods, Packaged	2	10		
Farinaceous Foods, Bulk	2	5		
Bakery Products	1	77		
Meat Products			100	
Dairy Products				95
Confectionery Products		5		
Soft Drinks	3			
Tobacco Products	6			
Soaps and Cleansers	9			
Fresh Fruit and Vegetables	30			
Coffee	9			
Miscellaneous Edibles	9			
Miscellaneous Non-edibles	6			
Frozen Foods				5
Total	100	100	100	100

WORKSHEET 5. ALLOCATION OF CLERKS' SALARIES TO DEPARTMENTS

Department	Brown	Jones	Smith	Cox	Total
Canned Foods	$ 326.60	$ 39.00			$ 365.60
Farinaceous Foods, Packaged	28.40	130.00			158.40
Farinaceous Foods, Bulk	28.40	65.00			93.40
Bakery Products	14.20	1,001.00			1,015.20
Meat Products			$2,080.00		2,080.00
Dairy Products				$1,235.00	1,235.00
Confectionery Products		65.00			65.00
Soft Drinks	42.60				42.60
Tobacco Products	85.20				85.20
Soaps and Cleansers	127.80				127.80
Fresh Fruit and Vegetables	426.00				426.00
Coffee	127.80				127.80
Miscellaneous Edibles	127.80				127.80
Miscellaneous Non-edibles	85.20				85.20
Frozen Foods				65.00	65.00
Total	$1,420.00	$1,300.00	$2,080.00	$1,300.00	$6,100.00

WORKSHEET 6. ALLOCATION OF DIRECT CHARGES TO EACH DEPARTMENT

Expenses	Meat	Fresh Fruits and Veg.	Coffee	Misc. Non-edibles	Total
Licenses and Taxes—Oleo	$ 50.00				$ 50.00
Purchasing	200.00				200.00
Free Goods—Premium					50.00
Manufacturing—				$50.00	
Fixing Coffee Grinder			$50.00		50.00
Spoilage		$100.00			100.00
Telegraph	50.00				50.00
Total	$300.00	$100.00	$50.00	$50.00	$500.00

There are a few insignificant items of expense which would cause a great deal of work if they were allocated to departments or commodities on the most logical factors. Insurance and depreciation on furniture and fixtures, for example, should be distributed on the basis of use by departments. This would entail, however, a special detailed calculation. Therefore, if such expense items are not great, they may be distributed on the basis of sales volume or average inventory without perceptibly affecting the final result.

A reasonable rule to follow is that "nuisance" items of expense may be distributed on a common factor if their aggregate does not exceed one-half of 1% of sales.

Expense Items Omitted

The system here outlined does not show all of the expenses that may be incurred in grocery store operations. It merely gives numerous examples of the several types of cost that are likely to be entailed. When an expense not shown on the worksheets occurs, the grocer can determine the way in which it should be allocated by "relating" it to a function or an item shown. For example, the cost of water is not treated here. But since water is used chiefly for the convenience of employees, the grocer can reason that water cost is related more closely to the number of employees and should therefore be allocated on the percentages shown in Worksheet 4. This would mean that Canned Foods would be charged with 26/400 of water cost, Farinaceous Packaged Foods with 12/400, and so on.

Conclusion

The system outlined herein is an allocation, and not a "running," cost system. It can best be applied at the end of the accounting period when the conventional books have yielded the expenses for the period in itemized form. When the expenses have been applied to commodities or departments, the results can serve as a guide to management during the ensusing period.

Due to the several worksheets required and the separate calculations entailed, the system may at first appear to be complicated and costly. Such however is not actually the case. It is estimated that one person of managerial caliber can do the job for a store of $100,000 annual volume in about seven man-days.

COST ACCOUNTING IN THE HARD SURFACE FLOOR COVERING INDUSTRY

By
I. WAYNE KELLER *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Hard surface floor coverings are those decorative floor coverings produced from oxidized oils and synthetics and having a firm resilient wearing surface in contrast with that of the soft surface floor coverings produced from wools and other fibrous materials. There are three general classifications of these resilient floor coverings: Printed felt base, linoleum, and tiles. Since the production processes incident to the manufacture of the tiles are very similar to those of linoleum, except that no backing material is used, they may be considered in the category of linoleum in any discussion of the cost accounting procedures. Printed felt base is a material produced by applying a wearing surface of paint in designs to a backing material of rag felt saturated with asphalt or synthetic resins. It is marketed in the form of piece goods and rugs. Linoleum is a mixture of linseed oil, other vegetable oils, ground cork, finely ground wood, resins, and pigments compressed onto a backing material such as burlap or felt. Each manufacturer produces many different types, grades, and patterns. Recent developments have led to the production of a type of floor covering similar to linoleum but using synthetic binders instead of linseed oil. Technically, this material is not linoleum, but the production processes are very similar to those used for linoleum.

Linoleum and felt base are sold under many different trade names which may or may not include the generic term.

Origin of the Products

Linoleum was developed by Frederick Walton in England in 1863. He called his invention "linoleum"—from *linum,* the Latin for flax (the plant which produces linseed oil) and *oleum,* oil. Since that time, many improvements in the products have been made both in the design and quality. As modern chemistry developed new pigments and binders, they were added to the basic cork and oxidized linseed oil mixture discovered by Walton. Some years later the application of a printed surface to felt base was developed in order to provide a low-cost decorative hard surface floor covering.

The many developments of the chemical industry provide a constant source of new materials which will produce more attractive colors and a more durable goods. Resins, plasticizers, pigments, and fabrics are subjected to constant examination and tests in new formulations. Adaptations must be made to developments in the architectural field, such as radiant heating with the heat elements located beneath

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the surface of the floor. All of these combine to make research and development a major item in the budgets of the progressive companies. Coupled with the research is close laboratory control of raw materials used and of reactions in process. Since many of the raw materials are natural products (cork, wood, flaxseed) some variation is inevitable and control must be maintained to produce constantly a uniform product.

Sources of Raw Materials

Linseed oil is secured by crushing flaxseed, which is grown in the United States, Canada, and the Argentine. Resins and pigments are the products of many phases of the chemical industry. The combination of oils, resins, and pigments provides the wearing surface which is applied to a carrying medium or backing material. In the case of linoleum this backing may be burlap from India or Scotland, domestic cotton sheeting, or rag felt. In the case of printed felt base it is, as the term implies, a rag felt produced from trimmings from the garment industry and other sources of rags. Most manufacturers secure their raw materials from common sources of supply.

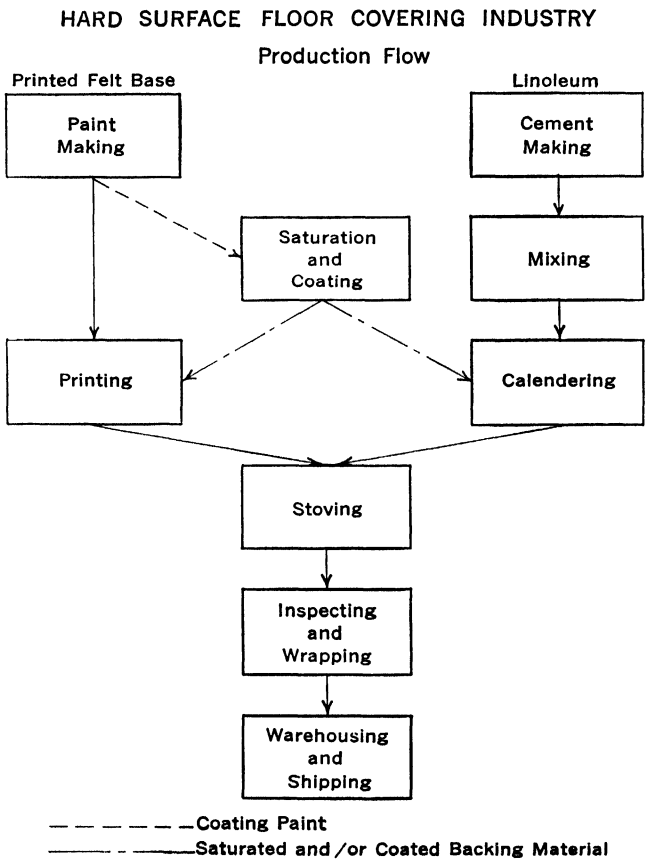

Fig. 1.

Organization of Plant

In this description, it is assumed that the plant purchases backing materials (rag felt, cotton sheeting, or burlap) in the raw state, and the manufacturing cycle begins with their processing. All other ingredients are basic raw materials. Certain processes and equipment for producing printed felt base are entirely different from those used for linoleum production, while others are common to both (Figure 1).

Some companies manufacture only one of these products, but since they are so closely related most produce both. A typical plant producing both types of hard surface floor covering will have the following service and productive departments:

Service Departments:

Plant Management Industrial Engineering Production Planning Maintenance Purchasing Controller Personnel	These have the usual duties and functions of industrial plants and present no problems peculiar to this industry.
Laboratory	Many raw materials are natural products; for this reason and because of seasonal changes in temperature and humidity, close product control is necessary. This cost must be segregated from that of research and development.
Design	Develops new patterns and styles.
Engineering	Most production equipment is specialized and must be constructed, or adapted from standard machines.

Productive Departments:

Department	*Processes*	*Equipment and Facilities*
Saturation and Coating	Saturating rag felt with asphalt or resins. Applying surface coatings for smoothness and adhesion.	Large rolls of backing material are unrolled, immersed in tanks of saturant, dried, and rerolled mechanically. When required, a face and backing coat of pigment or adhesive is applied with doctor blades or roll coaters after the saturant has dried, but before rerolling.
Paint Making	Preparing paste paints, thinning and matching shades.	Pigments and oils are ground on pebble or roller mills, vehicle is added in mixing tanks to secure desired viscosity, pigment is balanced to exact shade. All materials handling and processing is mechanical except matching which is a skilled hand operation.
Printing	Applying the wearing surface design to felt base.	Saturated and coated felt base is printed on a flat-bed press having numerous printing blocks. The paint thus applied provides both the wearing surface and design or pattern.

Department	*Process*	*Equipment and Facilities*
Cement Making	Mixing and oxidizing oils and resins.	Oils and resins are weighed and are mixed in large heated mixers, producing a semi-solid oxidized compound referred to as "cement."
Mixing	Mixing and blending cement, cork, wood flour, and pigments.	Ingredients of linoleum are ground and mixed in heavy, specialized mixers. Production is continuous with ingredients added at top of production line and passing by gravity or mechanical conveyers through successive types of mixers.
Calendering	Applying linoleum mix to the backing material.	Linoleum mix is compressed onto the backing material by heavy controlled-temperature rolls. Marble effects are secured by introducing contrasting shades of mix. Roll dies may be used to cut blocks from calendered sheets of mix. These blocks are then arranged in patterns and compressed onto the backing.
Stoving	Curing printed felt base or linoleum in controlled - temperature rooms (stoves).	Printed felt base and linoleum pass from print machines and calenders, respectively, into stoves where it is hung in festoons for curing at controlled temperature.
Inspecting and Wrapping	Visual and mechanical examination of stoved goods, following which it is wrapped to protect surface.	Goods is removed from stoves by mechanical winding into large rolls. Rolls are unwound onto inspection tables. Highly skilled inspectors inspect for defects in pattern or quality and grade material as perfects, seconds or scrap. Graded goods is wrapped in roll sizes delivered to trade.
Warehousing and Shipping	Placing material in warehouses, removing and placing in shipping containers and shipping.	Regular materials handling devices and procedures.

Raw materials are bulky and heavy. Therefore, it is desirable in so far as possible to store them at the points at which they will be used so as to minimize the cost of intra-plant transportation. Under these circumstances central storerooms are not practicable except for supplies and sundry materials.

The processes and facilities used in this discussion are those which are basic to the production of hard surface floor covering. Each may be broken down into more specific processes by the larger manufacturers and there may be some further combination by the smaller manufacturers.

Production Order System

The scheduling of production is complicated by the fact that relatively long runs must be scheduled on production equipment that is specialized and costly and must be kept operating at full volume. As against this, the industry is dependent upon the shifts in customer preferences as to type, quality and design of the finished product. Reports are received from wholesalers and retailers indicating the movements of goods by grade and patterns, and factory production is scheduled for inventory in order to provide economical runs and at the same time maintain a satisfactory inventory to meet the demands of customers. Each pattern and grade carries a numerical code designation which is expanded into a roll (register) number for the finished product so that complete records of the movement of material from department to department can be maintained and finished merchandise can be traced back to the department and crews making it and the dates on which it was made. This code number is used in scheduling and reporting production.

II. How to Design the Cost System

What Information Is Required

The primary consideration in the designing of a cost system in this industry is *control*—control of cost, control of quality, control of production, and control of inventory. This is effected by providing for:

1. Daily reports for operating supervisors on the efficiency of each operation.
2. Measurement of cost changes resulting from material and process specification changes.
3. Monthly reports of operating effectiveness, adapted to each level of management.
4. Product costs and profits by types, grades, and patterns.
5. Corporate financial statements.

Consideration in Designing the System

The industry uses costly specialized production equipment, power demand is high, and the necessary technical and supervisory personnel relatively heavy. Therefore, volume has an important bearing on unit costs. Hence this effect of volume must be segregated so that it will not influence pricing policies.

The production cycle is long (as much as sixty days for some grades) and cost and quality are affected at each operation. This requires a system of reports that not only records the material scrapped at each operation but also provides for tracing defects discovered at the final inspection operation back to the operation which caused them and to the shift and crew which worked on the material.

Finished salable material is graded as "perfects" or "seconds." The cost system must provide for inclusion in the cost of the perfect goods of the necessary markdown of the seconds.

The "Standard" Cost System Is Used

Because of the variety of types, grades, and patterns passing through each operation, the cost of operating an actual cost system which provide all of the required information is prohibitive. Hence the standard cost system is used. Vari-

ances from standard are usually determined at each operation and the material moves from operation to operation at standard cost.

Also, standard costs provide the only means of measuring cost while a given pattern is in process. Inefficiencies and errors in formulation can thus be detected and corrected before the entire run has been started or, at least, before subsequent operations have used more material and expended more cost on unsatisfactory material.

III. Description of the Cost System

The steps in developing a standard cost procedure and system of control reports in this industry are as follows:

1. Standardize production processes and formulas.
2. Develop standard unit costs for labor and material by type, grade, and pattern by operation.
3. Develop factory expense budgets and establish expense rates at normal volume by department or operations within departments.
4. Build total standard costs by type, grade, and pattern.
5. Provide basic material usage, labor, and production reports.
6. Provide daily control reports for material, labor, and controllable expense for operating supervisors.
7. Provide monthly variance reports for plant management.
8. Provide profit-and-loss reports by products for sales and company managements.
9. Establish the procedures for operating the cost system and producing the desired data.
10. Design the necessary forms and set up the required Chart of Accounts.

Standardize Production Processes and Formulas

The intensive engineering and research program of the industry results in comparatively frequent changes in production processes and formulas. Since it is customary to revise standards each year the technical changes expected to be effected during the year that will cause important cost changes are appraised and incorporated in revised standard specifications. As a result the standards established for each year reflect the cost that the factory ought to attain when a normal volume is produced.

Standard Material Costs

Material costs usually include the cost of the cores and wrapping paper used at the inspection operation and also the shipping containers in which the rolls are placed at time of shipment. Specifications are set for physical and chemical properties of each raw material, formulation, and unit weights.

Standard formulas are established by the laboratory and submitted, with proper approvals, to the controller (Figure 2). Formulation is in several successive steps, so that the standard formula for mix will include cement which in turn includes prepared oil. Each of these semi-processed materials has a standard formula. Weights per square yard are also established by the laboratory for the amount of saturant and coating to be used on the backing material and for the amount of paint or mix to be applied as a wearing surface.

The engineers determine quantities of scrap to be expected at each operation. They also set package specifications, which in this industry are extremely important

MATERIAL STANDARDS

Operation No.
Index No.
Date Issued
Date Effective

PRODUCT Cement

Cost Class:—

Formula X Process Loss— Weight Per Unit— Defect Loss— Scrap Loss—

	Pounds	Rate	Value
Linseed Oil	xxx	xx	xxx
Resin	xxx	xx	xxx
A	xxx	xx	xxx
B	xxx	xx	xxx
Total	xxx		xxx
Oxidizing Gain %	xx		–
Total	xxx		xxx
Per 100 Pounds Cement		xx	

APPROVALS

Plant Laboratory		Date
Plant Industrial Engineer		Date
Controller's Department		Date
General Foreman		Date
Superintendent		Date

Fig. 2.

because of the necessity for complete protection of heavy rolls of material against indentation, scratching, and compression.

Prices expected to be paid on the average for raw materials f.o.b. plant during the period the standards are in effect are established by the purchasing department and approved by the management. The Controller's Department applies these rates to the formula and quantity specifications (Figure 3) to develop standard material cost of each finished product.

Standard Labor Costs

Direct labor standards are set by the industrial engineers for each operation, by grade and pattern when possible (Figure 4). Incentive systems are used which usually give consideration to both quality and quantity and these incentive payments are reflected in the standard cost on the basis of expected achievement during the year. The Controller's Department combines these operational costs into total labor cost of each finished product, making due allowance for expected scrap in each operation.

Standard Cost Summary

Grade _____
Code _____ Plant _____ Date _____ 19____

Description	Unit	Quantity	MATERIAL		LABOR		EXPENSE		TOTAL COST	
			Rate	Amount	Rate	Amount	Rate	Amount	Rate	Amount
Cement (see Page___)				x		x		x		x
A				x						
B				x						
C				x						
D				x						
Mixing						x		x		
Total				xx		xx		xx		xx
Allowance line loss — %				x		x		x		x
Total				xx		xx		xx		xx
Coated Burlap (See Page___)	Sq. Yds.	1000		x		x		x		x
Calendaring		1000				x		x		x
Stoving		1000				x		x		x
Inspecting & Wrapping		1000		x		x		x		x
Total		1000		xx		xx		xx		xx
Scrap		50								
Net salable Production		950		xx		xx		xx		xx
Cost to make 1000 Salable Yds.		1000		xx		xx		xx	x	xx
25% Seconds x 20% Markdown ÷ 75% Perfects = 6.667% Markup on Perfects										
Perfects										
Cost to Make		1000		xx		xx		xx		xx
Markup — 6.67%				x		x		x		x
Total		1000		xx		xx		xx		xx
Warehousing and Shipping		1000		x		x		x		x
Total		1000		xx		xx		xx		xx
Seconds										
Cost to Make		1000		xx		xx		xx		xx
Markdown — 20%				x		x		x		x
Net		1000		xx		xx		xx		xx
Warehousing and Shipping		1000		x		x		x		x
Total		1000		xx		xx		xx		xx

DIRECT LABOR STANDARDS

Year_____ Operation_____ Page_____

Dept. No.	Class No.	Item	Crew Size	Actual Man Hours	Av. Base Rate	Base Rate Std.	% Bonus	Std. Labor Per Hr.	Inv. Unit	Prod. Per Hr.	Std. Labor /100 I. U.	% Qual. Bonus	$ Qual. Bonus

Fig. 4.

Standard Expense Cost

Expense budgets are built annually for each operation by classes of expense such as salaries, indirect labor, supplies, maintenance, depreciation, and taxes. Each of these classes is formulated at several activity levels to establish its fixed and variable components. The variable expense is related to a suitable measure of activity for each operation and variable expense rates are determined which are used in measuring performance and developing standard expense costs.

The most important step in building standard expense costs in this industry is the establishing of normal or expense absorption volumes, because of the effect on standard fixed expense rates. Fixed expenses are high and activity has marked seasonal and cyclical fluctuations. If these are related to a volume which cannot be attained, on the average, over a period of years, unit costs will be too low. Conversely if they are related to a volume which is low, unit costs will be too high. In either circumstance, not only will sales prices based on costs be unsound, but also the appraisal of the effectiveness of the performance of sales and production organizations will be distorted. Normal volume is therefore set for each grade of product at a level that can be made and sold on the average over the period of a business cycle. These normal sales volumes are converted into production units for each operation, giving consideration to scrap losses in process. If there is excess capacity in any operation because of unbalanced production facilities, the cost of carrying such excess is usually segregated and not included in the standard. Fixed expenses are related to activity at normal volume, variable rates added, and the total applied to the production time or quantity factors used for labor standards.

Total Standard Costs

Material, labor, and expense standards are computed and summarized for each grade and pattern of material (Figure 3). Costs of processed materials which are used in subsequent processes are brought into those by cost element so that the total standard will reflect the true expected material, labor and expense cost.

Consideration is given to the production of imperfect material which will be sold as seconds. The standard factory cost of such material is marked down in relation to the differential in sales price. The cost of perfects is in turn marked up to carry the markdown on the expected percentage of seconds expected to be produced. Thus, if seconds are sold at 20% off the list price of perfects, and 25% of the production is seconds, the cost to make would be increased 6⅔% to arrive at the finished manufactured cost of perfects ($25\% \times 20\% \div 75\% = 6\frac{2}{3}\%$).

Basic Reports

Since the objective of the entire system is to provide effective tools for control, the basic reports of material usage, labor cost, controllable expenses, scrap, and production are usually quite detailed and comprehensive. The high cost of materials and the use of equipment with both high initial and carrying cost justifies a comparatively elaborate system of basic reports. These reports in turn permit and provide for the preparation of daily control reports.

Raw material usage is reported by types of raw material and by semi-processed or finished products for which it is used. It is desirable to provide for summaries by days, by products, by operations and by raw material. A "pegboard" form (Figure 5) is frequently used for these reports to facilitate the preparation of these sum-

maries. Specialized report forms may be used in certain operations (Figure 6). These reports may combine usage, scrap, and production, particularly where certain of these factors are derived from other known or computed factors.

RAW MATERIAL USAGE

Material _____ Date _____

Leader _____ Oper. _____

_____ Batches

TOTAL LBS.	MATERIAL	LBS. PER BATCH	
	18 OIL		
	19 OIL		
	126 OIL		
	COMP. OIL		
	PRINT PASTES		
	2		
	3		
	5		
	9		
	12		
	13		
	14		
	15		
	16 N.C.		
	21		
	22		
	26		
	34		
	35		
	36		
	37		
	38		
	39		
	TOTAL		
	VAR.		
	RAW MAT. CREDIT		

Fig. 5.

Payroll reports (Figure 7) are adapted to the incentive system in use. Since there must be a perfect balance between quality and quantity of production, these factors are weighted accordingly. The reports provide for this, and also for the classification of labor as to direct and indirect. Certain operations, particularly maintenance and other service labor, are not usually paid on an incentive basis, and here payroll reports follow the customary form.

SATURATION DEPARTMENT PRODUCTION

Date_____ 19____ Shift_____

DRY FELT								SATURATED FELT					
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Roll No.	Kind	Weight Per Roll	Weight Per Sq. Yd.	Yards Per Roll (Counter)	Wrap & Core Scrap Yards	Festo'n Scrap Yards	To Saturation (5 minus 6 & 7)	Yards Saturated (Counter)	Yards Scrap (8 minus 9)	Weight Per Roll	Weight Per Sq. Yd.	% Sat. 12 + 4	Remarks

Fig. 6.

PAYROLL REPORT

MATERIAL | PATTERN No. | Q. I. No. | Q. I. % .

Date_____

Shift_____ Dept._____ Sheet No._____

Leader_____ Standard Man Min. _____ % Bonus ☐

Operation No.

	CLOCK NUMBER	Total Hours	QUALITY BONUS			UNMEASURED WORK						MEASURED WORK								DIRECT		INDIRECT		
						STRAIGHT TIME				OVERTIME		STRAIGHT TIME					OVERTIME							
			Hrs	Base $	Bonus $	Hrs	Job No.	Rate	$	Hrs	$	Hrs	Job No.	Rate	Base $	Meas. $	Hrs	Base $	Meas. $	Hrs	$	Hrs	$	Accts. Class.
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
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16																								
17																								
18																								
19																								
20																								
21																								
22																								
23																								
24																								

Foreman_____ Total Pay $_____

Fig. 7.

LINOLEUM INSPECTION REPORT

SCRAP CUT OFF				REGISTER NO.	LENGTH		PERF.	SECONDS	REMNANT	TO BE REPAIRED	SIDE GUAGE	CENTER GUAGE	DEFECTS	CUT OFFS		STOVE NO.		
FT	IN	DEFECT	BATT MARK		FT	INS								LIN FEET	DEFECT	MAKING REGISTER	LACQUER YARDS	INSPECTED YARDAGE

Expense materials are usually carried in central storerooms and are charged to expense as withdrawn by the operating departments through stores requisitions.

The inspection reports (Figure 8) provide the final link in the chain of basic reports. These reports provide a complete analysis of the disposition of the total yards on each roll of material into stock or scrap. The "making register" number which is usually assigned to material in the first operation (see Figure 6, "Roll No.") and follows the material through each succeeding operation will permit the tracing of all defects back to the operation causing them. This is an integral part of the quality bonus system. Also, a finished stock "Register No." is assigned at the inspection operation to provide detailed control of finished stock.

Daily Control Reports

The data supplied by the basic reports may be summarized daily and compared with the standard allowances. Since such reports would be prepared primarily for the use of the operating foremen, the comparisons would be made in units rather than dollars. These comparisons may be made by clerks in the offices of the foremen and thus be available for use no later than noon of the day following production.

Comparisons can be made for all cost components, in as much detail as each foreman desires. A typical labor control report is shown as Figure 9.

Since maintenance does not lend itself to daily control on the basis of actual expenditures related to activity, a special control procedure may be followed (Figure 10). Each month a "budget position" can be established by adding to the unreleased balance of allowed maintenance expense at the beginning of the month the fixed allowance and the variable allowance at expected activity for the month. All maintenance work is done on job order and, as jobs are estimated and approved each day, releases are posted and deducted from the unreleased balance. Actual costs are compiled by jobs and upon each completion, an adjustment is made to the unreleased balance for the difference between estimated and actual cost.

Monthly Control Reports

When a system of daily control reports is used, the foremen effect control of the operational costs on the basis of such data. Monthly reports of variances from standard cost, in dollars, may be prepared by operations or departments. These would provide historical summaries of the effectiveness of the daily control and serve as check points for the foremen and for the information of the superintendent or manager of the factory.

However, for the use of the top executive and sales managers, a monthly summary control report "Statement of Profit and Loss by Major Commodity Groups" (Figure 11) is used by most companies in the industry. In this report operating results achieved by each level of responsibility (factory, selling, and administration) can be shown by product lines. This is of vital importance because of the marked differences that may exist between unit income, costs, and profit margins on different products.

The effect on net profit of sales volume and gross sales prices may be determined by comparing the actual with the budget for the month. Trends are also indicated by the comparison of the achievemnt for the month with that of the year to date. Freight allowed, trade discounts, cash discounts, and returns and allowances are

LABOR CONTROL REPORT

Operation # _____

Week Ending _____

Date	Crew	Shift	Units Produced	Direct Labor Hours			Machine Hours			Indirect Labor Hours			Total Labor Hours		
				Goal	Actual	%	Goal	Actual	%	Goal	Actual	%	Goal	Actual	%
		11-7													
		7-3													
		3-11													
	Total														
		11-7													
		7-3													
		3-11													
	Total														
		11-7													
		7-3													
		3-11													
	Total														
		11-7													
		7-3													
		3-11													
	Total														
		11-7													
		7-3													
		3-11													
	Total														
Minimum Acceptable Performance															

Fig. 9.

usually included in the deductions from gross sales to arrive at net sales, rather than being reflected as miscellaneous expense.

The standard manufactured cost of sales may be determined by summarizing unit shipments, by type, grade, and pattern, for the month and extending the totals by the standard manufactured cost. The register number assigned to each roll at

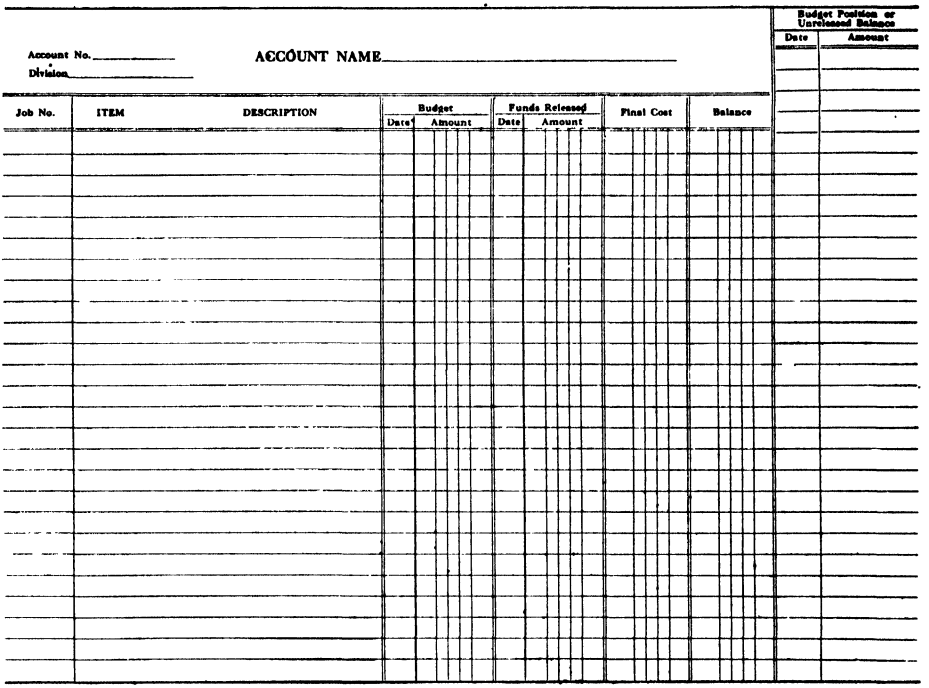

Fig. 10.

inspection is frequently used in this connection. Mechanical accounting through the use of punched cards, with a card for each register number, provides an effective inventory control for checking age of stock and turnover and preparing weekly stock records. As shipments are made, the cards can be removed from the active file according to register numbers shown by the shipping tally. These are sorted by the product classifications desired and tabulated as to units shipped at the close of each month.

Manufacturing variances may be detailed in a supplementary report (Figure 12) and may be determined in the following manner. Material usage as summarized for the daily control reports (Figure 5) is further summarized according to the products in which the raw materials were used. Charges are made to the material utilization variance account and credited to the raw material inventory at standard cost. Production is also summarized by products and extended at standard allowances for material for charges to inventory and credits to the material utilization variance account. If desired, material variances may be detailed as to formula, weight of material applied to backing, etc. Package material usage is measured as

"material" on the basis of units inspected for warehouse package material, and units shipped for shipping containers.

Direct labor variances may be computed for both base rate and bonus. This is desirable since an expected amount of bonus should be included in the Standards. Variations in base rate costs may occur because of extra men on crews, changes in

STATEMENT OF PROFIT AND LOSS BY MAJOR COMMODITY GROUPS

MONTH OF

		Linoleum	%	Felt Base Rugs	%	Felt Base Piece Goods	%	Total	%
Units Sold:	Budget								
	Actual								
Unit Price:	Budget								
	Actual								
Gross Sales:	Budget								
	Actual								
Net Sales:	Actual								
Std. Mfg. Cost of Sales									
Mfg. Variances									
Plant Volume Variance									
Purchasing Variance									
Actual Mfg. Cost									
GROSS MARGIN									
Selling Expense									
Commercial Expense									
Other Income (Expense)									
NET PROFIT (LOSS) before tax									

Five MONTHS 194-

			%		%		%		%
Units Sold:	Budget								
	Actual								
Unit Price:	Budget								
	Actual								
Gross Sales:	Budget								
	Actual								
Net Sales:	Actual								
Std. Mfg. Cost of Sales									
Mfg. Variances									
Plant Volume Variance									
Purchasing Variance									
Actual Mfg. Cost									
GROSS MARGIN									
Selling Expense									
Commercial Expense									
Other Income (Expense)									
NET PROFIT (LOSS) before tax									

Fig. 11.

process specifications, variation in machine speeds, and variation in raw materials. Quantity and quality bonus will vary from the amount estimated for each product as efficiency is higher or lower than estimated. Both actual costs and standard labor allowances are computed and summarized by product groups in each operation.

Scrap is unavoidable because of line loss in mixing, material damaged in transfer, damage at the end of rolls in roll-up, and defects revealed at inspection. Actual scrap is measured and credited to the inventory and charged to the scrap account at standard cost up to the point of scrapping. A charge is made to inventory with a

VARIANCES FROM STANDARD COST

Month of May 19--

	LINOLEUM		FELT BASE RUGS		FELT BASE PIECE GOODS		TOTAL	
	Amount	%	Amount	%	Amount	%	Amount	%
Manufacturing								
Variance from Allowance for:								
Material Utilization								
Direct Labor								
Scrap								
Expense Budgeted								
Reconditioning-Mfg. Respons.								
Total - Production Efficiency								
Cost not Included in Standards								
Overtime								
Wage Increase-Direct Labor								
Wage Increase-Indirect Labor								
Expense (Dif. between Budgeted) (and Std. Allowance)								
Reconditioning-Sales Respon.								
Misc. Income or (Expense)								
Total - Other Manufacturing								
Total Manufacturing								
Expense - Volume								
Purchasing								
TOTAL VARIANCES								
Std. Cost of Units Processed								
Actual Cost of Units Processed								

Comments:

Fig. 12.

credit to the scrap account for the standard allowance for scrap on the basis of the quantity of good production, Again product groups are followed.

Flexible manufacturing expense budgets are used to provide a measurement of expense control at any level of activity. Variations from the budget are computed for each service and productive operation. The variances of the service operations are allocated to the productive operations on the basis of service rendered. The total of the specific variance and allocated service operation shares for each productive operation is allocated to products on the basis of relative activity for the month.

Cost not included in the standards is also compiled by product groups. Overtime not considered to be normal, and wage increases granted after standards are built are typical items of labor cost not included in the standards. Also, allowances are made in the budget for measuring efficiency which are not included in the standards. The difference between the amount allowed in the budget and the amount included in the standard cost is allocated to products on the basis of relative activity in the operations where such differences occur.

Fixed manufacturing expenses are determined when standards are built and are allocated to products in each operation on relative normal activity. Each month the standard fixed expense rate is applied to the units of each product produced to establish the fixed expense absorbed. The difference between this and the standard fixed expense is the plant volume variance for each product group.

Purchasing or material price variances are determined as the raw material is received and placed in inventory. Invoice costs, transportation, and handling charges are summarized in an "in transit" account. As material is received, the variance account is charged and the "in transit" account credited. Standard raw material inventory rates are applied to quantities received and a charge made to raw material inventory with a credit to the variance account.

Manufacturing, plant volume, and purchasing variances are not usually allocated to inventory and to cost of sales. Over the period of a year, production and sales will, under close production control, be approximately equal. Therefore, any allocation from month to month would serve no purpose which cannot be achieved through explanation.

Selling expense will usually vary as to product lines. Advertising and promotion will in most instances be of a product rather than an institutional character. Direct sales effort may be analyzed as to the number of calls, the men assigned to product classes, the number of dealers selling each product, or other appropriate measurement of effort expended. A study of these factors will indicate the basis of allocation to products that is most desirable when considered in the light of the method of selling, the classes of customers, and the product lines of each company.

Commercial expense as used in this industry includes administration, engineering, and research. Administration costs by products may be established on a fairly accurate basis for certain functions, such as traffic, credit, billing, accounts receivable, industrial engineering, and production control. For other functions, such as the president's office, secretary, and treasurer, normal sales dollars may be the best allocation basis available. Research and engineering are usually directed along specific product lines. If job orders are assigned under which these costs are accumulated and such projects give consideration to product groups, the determination of product costs is almost automatic.

Other income and expense, such as credits from the sale of salvage material or charge for materials obsoleted, are usually specific to product groups.

Operating the System

The cost and general accounting procedures in the hard surface floor covering industry are usually set forth in accounting manuals which incorporate appropriate charts of accounts. Great amounts of detailed information must be accumulated in each operation on a uniform basis. Summaries are needed daily and monthly for control and for financial statements. For these reasons numerical codes are usually assigned to all transactions and mechanical accounting devices are used to facilitate rapid, accurate summarization. Personnel skilled in the technique of cost accounting and possessing a well-developed sense of industrial management should constantly interpret these summaries for all levels of administration.

COST ACCOUNTING IN THE HOSIERY INDUSTRY

By

LLOYD F. MOGEL *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

In the hosiery industry there are various types of mills described as to the kind of hosiery they make. There are the following kinds of hosiery.

1. Ladies Full Fashioned Hosiery
2. Seamless Ladies Hosiery
3. Men's Full Fashioned Half Hose
4. Men's Seamless Half Hose—Staples and Fancies
5. Children's Seamless Hose—Staples and Fancies
6. Infants Seamless Hose
7. Cut and Sewed Hosiery

1 and 2. Ladies' Full Fashioned Hosiery and Seamless Ladies' Hosiery are fairly staple products with some variations as to foot design or ornamentations, such as lace designs in the tops. There is a seasonal problem in ladies hose regarding the color of the product: Light shades for the spring and summer season; and dark shades for the fall and winter season. The shades will change each year to match the latest style shoes and dresses. For this reason it is important to control carefully the stock of colors, especially at the end of the season. Old shades can be redyed at additional expense or sacrificed at a reduced price.

3. Men's Full Fashioned Half Hose have a similar seasonal trend. Colors in men's socks are not affected as much by styles as ladies'. However, designs of embroidering on the socks may change a trifle. The problem of close outs at the end of the season is not important.

4 and 5. Men's Seamless Half Hose and Children's Hose in staples present no seasonal problem. In the fancy business styling is quite important. These hose are made on machines that have many pattern possibilities. A change in patterns and color combinations is demanded by the trade from season to season. Light shades and short ankle lengths predominate in spring and summer, while dark shades and regular lengths are in demand in fall and winter. However, short ankle lengths are also worn in fall and winter. At the end of each season (each six months) the manufacturer is faced with close-outs because of style and color. The extent of this sacrifice of inventory depends on how good his control of merchandising was, and on how closely his production schedules followed the demands of the trade.

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Sources of Raw Materials

The materials used in the hosiery mill are nylon yarn, cotton yarn, rayon yarn, silk yarn, wool yarn, rubber thread, angora yarn, etc. In the average mill these yarns are purchased in the finished state, that is, they are ready for use on the knitting machines without any additional processing. In the larger mills some of these yarns are purchased in a semifinished or unfinished state, either processing this yarn in their own yarn mill or department or sending same to an outside yarn mill for additional treatment and additional twisting. For nylon yarn, rayon yarn, and silk yarn, these processing mills are called "throwsters"; and for cotton, wool, angora, etc., "spinners." In cases where the mill has its own "throwing" plant, a cost system is a necessity and such throwing cost must be added to the yarn cost. If yarn is processed by an outsider, this cost will appear on their invoice and must be added to the yarn cost.

The yarns are contracted for as much as a year in advance. This calls for shrewd buying and a close contact with the forecasts of the industry.

Organization of Plant

For this description of plant we will consider a mill that buys its yarn finished or has it finished by an outside throwster or spinner. A typical mill will be arranged in departments by employees and machines performing similar operations. This will be necessary to create cost centers for the purpose of expense control, assembling of direct labor and overhead costs. The larger the plant, the more subdivisions are possible.

The following are typical departments:

Service Departments:

General Manufacturing Dept.	(Supervision, factory office, general expenses)
Building Expense	(Taxes, janitor service, repairs, depreciation)
Power and Steam Expense	(Power bill, coal, water, fireman, repairs, depreciation, etc.)
Maintenance Expense	(Machinists, electricians, carpenters)
Auto Expense	(Chauffeurs, gas, oil, tires, supplies and repairs)

Productive Departments:

Department	*Operation*	*Equipment*
Full Fashioned Knitting	Knitting of Leg Knitting of Foot	Large flat bed knitting machines producing from 20 to 32 stockings simultaneously. Stocking is produced in a flat shape.
Seamless Knitting	Knit complete stocking except for closing of toe	Circular knitting machines.
Looping	Closing heel and toe	Dial looping or sewing machines which will join the stitches in closing the toe and heels.
Seaming (on full fashioned)	Seaming the leg and foot	Horizontal sewing machines to join the edges of the flat stocking.

Department	*Operation*	*Equipment*
Grey Examining	Inspection of stocking before dyeing	Expanding black metal forms, classification racks, and bins.
Mending	Repairing defective stockings	Special pick-up needles, tables, and bins.
Grey Stock	Storage and assembling sizes, etc., for dye lots	Bins and scales.
Dyehouse	Bleaching and Dyeing	Special noncorrosive metal dyeing machines usually constructed out of monel metal. Extractors.
Boarding	Forming or pressing finished stocking	Special drying machines composed of a heated chamber through which the stockings pass. Or hollow stationery forms heated by steam, electricity, or hot water.
Finishing	Final inspection and grading of stockings	Proper tables and shelving.
Packing	Stamping sizes, trademarks, packaging	Stamping equipment and special fixtures for packaging.
Shipping	Fill orders and pack for shipment	Customary equipment.

The stockings of all types will pass through each of the above departments except seamless stockings, which are knit in a different knitting department. As a rule seamless stockings do not pass through the seaming department unless a "mock seam" is added or a cuff is sewed to the top of a seamless leg, as in the children's fancy styles and some ladies anklets.

In the transportation of stockings between departments care must be taken to prevent damage to the product, especially the fine gauge ladies' nylon stockings. The stockings should be placed in pouches or bags. Some mills put standard quantities in each bag (for example, 10 dozen), thus facilitating inventory control and counting of production.

In preparing for the dyeing operation, ladies' stockings are placed loosely in cloth bags of about three dozen capacity. The bags with their contents are placed in the dye bath. In some mills these bags are filled by the grey examiner as part of her operation and in other mills this is a separate operation.

Production Control

In order to keep the inventory of work in process to a minimum it is necessary to plan carefully the production of sizes and colors. In ladies' full fashioned mills it is customary to carry a grey stock (undyed stock) against which dye orders are issued by the production planning department. It is important to keep the proportion of sizes balanced to a standard assortment. If this is not done stocks of unwanted sizes will be accumulating and dyeing orders will be held up for lack of the proper sizes. The planning department must be guided by daily or weekly analysis of customers' orders received, the condition of the finished stock, and the production schedule. A work sheet similar to the following will be helpful in planning sizes required for the next week's production.

KNITTING SCHEDULE FOR WEEK ENDING JUNE 8, 1946

Style No. 800

	Total	8½	9	9½	10	10½
Standard Assortment	100%	7%	17%	33%	26%	17%
Grey Stock and In Process End of Previous Week	—	—	—	—	—	—
Plus Production this Week	—	—	—	—	—	—
Less Dye Orders Issued this Week	—	—	—	—	—	—
Grey Stock before Next Week's Production	—	—	—	—	—	—
Planned Production Next Week	—					
Total Stock and Planned Production in Balanced Assortment	—	—	—	—	—	—
Knitting Schedule Required in Next Week's Production to Balance Sizes	—	—	—	—	—	—

Fig. 1.

In a mill making fancy styles, planning must provide for sizes, color, and pattern combinations. It is the custom in some mills to pack in one box three to six styles or color combinations. Therefore, all these related patterns must be finished before any one can be packed for sale. These are known as rounds in the industry. Planning of knitting and finishing must therefore be in terms of rounds and require more follow-up.

II. How to Design the Cost System

What Information Is Required

The cost system should furnish management with the following essential data:

1. Cost of each operation or process.
2. Cost of each product.
3. Cost and efficiency of each department.
4. Material usage and waste reports.
5. Profit contribution of each product or class.
6. Profit-and-Loss Statement and Balance Sheet.
7. Quality reports.

Standard Cost System Is Desired

The system should be streamlined to give management prompt reports of the operations, because the more delay in completing reports the less effective they will be. Most hosiery mills operate on a process cost system and are well suited for a "standard" cost system. Most mills of fair size use the "standard" cost system. Some use the standards throughout all the books, writing off any variances to variance accounts; and others use the "basic standard" cost whereby some variances are carried into the inventory accounts, the standard being used to develop the actual costs. The use of a standard system (standard or basic standard) is the most economical and provides the best tools for cost control of present and future costs. This will also enable management to budget or forecast the financial results of a season's projected business.

Considerations in Designing the System

While in some industries the cost system serves as a means of establishing selling prices, the hosiery industry prices are established by a highly competitive market. For this reason the cost data must be accurate and current so as to reflect any variance from the standard or projected cost. Inefficiencies must be brought out in the reports so that corrections can be made immediately. Variances from standard must be studied carefully with the objective of eliminating them.

Direct Labor Variances

Although the industry is almost 100% on a straight piecework basis, the inefficiency of labor should be studied because the more units that labor produces per day or unit of time, the more overhead will be absorbed; and, in the initial operations, more units will make available more gross profit.

Material Variances

Material is a major portion of total cost and should be controlled to insure the proper yield in stockings. Weights of hosiery should be checked frequently to see that they conform with standards. Hidden material losses can thus be prevented. Care must be used in establishing standard weights to eliminate excess moisture, sizing, oil, etc. Many mills send samples of stockings to the United States Testing Company or some other similar laboratory that will furnish the proper clean fibre weights.

Quality Variances

Quality reports are very important because the loss on substandard stockings known as "irregulars, seconds, thirds" can be a substantial part of the cost of firsts. The first quality must bear the loss in value of substandards. We believe that this loss should be considered as part of the cost and not be shown as a deduction in the average selling price. This loss is the difference between cost and realizable value received. A quality report to the superintendent showing the causes for imperfections will be most useful in reducing losses to standard allowances.

Expense Variances

In setting up a cost system, cost centers must be established, preferably by departments, to provide a measure and control of expenses. This can be done by using departmental expense statements comparing actual with standard, using a flexible budget for the departmental expenses. In a low margin industry these variances can be serious.

III. Description of the Cost System

The most important steps in establishing a standard cost system as we shall describe are:

1. Design product profit-and-loss statement.
2. Design standard cost sheet for each style.
3. Establish standards for material, labor, supplies, and quality percentages.
4. Establish departmental budgets for overhead expenses.

5. Set up chart of accounts to conform with budgets and profit-and-loss statement.
6. Design operating statements for each department.
7. Material usage report.
8. Establish the procedures to operate the cost system.
9. Quality reports.

Product Profit-and-Loss Statement

In any mill there will be a certain amount of planning of sales, production, and profits. This planning or forecasting is synonymous to budgeting. Evaluating the various steps in the planning will produce the budget. Standard costs are the budgeted costs and will give us the desired data for forecasting.

A profit-and-loss statement for product classes or products as shown in Figure 2 will give management the important facts to control the actual profit picture and will show through the variances the chief reasons why budgeted results have not been attained. This will also show the profit contribution of each product compared with budget and total.

Cost of Sales. This is calculated by extending the dozens sold by the standard cost per dozen. This calculation can be made as soon as the sales analysis is available.

Variances Used	*For Accumulating the Difference Between*
Material Price	Standard and actual costs of yarns.
Material Usage	Standard and actual quantities of yarns used; dyestuffs used.
Labor Rate	Standard and actual rates of pay for production on day-work operations or if piecework rates changed and standards were not changed.
Labor Efficiency	Standard and actual output on day-work operations. Also make-up pay to meet guaranteed minimum wages.
Overhead Spending	Standard and actual for the volume of operation in each department. The standard is the budgeted amount at the given volume.
Overhead Efficiency	Standard and actual volume evaluated by standard rates in between actual time and standard time on production in each department extended by the standard overhead rate in each department.
Overhead Idle Expense	Standard and Actual volume evaluated by standard rates in each department.
Quality	Standard and actual quantities of rejects or irregulars at markdown losses.

For ease in preparing this profit-and-loss statement, there should be separate ledger accounts for each item on the report. This detail need not be in the general ledger but could be in subsidiary ledger cards controlled by the general ledger accounts that would be totals of the items of similar nature.

The labor and overhead variances are accumulated from the various departmental operating reports.

The number of product classes desired on the profit-and-loss statement will determine the amount of detail required.

PRODUCT CLASS PROFIT AND LOSS STATEMENT

Period ending _____

	Total	Ladies F.F. Nylon	Ladies F.F. Rayon	Mens F.F. Half Hose	Mens Seam-less Fancies	Mens Seam-less Staples	Ladies Seam-less Nylon
Gross Sales							
Less Returns Discounts							
Net Sales—Actual							
Net Sales—Budget							
Less Cost of Sales at Standard Cost							
Gross Profit at Standard							
Less Variances:							
Material Price							
Material Usage							
Labor Rate							
Labor Efficiency							
Overhead Spending							
Overhead Efficiency							
Overhead Idle Expense							
Quality							
Total Variances							
Gross Profit—Actual							
Gross Profit—Budget							
Less:							
Shipping							
Selling							
Advertising							
Administrative							
Total							
Net Profit—Actual							
Net Profit—Budget							

Fig. 2.

How Variances Are Allocated

Variances are calculated in labor and overhead in the monthly departmental operating reports. If a certain product is responsible for the variance, that product variance is charged. Otherwise, the variances are apportioned on the products going through that department. For example, if the variance would be in labor rate caused by Ladies' Nylon, this variance would be charged. If a general labor inefficiency resulted, this would be apportioned. A make-up pay caused by earning less than guaranteed minimums could be charged direct if the employee worked exclusively on one product.

Overhead variances are apportioned according to the production of the product classes going through each department.

Material price variances can be calculated when the purchase is recorded. However, some mills may carry a large inventory of yarns for seasonal items and in such a case it may be desirable to carry this inventory at actual costs for balance sheet purposes and calculate the price variance when the yarn is withdrawn from stock for production, thereby giving a more accurate profit picture for current sales and production. Yarns that are used in one product class only will have the price variance charged to that class. A yarn used in several product classes will have the variance charged to those classes based on projected or budgeted production.

Standard Cost Sheets for Each Style

A standard cost sheet is shown in Figure 3. This is the foundation on which rest the various reports. All comparisons are made with a view to determine why the costs differ from the cost sheet. (a) The direct labor standard will be the piecework rates in effect when the standard is set. In the knitting operation for full fashioned styles the standard should be weighted if the mill has various section and speed machines. (b) The standards for overhead are the number of overhead units extended by the standard overhead per unit. These units in most departments should be a measurement of time, that is machine hours or labor hours. (c) The material weight standard should be the laboratory weights, or test runs on a given weight of yarn. Care must be exercised to select the average size for this standard. A standard allowance for waste is added. These weights times the standard prices of yarns will make up the standard material cost. (d) The standard for dyestuffs is derived from the dyehouse formula. (e) The standard allowance for "Loss on Irregulars" is calculated before adding packing because seconds, etc., as a rule have a cheaper packing than firsts. This "loss" is the difference between the cost paired and the salvage value of the seconds, thirds, etc. This salvage value is the selling price received for seconds, thirds, etc., less the selling expense and packing cost on seconds. Up to pairing, the cost of seconds and thirds is the same as firsts. But when they have been graded the first quality must bear this loss in the inventory value of seconds, thirds, etc. (f) Allowance for variances should be included on the cost sheet for conservative forecasting of profits and for margin lists given management. This is not part of the standard cost because the standard ends with the "Cost Packed." (g) The cost sheet shown is for a full fashioned ladies' style. Other types of hose would follow this same form except that the operations would be slightly different. On Fancy Half Hose an extra item would appear on the sheet to cover "Style Changing" expense.

STANDARD COST SHEET

(All figures are hypothetical)

Date Jan. 1, 1946 Style No. 6470

Description: 45 gauge Ladies Celanese, Cotton Welt

Material Standard (Including 5% waste)	*Wt.*	*Price*	*Amount*
Welt 60/2 C.P. Merc. and Gassed Cotton	0.398	1.12	$0.446
Body 75 Denier Celanese 25 Turns	0.612	1.74	1.065
Reinf. 80/2 C.P. Merc. and Gassed Cotton	0.194	1.32	0.256
Seam 80/3 C.P. Merc. and Gassed Cotton	0.015	1.41	0.021
	1.219		1.788

DIRECT LABOR AND OVERHEAD

Operation	Stand. No. of OH Units	Stand. Direct Labor	Stand. Overhead Rate	Stand. Overhead Amount	Total Stand. Lab. and OH	
Legging	0.734 M hr.	1.144	1.159	0.851	1.995	
Footing	0.218 M hr.	0.466	1.159	0.253	0.719	
Foot Helper		0.110			0.110	
Foot Topper		0.500			0.500	
Knitting Deprec. on Mach.	0.952 M hr.		0.108	0.103	0.103	
Unearned Wages		0.033			0.033	
Looping	0.119 L hr.	0.125	0.317	0.038	0.163	
Seaming	0.316 L hr.	0.350	0.317	0.100	0.450	
Examining	0.067 L hr.	0.056	0.475	0.032	0.088	
Mending	0.038 L hr.	0.033	0.475	0.018	0.051	
Grey Stock		0.012			0.012	
Dyeing	1.219 lbs.	0.011	0.047	0.057	0.068	
Dry Out		0.007			0.007	
Boarding	0.100 M hr.	0.145	1.492	0.149	0.294	
Pairing	0.114 L hr.	0.094	0.374	0.043	0.137	
Fin. Mending	0.014 L hr.	0.012	0.475	0.007	0.019	
Royalty				0.039	0.039	
		3.098		1.583	4.788	4.788
Dyes and Chemicals						0.128
Cost Paired before Loss on Irreg.						6.704
Loss on Irregulars @ 85% Regulars						0.252
Packing Costs—Labor, supplies and boxes						0.290
COST PACKED—Standard						7.246
Allowance for Variances 5% of Lab. and OH.						0.239
Shipping 1%						0.090
Selling 9%						0.810
Administrative 2%						0.180
Total Cost Sold						8.565
Selling Price						9.000
Margin						0.435

Calculation of Loss on Irregulars:

Mfg. Cost of	15% Rejects	@ 6.704		$100.56
Net Invent. Value	8% Irregulars	@ 6.25	50.00	
Net Invent. Value	5% Seconds	@ 5.12	25.60	
Net Invent. Value	1% Thirds	@ 3.57	3.57	
Net Invent. Value	1% Rags	@ 0		79.17
Loss on 15 dozens Rejects				21.39
Loss on Irreg. per doz. based on 85% firsts				0.252

Fig. 3.

Revision of Standards

Revisions should be made as often as new budgets are set up. Labor standards should be revised when the method of operation changes or when a new wage scale is adopted as a result of union negotiations. Overhead standards would change

with the budget changes because standards and budgets are identical. Some mills change their budgets every six months. Material prices would change when the budget is changed unless important changes took place in the yarn market that would make necessary a new forecast, before the end of the six months. The ideal way would be to arrive at a long-range forecast of yarn prices if that were possible and keep the standard for a year or several years.

Departmental Budgets

In establishing departmental standard overhead rates, a budget of expenses should be set up (See Figure 4). This should be the result of conferring with the

STANDARD OPERATING BUDGET Effective Jan. 1, 1946

Full Fashioned Knitting Department

Capacity 24,000 Machine Hours
Period 20 days

	Standard Cost	
	Amount	Per Unit
Fixed Expense:		
Foreman and Fixers	$ 2,544	$0.1060
Inspectors	391	0.0163
Needle Straighteners	178	0.0074
Interdepartment Deliveries	398	0.0166
Depreciation on Machines	3,166	0.1319
Depreciation on Other Equipment	2,179	0.0908
Fixed Distributive Expense (Building, Power and General Manufacturing Expenses)	2,585	0.1077
Total Fixed Expense	$11,441	$0.4767
Variable Expense:		
Machinists	$ 922	$0.0384
Machine Cleaners	382	0.0159
Stock Collection	422	0.0176
Examiners	984	0.0410
Salvage Examiners and Menders	667	0.0278
Overtime Extra	1,726	0.0719
Learning	310	0.0129
Vacation Wages	1,068	0.0445
Health Insurance	1,159	0.0483
Repairs	1,890	0.0787
Supplies	283	0.0118
Needles	1,123	0.0468
Sinkers, Points, etc.	355	0.0148
Payroll Taxes	2,080	0.0867
Variable Distributive Expense (Building, Power and General Manufacturing Expenses)	3,014	0.1256
Total Variable Expense	$16,385	$0.6827
TOTAL DEPARTMENTAL EXPENSE	$27,826	$1.1594

Fig. 4.

DEPARTMENTAL EXPENSE STATEMENT

Full Fashioned Knitting

Period ending June 29, 1946

(All figures are hypothetical)

Machine Hours	
Capacity	24,000
Idle Capacity	3,442*
Used Capacity	20,558
Stand. Capacity	22,329
Efficiency	1,771

Item	Standard per unit (a)	Actual Cost (b)	Idle Capacity (c)	Actual Operating Cost (d)	Standard Cost (e)	Operating Cost Variance (f)	Direct Labor (g)	Efficiency (h)	Spending Variance (j)
Units			3,442*		22.329			1,771	
Direct Labor:									
Legging		$31,835		$31,835	$31,904	$ 68	$ 68		
Footing		5,622		5,622	5,535	86*	86*		
Foot Helping		1,466		1,466	1,754	287	287		
Foot Topping		7,473		7,473	7,295	177*	177*		
Unearned Wages		849		849	820	29*	29*		
Cost of Living Bonus		2,801		2,801	2,816	14	239*	253	
		50,049		50,049	50,126	76	177*	253	
Fixed Expense:									
Foreman and Fixers	0.1060	2,825	364*	2,460	2,366	93*		187	281*
Inspectors	0.0163	333	56*	277	363	86		28	57
Needle Straighteners	0.0074	143	25*	117	165	47		13	34
Interdepartment Deliveries	0.0166	476	57*	419	370	48*		29	78*
Depreciation on Machines	0.1319	2,637	123*	2,514	2,945	430		318	112
Depreciation Other Equip.	0.0908	1,996	312*	1,684	2,027	343		160	182
Fixed Distributive Expense	0.1077	2,702	370*	2,331	2,404	73		190	117*
		11,116	1,310*	9,806	10,644	838		929	91*

Variable Expense:								
Machinists	0.0384	696	696	857	161		68	93
Machine Cleaners	0.0159	398	398	355	43*		28	71*
Stock Collection	0.0176	333	333	392	59		31	28
Examiners	0.0410	746	746	915	168		72	95
Salvage Exam. & Mending	0.0278	546	546	620	74		49	25
Overtime Extra	0.0719	2,724	2,724	1,605	1,119*		127	1,246*
Learning	0.0129	72	72	288	215		22	192
Vacation Wages	0.0445	1,136	1,136	993	143*		78	221*
Health Insurance	0.0483	1,204	1,204	1,078	126*		85	211*
Repairs	0.0787	1,344	1,344	1,757	412		139	273
Supplies	0.0118	153	153	263	110		20	89
Needles	0.0468	829	829	1,045	215		82	132
Sinkers, Points, etc.	0.0148	495	495	330	165*		26	191*
Payroll Tax	0.0867	1,966	1,966	1,935	30*		153	184*
Variable Distributive Exp.	0.1256	3,430	3,430	2,804	626*		222	848*
		16,079	16,079	15,244	835*		1,209	2,044*
Total Departmental Costs		$77,245	$75,935	$76,014	$ 78	$177*	$2,392	$2,135*
Efficiency: 108.6%								

* Red Figures
Cents were omitted in the typing. Additions include the cents.

Fig. 5.

superintendent and foreman. The expenses are divided into fixed and variable. After establishing the normal capacity in units, these units are divided into each item of expense that will give the standard allowance per unit for each item. These allowances are used to calculate the standard allowances on the departmental operating statements. A budget like this is essential in controlling departmental expenses. The foreman can be guided by the standard allowances to control the expenses currently or daily by a simple calculation using number of overhead units used times the standard allowances. He can guide himself in incurring the expenses of the department. It should be the aim of management to make each department head cost conscious. And with the proper standards he can produce remarkably close to standard costs.

Departmental Expense Statements

Figure 5 shows a departmental operating statement which will enable management to measure the performance of each department head. The actual cost figures are obtained preferably from factory ledger cards and entered in column "b." The idle expense is calculated on fixed expenses only. The calculation is the total idle overhead units extended by the standard allowances per unit. Actual cost minus idle expense will be the actual operating expense. The standard cost in column "e" is calculated by extending the standard overhead units produced by the standard allowances. The cost variances on this statement are analyzed into direct labor (column "g"), efficiency (column "h") and spending variance (column "j"). A summary of all departmental reports will give management the performance of the mill as a unit.

Variances shown on the summary sheet of the expense reports form the basis for an entry recording the variances to the proper accounts and transfer the costs from the expense and labor accounts to work in process accounts.

Material Usage Report

In many mills the material usage is overlooked and after an inventory there may be many rude awakenings when the results are known. By preparing a material usage report, conditions can be known before too much damage has been done. This report is compiled by summarizing requisitions showing withdrawals from yarn stock. This actual quantity of yarn is compared with the standard quantities that should be used for the dozens produced. This is the production times the standard weights for each count of yarn. Assuming that the price variance is calculated when the yarn is used in production, a material usage report could be designed as in Figure 6.

REPORT OF MATERIAL USAGE AND PRICE VARIANCE

For Period Ending_____

Description of Yarn	Actual Used			Should Use		Variances	
	Lbs.	Amount at Actual Prices	Amount at Stand. Prices	Lbs.	Amount at Stand. Prices	Lbs.	Amount

Fig. 6.

Usually this report would show only the values from which the variances would be calculated. But in working with the mill officials to remedy a large variance, it is necessary to talk their language by translating values into quantities, showing pounds of yarns involved. The "Price Variance" is the difference between actual quantities used at standard prices and actual amounts used at actual prices. The "Usage Variance" is the difference between actual quantities used at standard prices and standard quantities at standard prices.

Quality Variance Report

This is another phase of the hosiery business that some mills may treat lightly. But one can see the importance of bringing this variance to light and following it up with the proper reports to the supervisory force, when this cost is shown separately on the cost sheet and the variances evaluated. This report can be shown as in Figure 7. The standard "Loss on Irregulars" shown on this report is the loss per dozen as per standard cost sheet. The actual "Loss on Irregulars" per dozen is the loss in inventory value on the actual quantities of irregulars, etc. (rejects).

QUALITY VARIANCE REPORT

		Actual		Standard		Variances	
Style No.	Dozens Regulars	% Regulars	Loss on Irreg. per Doz.	% Regulars	Loss on Irreg. per Doz.	Per Doz.	Amount of Variance

Fig. 7.

In addition to this variance there is a further loss in profits on the quantity of first quality merchandise not obtained if the percentage of firsts is less than standard.

To enable the mill supervisory force to remedy the causes of imperfections a more detailed report is presented showing the percentage of rejects due to various causes. This is tabulated from a summary of inspection reports originating in the finishing department. This inspection report in a typical mill appears as in Figure 8. The left column is a summary of the grading of the hosiery. The right column is an analysis of the irregulars, seconds, and lower grades as to cause of the defects. This analysis by causes is made out on random test lots. The grading report is made out on all lots.

Labor Ticket

A labor ticket used by a typical mill is shown in Figures 9 and 10. Each employee daily fills out the form shown in Figure 9. These daily tickets are summarized at the end of each week and entered on a summary sheet; the calculation of the gross earnings is then made on the form in Figure 10.

Finished Inspection Report

A	B	C	D	E

Regulars 60	Style No. 6470		Date 6/14
Specials 10	Size 9½		Exam.
Redyes	Dye Order No. 436		Re-Exam.
			Paired
	TOTAL DOZENS 70		
54 8/24	Regulars		
7 12	N. & H. I.	Casts & Slugs	1 6
4 18	Seconds	Split Threads	12
1 10	Lower Grades	Misc. Yarn Defects	8
1 16	Redye Spots Etc.		
0	Redye Odds	Tight Foot	3 6
0	Lower Grade Odds	Loose Foot	1 8
8	Rags	Foot & Topper Mends	3 12
68	Total Forwarded To Stock	Leg Mends	12
1 4	Pulls	NEEDLE and SINKER LINES	1 6
3 2	Menders	Wash Board	6
	Reboards	Two Tone	1 10
12	Odds	MISC. MFG. DEFECTS	10
	Bad Boarding		
8	Over-Short		
52	TOTAL TO BE REPAIRED		
	GRAND TOTAL		14

Boarded By 1282

Fig. 8.

Bundle Number	Size	Units	Bundle Number	Size	Units
35684	9½	10			
25561	9½	9			
35683	9½	8			
31642	10	8			

OPERATION	P. W. HOURS	TOTAL UNITS
Looping	8	35

STYLE NO. 6470 MACHINE NO.

SEC & SPEED	GAUGE	END MACHINE	P W RATE
SINGLE SHIFT ✓	HELPER	WHITE ✓	.20
	NEW AMMON	COLORED	P W EARNINGS
DOUBLE SHIFT	OLD AMMON	NAVY	7 00

SUPERVISOR NO

	OPERATION	UNITS	HOURS	RATE	D W EARNINGS
DAY WORK					

CLOCK NO	DEPT. NO.	W C	DIV.	Total Earnings
1375	50			

118757 DATE 6/14/46 — 7 00

MOORE BUSINESS FORMS, INC — ELMIRA N. Y.

Fig. 9.

PIECEWORK EARNINGS

Oper.	Style	Units	Rate	Hours	Piecework Earnings
51	6470	35	.20		7 00
	6501	30	.21		6 30
	6502	60	.21		12 60
	6475	30	.20		6 00
				42	
	Re-work				
				Total P. W. Earnings	31 90

DAYWORK EARNINGS

Operation	Units	Hours	Rate	Daywork Earnings
Sampleo		2	.75	1 50
			Total D. W. Earnings	1 50

Straight Time Hrs. 40	Overtime Hours 4			
		Regular Earnings	33 40	
		Cost of Living Bonus	2 86	
		Overtime Earnings	[redacted]	1 62
		Diff. to Minimum	0	
		Bad Work	.50	
Week Ended			Preliminary Earnings	35 76
			Supplies	0
Dept. 50	Clock No. 1375		Total Hours 44	Total Earnings 37 38

Fig. 10.

COST ACCOUNTING FOR HOSPITALS

By

HARRY W. WOLKSTEIN *

I. DESCRIPTION OF THE INDUSTRY

General Administrative Problems

Lexicographers define a hospital as an institution for the reception, care, and medical treatment of the sick or wounded. To the layman it is a building to shy away from except in cases of extreme emergencies. To those responsible for the administration of a modern hospital, it is a complex organization whose primary objective is to render a humane service to the community without regard to profit.

Hospitals may be classified as to the type of service performed or to the kind of control under which they operate. Services rendered are either general or special. General hospitals serve general medical and surgical patients, maternity patients, and children. Special hospitals are those which limit their services to patients with some particular disease or condition, such as cancer, joint disease, maternity, etc. Control may be of three types: Voluntary or nonprofit hospitals, government and veteran hospitals, and those hospitals operated for profit.

The success of a hospital is measured by the value of its humane services to the people of the community—not by the record of its earnings as in a commercial enterprise. The organization functions at its best, however, when its financial administration is based upon a strong fiscal structure, supported by sound financial policies, efficient management, controlling budgetary practices, and an adequate accounting system.

Technical Accounting Problems

The technical problems confronted in hospital accounting differ to some extent from those of a commercial enterprise. The assets are largely represented by cash funds in the hands of responsible officers, or funds invested in securities, plant, and equipment. The capital consists of the surplus accounts.

The fundamental thought underlying the accounting system of such an institution provides for the proper segregation of income and principal. The accountant must determine what restrictions, if any, are placed upon the various funds and the disposition thereof, by the hospital's charter and by-laws, the minutes of the board of directors, and the appropriation records. There must be a clear distinction at all times between income which serves to increase principal and revenue which may be used for operating purposes. Bank balances, revenue receipts and disbursements, and investments in securities must be adequately controlled and periodically checked and verified. Expenditures must be authorized properly by budget appropriations and resolutions of the directors or duly authorized officials.

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Segregation by Funds

Legacies, special gifts, and voluntary contributions to the hospital may be classified as restricted or nonrestricted. The institution may use its discretion in determining the purpose of a nonrestricted gift. A restricted gift, however, must be used for the particular purpose or project requested by the donor in accordance with his terms and restrictions. Restricted contributions may be classified as expendable or nonexpendable, the latter becoming endowment funds, the principal of which cannot be drawn upon for current operations.

Webster has defined the word "fund" as a sum of money or stock of convertible wealth employed in, set aside for, or available for a business enterprise or other purpose. Accountants usually refer to the term "fund" as the present balance of a sum received or earned that may be expended for a specific purpose or for general purposes. It will be noted that the present balance of a fund appears on the liability side of the balance sheet, while the cash, securities, or other assets composing the fund are listed on the asset side.

The fund accounts of a hospital are usually divided into four major classifications. The first of these is "Plant and Equipment," which includes the permanent capital assets. This group does not constitute a fund in the accepted sense; nevertheless, it is a convenient segregation. Next come three groups which, strictly speaking, *are* regular funds. They are: "The General Fund," "Current Designated Funds," and "Restricted Funds."

The General Fund represents the unrestricted working capital of the hospital, or the funds available for its current operations. Expendable gifts, donations, contributions, etc., that are unrestricted as to use are credited to General Fund income accounts. Current operating expenses are accordingly debited to General Fund expense accounts.

Current Designated Funds consist of resources given to the hospital for specific purposes, such as medical research. These resources may be restricted as to the period of time in which they may be used, and are not available immediately for general operating purposes.

Restricted Funds consist of permanent resources given to the hospital as a trust, the principal of which must remain intact.

The Need for a Cost System

The cost of operating a hospital has increased so greatly in recent years that it has become essential for hospital administrators to maintain an exact accounting control over functional unit costs. An adequate cost accounting system that will "tie in" properly with the general accounting system will enable hospital administrators to conduct their institution efficiently, and to render the best possible service to their community at the lowest possible cost.

During the past ten years much progress has been made in the standardization of accounting for hospitals, as is now reflected in current financial statements issued by individual institutions. These statements, taken generally however, reflect merely the institution's revenue and expense accounts. There is an urgent need for improvement in comparable statements reflecting standardized departmental costs and service costs. The hospital's expense accounts must serve as a foundation for the analysis of such costs.

The Annual Budget

Gladstone once stated, "Budgets are not merely affairs of arithmetic, but in a thousand ways go to the root of prosperity of individuals, the relation of classes, and the strength of kingdoms." Budget making requires skill in planning administrative work, a thorough knowledge of financial details, and an understanding of the functions and requirements of each department of the institution. The annual budget of the charitable hospital is the authoritative, formal source of all expenditures; it should serve to balance the expenditures with the anticipated revenue. It is a combined expense and cash budget.

The annual budget, as finally drafted and approved by the directors, becomes the basic plan for the operation of the hospital and for the control of all expenditures and receipts for the ensuing fiscal year. The annual budget is subdivided into departments to coincide with the general ledger accounts, so that individual expenditures may be maintained within the limits of the budget. It is apparent that the budget sets a goal (total estimated expenses) to be covered by anticipated revenue.

An efficient cost accounting system will assist materially in the preparation of a practical working annual budget, and in allocating costs to the activities which benefit therefrom.

II. How to Design the Cost System

Objectives of the Cost System

The objectives of a hospital's cost system include the improvement of budgeting, better reporting to the public, governmental agencies, and other interested groups, and provision for a basis for determining accurate costs to patients for services rendered. Further uses for which cost data may be employed are: To compare costs with other hospitals and to develop sound financial policies relative to expansion or contraction of services. Hospital patients will undoubtedly have greater confidence in hospital rates if they know that the rates are based upon a standardized cost accounting system.

An efficient cost accounting system will enable hospital administrators to ascertain which services are costly, and thus to revise their unit rates upward or downward, and further, to effect operating economies wherever practicable.

Considerations in Designing the System

Hospital departments usually function on a daily or a weekly requisition system. The purchasing of supplies should be centralized within one purchasing department for the entire hospital. Supplies requisitioned from inventory should be charged directly to the individual department, which in turn has to account for the inventory of supplies. At the close of the week or month, each department has to take a physical inventory of supplies on hand, and check the physical inventory against its perpetual stock records. The maintenance of a perpetual inventory record of materials and supplies by each department is a comparatively simple matter. Supplies should be charged to each department as operating expenses when the supplies are consumed.

It is important to effect an exact accounting control and a cost analysis over the direct expenses of each department, in order to control over-all expenditures.

Thus, hospital administrators can be kept properly informed as to which department has operated at a profit and which department has operated at a loss.

It is also necessary to distribute hospital overhead costs and the cost of non-revenue bearing units to each revenue department. Many hospitals use the total of the departmental labor and materials costs as the basic denominator for distributing overhead costs. A few hospitals use direct labor costs per department or the floor area per department as the basic denominator for distributing overhead costs.

The objective desired is that the administrators be able to compare operating costs (including apportioned overhead costs) of each unit with the revenue earned by that particular unit, and that they adhere to the policy of fixing rates for each service at a figure that will cover the cost of that service.

Organization of Hospital

The organization of the modern hospital may be divided into five major departments or units:

I. *General Service Department:*
- Administration
- Dietary and Steward's Department
- Household
- Linen and Sewing Service
- Laundry
- Operation of Plant
- Maintenance Personnel
- Receiving and Storeroom

II. *Professional Care of Patients Department—General Service:*
- Medical and Surgical Care
- Nursing Care
- School of Nursing
- Pharmacy
- Central Sterile Supply Department
- Medical Records and Library
- Social Service
- Occupational Therapy
- Follow-up Department
- Photographic Department

III. *Professional Care of Patients Department—Special Service:*
- Operating Room
- Delivery Room
- Anesthesia Department
- X-ray Department
- X-ray Therapy
- Laboratory
- Physical Therapy
- Ambulance Service
- Oxygen Therapy
- Electrocardiography
- Metabolism

IV. *Out-Patient Department and Emergency Service*

V. *Other Departments:*
Religious Services
Research and Education
Non-hospital Services

It is noted that a small hospital may be able to operate with only 25 or 30 expense accounts. The chart of accounts may be made more elaborate for larger hospitals by expanding or subdividing these accounts.

It is important that all hospitals in each State adopt the practice of including the same expenses within the same group of accounts as outlined above, for the purpose of building up cost figures that will be subject to intelligent comparison with other hospitals.

Donated Services

It is advisable that the hospitals calculate the financial worth of the "free and part-pay" service being rendered by part-time or full-time employees, by way of comparing the income from patients with its total operating expenses. Their services should be based upon wage scales prevailing in the community.

The "free service" should then be analyzed between in-patients and out-patients. In this way, the officials can determine the proportionate value of hospital services that are given "free" to patients.

When credits are made to the Donated Service account, corresponding debits should be made to the salary expense accounts appearing within the various departments.

Depreciation of Plant and Equipment

For some time in the past, authorities had recommended that hospitals ignore depreciation of buildings as a proper item of operating expense.

There is, however, an increasing trend of thought toward favoring the recording of depreciation as a necessary and proper operating expense. It is to be noted that the Emergency Maternity and Infant Care Program administered by the Children's Bureau of the U. S. Department of Labor and The New York State Compensation Board have, for many years, recognized depreciation of buildings as an operating cost.

There should be no question as to depreciating small equipment over its expected life, this depreciation to be charged as a direct expense of operating each department.

III. Description of the Cost Accounting System

The important steps to be taken in designing a cost accounting system for a hospital may be outlined as follows:

1. Design a detailed chart of accounts (Schedule 1).
2. Design a Statement of General Fund Expenses (Schedule 2).
3. Determine the various bases for distributing indirect expenses to individual departments.
4. Design a worksheet for basic apportionment of General Service Department Expenses (Schedule 3) on a percentage basis.
5. Design a worksheet for apportionment of Indirect Expenses (Schedule 4).
6. Determine the various bases for computing average costs of general service department.

Schedule 1 presents a detailed chart of the operating expense accounts pertaining to the cost system outlined in this article.

After having prepared the Statement of General Fund Expenses (Schedule 2), the accountant must distribute the indirect expenses to individual departments. This step is essential since he must add the indirect expenses to the direct departmental expenses before he determines final departmental costs and unit costs. The costs of nonrevenue producing departments must be absorbed by the revenue producing departments.

It is apparent that the indirect expenses of the general service department are distributed by using one or more of five bases: Analysis of service, area of department, payroll of the department, meals served in the department, laundry used.

Schedule 3 presents a worksheet for the basic apportionment of the expenses of the general service department, on a percentage basis. By means of this percentage worksheet, the accountant is able to determine what it costs each departmental unit to serve each of the remaining departments.

It is noted that each unit's own direct expense is first charged to that unit by listing that account's percentage as an undistributed department expense item on the last line of the schedule, the remaining percentage being apportioned as indirect expense to the other departments.

In preparing the Worksheet for Apportionment of Indirect Expenses, Schedule 4, the accountant first records each department's "direct expense," as indicated in the Statement of General Fund Expenses, in the column headed "Total Direct Expenses." The total amount of each department's indirect expenses is recorded in the total line and then distributed to the individual units on the percentage basis as previously computed in Schedule 3. The amounts recorded in the column headed "Total Expenses" will therefore agree with the amounts shown in the Statement of General Fund Expenses.

The advantages of these detailed worksheets are self-evident. Hospital officials can be informed quickly as to the aggregate cost of operating any department or unit, both as to direct expenses and apportioned indirect expenses. They can be informed quickly as to the average cost of operating each unit per employee.

For example, the cost of the social service department can be analyzed as follows:

Total Salaries	$
Total Supplies and Expenses	
Total Direct Expenses	$
Add Indirect Expenses (apportioned):	
Administration	
Dietary and Steward	
Household	
Linen and Sewing Department	
Laundry	
Operation of Plant	
Maintenance of Plant	
Total Indirect Expenses	$
Total cost of Social Service Department	$

An in-patient is defined as "any person housed in the hospital who occupies a regular bed."

An out-patient is defined as "a person who receives services in the regularly organized out-patient department or clinic, and does not occupy a hospital bed. Private ambulatory patients and accident patients are not included as out-patients."

The production unit in the hospital is the care of one patient in a single day, or the "patient day."

The American Hospital Association has defined a patient day as follows:

"A patient day is that period of service rendered a patient between the census taking hours on two successive days, the day of discharge being counted only when the patient was admitted the same day."

The number of in-patient days is arrived at through the following calculation, as instructed by the New Jersey Hospital Association: "To the midnight census at the beginning of the day add one patient day for each admission and deduct one patient day for each discharge during the day; to this total add one patient day for each patient who has been both admitted and discharged during the day. For patients both admitted and discharged between one daily census and another, a day of care is to be recorded, provided the patient is admitted, occupies a hospital bed and has a hospital chart originated."

In order to compute daily per capita costs, one must divide the current operating expenditures by the total hospital in-patient days. This computation applies only to in-patients and not to out-patients. An apparent increase in per-capita operating costs may be due to the fact that the hospital is giving increased special services such as X-ray and physical therapy.

The New Jersey Hospital Association has recommended the following method of determining the over-all operating cost-per-patient day:

A. Total operating expenses of the hospital		$
B. Less: $1.00 for each out-patient visit as defined	$	
60% of the charges billed to private ambulatory patients	$	
C. Balance representing net current in-patient operating costs		$
D. Ascertain the total in-patient days, by adding to the adult and children in-patient days one fourth of new born patient days.		
E. Daily per-capita cost equals Item C divided by Item D		$

After having completed Schedule 3 and 4, the accountant is ready to prepare his worksheet for the final apportionment of expenses to comparable services:

Private Patients
Semi-Private Patients
Ward Patients
Out-Patients
Total Patients

SUGGESTED UNIT FOR COMPUTING AVERAGE COST

GENERAL SERVICE DEPARTMENTS

Department or Service	*Suggested Base for Computing Average Cost*
Administration	Departmental payroll expenditures
Dietary	Served meals
Maintenance of Personnel	Number of employees residing in each department
Maintenance of Building, Grounds and Equipment	Man hours of service rendered or area
Operation of Plant	Area Electricity, kilowatt-hour Coal, pounds Oil, gallons Ice, tons Steam, thousand pounds
Laundry	Pounds or pieces processed
Household	Area

SPECIAL SERVICE DEPARTMENTS

Ambulance	Number of miles, trips, or calls
Physical Therapy X-Ray Therapy Oxygen Therapy	Number of treatments
Electrocardiography Laboratory	Number of examinations
Metabolism	Number of tests
X-Ray	Number of fluoroscopics, examinations or films
Delivery Room	Number of deliveries
Operating Room	Number of major and minor operations

The use of this cost accounting system will enable hospital administrators to determine the average cost for each unit of service and the average cost for each type of patient and thereby to compare unit operating costs with their departmental income.

It should be noted that the Department of Social Welfare of New York State has recommended the advisability of making the following important distinctions in computing per capita costs:

1. "Expense incurred by all hospitals in their services to patients as distinguished from expense not generally incurred by hospitals for their service to patients, such as interest on long-term indebtedness (bonds, mortgages, etc.), depreciation of buildings and equipment, taxes, rent and expense of non-hospital activities.
2. "Expense for in-patient service as distinguished from all expense of services to out-patients.
3. "Expense of day-rate service as distinguished from the expense for special services such as operating and delivery rooms, X-ray, laboratory, and other services.
4. "Expense of day-rate service to ward patients as distinguished from expense of day-rate services to other patients."

Cost Accounting for Meals

The function of the food cost accounting system is to enable hospital officials to furnish the best quality meals consistent with their established policy at the lowest possible cost.

Accordingly, a good cost accounting system should strive to do away with waste of food and leakages, yet not lower the portions or quality of food.

One person should be held responsible for checking in the weight of foods, as to quality, quantity, and recording the merchandise received on "receiving memos." The purchase invoice should be carefully checked by another employee against the receiving record for price.

At the close of each month or week a physical inventory should be taken and food consumed determined by use of opening and closing inventories.

It is a simple calculation to divide the number of meals served into the total cost of food consumed in the month to arrive at the average cost of each meal which is the unit cost desired. Many hospitals fail to make this basic computation to determine whether the current monthly average cost is out of line with preceding periods. However, it is advisable for the accountant to go further, and establish standard costs per day.

Personnel meals should be charged to the services in which employees work, on the basis of the number of meals served to such employees.

Food cost accountants hold that large hospitals can effect worthwhile economies in food purchasing, if they will purchase meat in commercial cuts, or untrimmed, especially for ward patients and for employees. For example, the purchase of lamb roasts instead of chops will be found more economical, without reducing the quality of food.

The head of the dietetic department should constantly compare the daily record of meals served and portions produced with the food cost record for the purpose of reducing waste in overproduction of food portions in the kitchen resulting in food spoilage.

Hospital officials will be enabled to compute statistical costs such as the following very readily:

AVERAGE COST PER PATIENT

No. of Patients		*Average Cost per Patient*
520	Private Patients	
310	Semi-Private Patients	
1,260	Ward Patients	
1,135	Out-Patients	
3,225	Total Patients	%

With the assistance of an exact accounting control over functional unit costs, hospital administrators will operate more efficiently and render the best possible service to their community at the lowest possible cost.

SCHEDULE 1

CHART OF ACCOUNTS

I—GENERAL SERVICE DEPARTMENT

Service	*Salaries and Wages*	*Supplies and Expenses*	*Total*
1. Administration	Executives, admission office, accounting and clerical offices, stenographers, purchasing agent, storekeepers, watchmen, collection department, personnel department.	Insurance, office supplies and expenses, telephone and telegraph, legal and auditing fees, taxes, dues and publications, collection expense, storeroom expense.	
2. Dietary and Steward's Department	Cooks and assistants, dietitian, kitchen staff, waitresses, and service room helpers.	Silverware, linens, dishes, uniforms, kitchen equipment and supplies, repair of kitchen room and service rooms and equipment, dining rooms and pantries.	
3. Household	Housekeeper, maids, and porters.	Equipment, household supplies, repair of equipment, tools, window-washing, brooms and mops, towels, etc.	
4. Linen and Sewing Room	Seamstresses, and linen room employees.	Linen and sewing room supplies, bedding, mattresses, repair of equipment.	
5. Laundry	Laundry employees.	Laundry soap and powder, irons, starch, outside laundering, repair of equipment.	
6. Operation of Plant	Engineers, firemen, elevator operators, and porters.	Light, heat and power, fuel, oil, bulbs, ice, repair of plant and equipment.	
7. Maintenance Personnel	Carpenters, plumbers, electricians, painters, gardeners, handy men.	Material for building repairs, building supplies, gardening tools and supplies, furniture and fixture repairs.	

SCHEDULE 1 (Continued)
CHART OF ACCOUNTS (Continued)

II—PROFESSIONAL CARE OF PATIENTS—GENERAL SERVICE

Service	*Salaries and Wages*	*Supplies and Expenses*	*Total*
1. Medical and Surgical Care	Physicians and interns caring for in-patients and employees not provided for elsewhere.	Uniforms, regular medical supplies such as bandages, gauze, etc., and repairs to equipment charged to in-patients.	
2. Nursing Care	Nursing administration, ward supervisors, general nurses, and assistants assigned to care for in-patients.	Uniforms, office expense, and repairs.	
3. School of Nursing	Instructors, administrative officers, and office salaries.	Student uniforms, textbooks, and repairs.	
4. Pharmacy	Pharmacists, clerks, and assistants.	Chemicals and drugs, supplies such as glassware and utensils, and repairs.	
5. Central Sterile Supply	Graduate nurses, employee technicians, and maids.	Supplies such as bandages and gauze, sterile expenses and repairs.	
6. Medical Records and Library	Librarian and medical record clerks.	Regular office supplies, periodical subscriptions, and repairs.	
7. Social Service	Senior and junior social workers and clerical staff.	Office, travel, recreation of patients, and repairs.	
8. Occupational Therapy	Occupation therapists and aides.	Office and special supplies as well as repairs of equipment.	
9. Follow-up	Graduate nurses and office personnel.	Office and repairs.	
10. Photographic	Photographer and assistants.	Film, developing equipment, and repairs.	

SCHEDULE 1 (Continued)

CHART OF ACCOUNTS (Continued)

III—PROFESSIONAL CARE OF PATIENTS—SPECIAL SERVICE

Service	*Salaries and Wages*	*Supplies and Expenses*	*Total*
1. Operating Room	Supervisors, nurses, and attendants.	Linen, surgical supplies and utensils, and repairs.	
2. Delivery Room	Supervisors, nurses, and orderlies.	Linen, surgical supplies and utensils, and repairs.	
3. Anesthesia	Anesthetists and assistants.	Anesthesia drugs and chemicals, and repairs.	
4. X-ray	Roentgenolists and technicians.	Office, films and special equipment, and repairs.	
5. X-ray Therapy	Radiologist and assistants.	Tubes and repairs of equipment.	
6. Laboratory	Pathologists, biochemists, bacteriologists, serologists, and aides.	Animal expenses for experimentation, drugs, glassware, and repairs.	
7. Physical Therapy	Physical therapists and technicians.	Special supplies and repairs.	
8. Ambulance Service	Chauffeurs, interns, and orderlies.	Auto expense, garage rent, fees, licenses, and repairs.	
9. Oxygen Therapy	Nurses and technicians.	Oxygen, special supplies, and repairs.	
10. Electrocardiograph	Nurses and technicians.	Special supplies and repairs.	
11. Metabolism	Nurses and technicians.	Oxygen and repairs.	

SCHEDULE 1 (Continued)
CHART OF ACCOUNTS (Continued)

IV—OUT-PATIENT DEPARTMENT

Service	*Salaries*	*Supplies and Expenses*	*Total*
1. Out-Patient Department	Administrative head, professional staff, resident interns, nurses, orderlies, clerks, and nurses aides.	Supplies for out-patient department, repairs to equipment.	

V—OTHER DEPARTMENTS

1. Religious Services	Chaplains, singers, and musicians.	Books, music, flowers, chapel equipment, repairs to equipment.	
2. Research and Education	Administrative staff, teachers, research employees, and clerks.	Books, stationery and printing, office supplies, repair of equipment.	
3. Non-Hospital Services a. Gift Shop b. Barber Shop and Beauty Parlor c. Radio Service	Employees, of gift shop, barber shop, beauty parlor, and radio service.	Small equipment, supplies, direct expenses apportioned to this department, repair of equipment.	

SCHEDULE 2

GENERAL HOSPITAL

STATEMENT OF GENERAL FUND EXPENSES

Department	Direct Expenses			Revised Total After Basic Apportionment
	Salaries	Other Expenses	Total	
I. *General Service Department:*				
Administration	$	$	$	$
Dietary & Steward's Department				
Household				
Linen and Sewing Service				
Laundry				
Operation of Plant				
Maintenance Personnel				
Subtotal	$	$	$	$
II. *Professional Care of Patients Department —General Service:*				
Medical and Surgical Care	$	$	$	$
Nursing Care				
School of Nursing				
Pharmacy				
Central Sterile Supply Department				
Medical Records and Library				
Social Service				
Occupational Therapy				
Follow-up Department				
Subtotal	$	$	$	$
III. *Professional Care of Patients Department —Special Service:*				
Operating Room	$	$	$	$
Delivery Room				
Anesthesia Department				
X-ray Department				
X-ray Therapy				
Laboratory				
Physical Therapy				
Ambulance Service				
Oxygen Therapy				
Electrocardiograph				
Metabolism				
Subtotal	$	$	$	$
IV. *Out-Patient Department*				
V. *Other Departments:*				
Religious Services	$	$	$	$
Research and Education				
Non-Hospital Services				
Total Department Expenses	$	$	$	$
Other Expenses:				
Interest Expense	$	$	$	$
Depreciation				
Provision for Bad Debts				
Subtotal	$	$	$	$
Total General Fund Expenses	$	$	$	$

SCHEDULE 3

WORK SHEET FOR BASIC APPORTIONMENT
OF GENERAL SERVICE DEPARTMENT EXPENSES
ON PERCENTAGE BASIS

	Administration	Dietary & Steward	Household	Linen & Sewing	Laundry	Operation of Plant	Maintenance of Plant		Total Per Cent
General Service Department:									
Administration									
Dietary and Steward's Department									
Household									
Linen and Sewing Department									
Laundry									
Operation of Plant									
Maintenance Personnel									
Subtotal									
Professional Care—General Department:									
Medical and Surgical Care									
Nursing Care									
School of Nursing									
Pharmacy									
Central Sterile Supply Co.									
Medical Records and Library									
Social Service									
Occupational Therapy									
Follow-up Department									
Photographic Department									
Subtotal									

SCHEDULE 3 (Continued)

WORK SHEET FOR BASIC APPORTIONMENT
OF GENERAL SERVICE DEPARTMENT EXPENSES
ON PERCENTAGE BASIS

	Administration	Dietary & Steward	Household	Linen & Sewing	Laundry	Operation of Plant	Maintenance of Plant		Total Per Cent
Professional Care—Special Department:									
Operating Room									
Delivery Room									
Anesthesia Department									
X-ray Therapy									
Laboratory									
Physical Therapy									
Ambulance Service									
Oxygen Therapy									
Electrocardiograph									
Metabolism									
Subtotal									
Out-Patient Department									
Other Departments:									
Religious Services									
Research Department									
Non-Hospital Services									
Subtotal									
Total Per Cent									
Add: Undistributed Department Expense									
Total (100%)									

SCHEDULE 4

WORK SHEET FOR APPORTIONMENT OF INDIRECT EXPENSES

	Administration	Dietary & Steward	Household	Linen & Sewing	Laundry	Operation of Plant	Maintenance	Total Indirect Expenses	Total Direct Expenses	Total Expenses
General Service Department:										
Administration										
Dietary and Steward's Department										
Household										
Linen and Sewing Department										
Laundry										
Operation of Plant										
Maintenance Personnel										
Subtotal										
Professional Care—General Department:										
Medical and Surgical Care										
Nursing Care										
School of Nursing										
Pharmacy										
Central Sterile Supply Co.										
Medical Records and Library										
Social Service										
Occupational Therapy										
Follow-up Department										
Photographic Department										
Subtotal										

SCHEDULE 4 (Continued)

WORK SHEET FOR APPORTIONMENT OF INDIRECT EXPENSES

	Administration	Dietary & Steward	Household	Linen & Sewing	Laundry	Operation of Plant	Maintenance	Total Indirect Expenses	Total Direct Expenses	Total Expenses
Professional Care—Special Service:										
Operating Room										
Delivery Room										
Anesthesia Department										
X-ray Department										
X-ray Therapy										
Laboratory										
Physical Therapy										
Ambulance Service										
Oxygen Therapy										
Electrocardiograph										
Metabolism										
Subtotal										
Out-Patient Department										
Other Departments:										
Religious Services										
Research Department										
Non-Hospital Services										
Subtotal										
TOTAL										

COST ACCOUNTING FOR HOTELS AND CLUBS

By
ALLAN C. GEORGE *

I. DESCRIPTION OF THE BUSINESS

Hotels and clubs are similar in many respects with regard to the services, facilities, and accommodations furnished. The revenue of hotels is derived from charges for services rendered to the public and for space occupied by tenants and concessionaires; whereas in clubs the services are generally restricted to the use of members and their guests. Clubs, in addition to charges made to members and guests for services rendered, are generally supported by additional payments by members in the form of dues, assessments, and initiation fees. Many clubs furnish facilities and services for the benefit of members, such as athletic facilities, libraries, lounges, meeting rooms, etc., which extend beyond the services customarily given by hotels.

Classification of Hotels

Hotels may be divided into three general classifications as follows:

Commercial and transient hotels—in which the major part of the rooms and other accommodations are offered to transient guests on a daily rental basis.

Residential hotels—in which over 50% of the rentals are offered for longer term occupancy than commercial and transient hotels, with the result that the majority of the rentals are on a monthly or annual basis. Such hotels rent accommodations in the form of single rooms or suites of rooms which may be unfurnished, partly furnished, or fully furnished. They differ from apartment houses in that the rentals include such hotel services as maid, linen, cleaning, telephone, office, and others, and generally a restaurant is maintained in connection with the hotel.

Resort hotels—operate primarily on a seasonal basis. Meals may be included in the price paid for the accommodations, which is known as the American Plan, or the room accommodations may be rented separately on the European Plan. Resort hotels may also have many additional facilities for recreation, such as golf courses, swimming pools, livery stables, beach facilities, etc.

Hotels and clubs vary considerably within each classification as to size and the number and variety of services and facilities furnished. Hotels may be of the simple inn type with only a few rooms and with very limited facilities for the service of food and a few other related facilities, or they may consist of a very large and complex structure containing as many as two thousand rooms with elaborate public spaces, a variety of rooms for service of food and beverages, and many other facilities designed to cater to the needs of the guests of the hotel and the social activities of the community. Similarly, clubs vary considerably as to their size and scope of activities, from small social and luncheon clubs to very elaborate country or city clubs with many varied activities. In some respects, country clubs may be similar

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to large resort hotels, and large city athletic social clubs may be comparable with hotels as to the scope of their facilities and accommodations.

Services and Products

The principal services and products of hotels and clubs are the sale of space and services related thereto in the form of the rental of rooms, and the preparation of food and beverages into the form of meals and refreshments and the sale thereof in public dining rooms, banquet rooms, bars, etc. Many hotels and clubs also sell merchandise, such as cigars, newspapers, candy, gifts, and sundry articles; and furnish services, such as telephone, valet, laundry, checking baggage and porter service, barber and beauty shop services, flowers, baths, swimming pools, etc.

II. How to Design the Cost System

What Information Is Required

The standard cost accounting systems generally used in manufacturing industries are not applicable, as such, to hotels and clubs. Due to the variety of services and activities of hotels and clubs, an over-all cost accounting system cannot be used but cost accounting methods are adaptable to various phases of their operations.

In hotels and clubs, the accounting and cost systems are very closely interrelated. In the smaller operations, the functions of a cost system may be contained entirely within the structure of a standard accounting system, particularly if the accounting records and controls are supplemented by the personal direction and attention of the proprietor or management. As personal services are the principal product of hotels and clubs, the most effective control of costs is obtained by proper supervision by the management and the supervisory staff. Accordingly, assuming that a hotel or club is properly organized for efficient managerial supervision, the primary purpose of the cost system is to furnish the management with necessary cost data, at a minimum of expense, consistent with the particular circumstances affecting each phase of the operation.

Considerations in Designing System

The cost system, applicable to each type and style of operation, should be designed according to the following principles:

1. The accounting system should be set up in accordance with the Uniform System of Accounts for Hotels or a standard accounting system for clubs.
2. Adequate accounting controls should be maintained over the various types of income and expenses with due consideration to maximum internal controls wherever possible.
3. There should be a proper system for ordering, receiving, storing, recording, and controlling materials and supplies.
4. Specific cost accounting systems should be installed where required in phases of the operations, such as food, beverages, merchandise sales, service charges, engineering and utility costs, repairs and maintenance, etc.
5. An adequate system of payroll records and controls should be maintained.
6. Statistical and cost data should be systematically compiled as one of the most effective tools of management.

III. Description of Cost Methods

Uniform System of Accounts for Hotels

The Uniform System of Accounts for Hotels was devised in 1925 by a committee of hotel and public accountants and endorsed by the principal hotel associations. It has been widely adopted by hotels. The summary form of profit-and-loss statement under the Uniform System is given as Figure 1. While this system of accounts is all-inclusive for the needs of large as well as small hotels, a variation thereof known as the Simplified System of Accounts for Small Hotels is available for smaller hotels whose activities may not require the more extensive form of accounts. The recommended profit-and-loss statement under this system is given as Figure 2.

The Uniform System of Accounts for Hotels is designed to reflect the results of the various operating departments, both income producing and service departments, into which the average hotel is divided. The accounts are stated on a departmental basis with the results of each department shown after deducting from the direct income, the direct costs and expenses thereof. In the Uniform System no allocation is made to the principal income producing departments, such as rooms, food and beverages, of any proportion of the so-called overhead and indirect expenses, which are classified as administrative and general, payroll taxes and employee relations, advertising and business promotion, heat, light, and power, and repairs and maintenance, nor is any allocation made of capital expenses comprising real estate taxes, interest, depreciation, etc.

Attempts have been made to arrive at allocations of overhead, indirect expenses, and capital expenses to the income producing departments by various methods, or a combination of several methods—such as by the square feet of space used; by estimating the amount of time devoted to the various activities and services; or by estimating or measuring by meters various utility services. However, all such methods have fallen down mainly because of the complexities involved and recognition of the fact that the variation in the basis of such allocations by the hotels would destroy the principal of uniformity that was the outstanding accomplishment of the Uniform System.

In order to obtain the benefits of uniformity in classification of accounts with other hotels and the universal understanding of hotel accounts provided thereby, all hotels should keep their books according to the Uniform System of Accounts for Hotels. However, in order to calculate operating costs of the larger departments any individual hotel can make an allocation of overhead costs, indirect and capital expenses on a basis most applicable to the particular circumstances and conditions. In order not to disturb the Uniform System, such allocations should not be recorded on the general books and accounts but should be in the form of analytical and statistical data prepared for the use of management.

Rather than become involved in complex allocations of such costs under various detailed methods which might be used, two simple methods are recommended:

1. If, as in the case of many residential hotels and some smaller hotels, the room business is by far the dominant income producing department, it is suggested that the departmental profits from all other income producing departments, such as food and beverages and other sources of income, be treated as an offset to the total

HOTEL

SUMMARY OF PROFIT AND LOSS

	Schedule	Month of (Current Month)	Month of (Previous Year)	Year to Date (Current Year)	Year to Date (Previous Year)
Rooms Department:					
Rooms Sales		$	$	$	$
Rooms Expenses					
Salaries and Wages		$	$	$	$
Other Rooms Expenses					
Total Rooms Expenses		$	$	$	$
Rooms Department Profit	"B-1"	$	$	$	$
Other Operated Departments:					
Food and Beverages	"B-2"	$	$	$	$
Cigar Stand	"B-3"				
News Stand	"B-4"				
Candy and Soda Shop	"B-5"				
Telephone	"B-6"				
Valet	"B-7"				
Check Rooms and Wash Rooms	"B-8"				
Porters	"B-9"				
Barber Shop	"B-10"				
Beauty Parlor	"B-11"				
Baths	"B-12"				
Florist	"B-13"				
Guests Laundry	"B-14"				
Total Other Operated Profits		$	$	$	$
Total Operated Departments Profits		$	$	$	$
Other Income	"B-15"				
Gross Operating Income		$	$	$	$

Deductions from Income:					
Administrative and General Expenses	"B-16"				
Payroll Taxes and Employee Relations	"B-17"				
Advertising and Business Promotion	"B-18"				
Heat, Light, and Power	"B-19"				
Repairs and Maintenance	"B-20"				
Total Deductions from Income		$	$	$	$
House Profit		$	$	$	$
Store Rentals	"B-21"				
Gross Operating Profit		$	$	$	$
Rent, Taxes, and Insurance	"B-22"				
Profit Available for Interest and Depreciation		$	$	$	$
Interest	"B-22"				
Profit before Depreciation		$	$	$	$
Depreciation and Amortization	"B-22"				
Net Operating Profit (or Loss) for Period		$	$	$	$
Other Additions and Deductions	"B-23"				
Net Profit (or Loss) before Income Taxes		$	$	$	$

Fig. 1. Summary of Profit and Loss.

"Uniform System of Accounts for Hotels"

HOTEL
NEW YORK
PROFIT AND LOSS STATEMENT

	Current Period		Current Period
Rooms:		Gross Income (Brought Forward)	$
Sales	$	Deductions from Income:	
Expenses:		General Expenses	$
Payroll	$	Advertising	
Other Expenses		Heat, Light, and Power	
Total Expenses	$	Repairs and Maintenance	
Departmental Profit	$	Total Deductions	$
Food:		House Profit	$
Sales	$	Store Rentals	$
Expenses:		Gross Operating Profit	$
Cost of Food	$	Taxes, Insurance, and Interest:	
Payroll		Taxes (Real Estate, Property, etc.)	$
Other Expenses		Insurance on Building and Contents	
Total Expenses	$	Interest on Mortgage	
Departmental Profit	$	Interest on Notes	
Beverages:		Total Taxes, Insurance, and Interest	$
Sales	$	Profit before Charging Depreciation	$
Expenses:		Depreciation:	
Cost of Beverages		Building	$
Payroll		Furniture and Equipment	
Other Expenses		Total Depreciation	$
Total Expenses	$	Net Profit before Income Taxes	$
Departmental Profit	$		
Cigar Stand:			
Sales	$		
Cost of Goods Sold			
Departmental Profit	$		
Telephone:			
Sales	$		
Cost of Service			
Departmental Loss	$		
Other Income	$		
Gross Income (Carried Forward)	$		

Note: Additional Columns showing Percentages to Sales and Operating Results of Comparative Period in Previous Year may be added if desired.

Fig. 2. Profit-and-Loss Statement.
"Simplified System of Accounts for Small Hotels"

operating costs of the hotel in a similar manner to the treatment of income from by-products in many industries.

2. Where the operations of the food and beverage or any other income producing department are of sufficient importance, segregation of overhead, indirect and capital expenses as between the rooms and the other important income producing departments is certainly desirable. In such cases, it is recommended that the food and beverage department or other important departments be analyzed as if they were separate businesses comparable with similar businesses operated independently. For example, the food and beverage department of the hotel can be compared with a separate restaurant operation and the allocation of overhead, indirect and capital expenses made on the basis of standards or experience applicable to such separate businesses. An illustration of this method of allocating overhead, indirect, and capital expenses is given in the computations contained in Figure 3.

Standard System of Accounts for Clubs

A standard system, very similar to that of the Uniform System of Accounts for Hotels, is used in larger clubs. This system of accounts is based on the same principles of departmental classification of accounts as the Uniform System of Accounts for Hotels. While the number of operated departments will vary with the type and size of clubs, an illustration of a "Comparative Statement of Operations" for clubs is given in Figure 4.

Accounting Controls

Accounting controls in hotels and clubs will vary considerably with the scope and size of each operation. Fundamentally, proper controls are required over the various sources of revenue, particularly in the accounting for sales of rooms, food, and beverages. The reader is referred to the discussion of this subject contained in the chapter on "Accounting for the Hotel Industry" in the *Handbook of Accounting Methods.*

Control of Materials and Supplies

Materials and supplies consumed by hotels and clubs are an important factor of their costs. A proper system of ordering, receiving, storing, issuing, recording and controlling thereof is required. Materials and supplies in this category include foodstuffs, particularly package and canned goods; liquor and beverages; linen, china, glass and silver; engineering and mechanical supplies; and sundry supplies, such as printing, stationery, cleaning materials, etc. It is desirable to use an approved form of purchase order, together with an adequate system of receiving merchandise and the record keeping in connection therewith. Important supplies should be safeguarded in suitable storeroom space and issued therefrom according to a standard system of control and recording. Wherever it is considered desirable, perpetual inventory records should also be maintained in standard form.

Specific Cost Accounting Systems

The need for specific cost accounting systems with respect to particular phases of the operation of hotels and clubs will vary with the size of the operation and the degree of management control and direct supervision of each activity. The application of cost systems to the more important phases of operation will be discussed under separate headings.

STATEMENT 1

ANALYSIS OF COSTS APPLIED TO ROOMS OPERATIONS

Rooms Operations per Available Room	Transient Hotels All Sizes		Transient Hotels 50 to 100 Rooms		Transient Hotels 101 to 300 Rooms	
	1945	1942	1945	1942	1945	1942
Direct and Indirect Expenses Applicable to Entire Hotel:						
Rooms Department Direct Expenses	$ 435.91	$ 286.93	$ 302.54	$ 193.51	$ 361.73	$ 236.78
Telephone Net Cost	7.06	5.48	5.62	6.67	8.94	5.48
Administrative and General	281.55	187.13	157.86	114.55	256.92	179.75
Advertising and Business Promotion	56.17	58.99	17.42	20.72	37.05	29.79
Heat, Light, and Power	150.18	122.15	79.42	69.59	142.37	116.77
Repairs and Maintenance	203.72	109.47	96.11	54.07	155.11	79.84
Fire Insurance and Franchise Taxes	19.69	11.15	11.84	11.00	15.25	10.82
Total	$1,154.28	$ 781.30	$ 670.81	$ 470.11	$ 977.37	$ 659.23
Less: Amount Equal to 10% of Food and Beverage Sales for Estimated Overhead and Indirect Expenses of Food and Beverage Operations	182.02	113.69	120.60	81.43	162.98	101.18
Balance of Direct and Indirect Expenses Applicable to Rooms Operations	$ 972.26	$ 667.61	$ 550.21	$ 388.68	$ 814.39	$ 558.05
Capital Expenses Applicable to the Entire Hotel:						
Real Estate Taxes	$ 114.83	$ 116.01	$ 48.14	$ 45.62	$ 70.36	$ 68.31
Depreciation—Estimated	183.73	185.62	77.02	72.99	112.57	109.30
Interest—Estimated	91.86	92.81	38.51	36.50	56.29	54.65
Total Capital Expenses	$ 390.42	$ 394.44	$ 163.67	$ 155.11	$ 239.22	$ 232.26
Less: Amount Estimated for Capital Expenses for Restaurant Operations (Real Estate Taxes, Interest and Depreciation of Building) Estimated Depreciation of Restaurant Equipment	$ 56.84	$ 56.84	$ 40.72	$ 40.72	$ 50.09	$ 50.09
	22.74	22.74	16.28	16.28	20.04	20.04
Total (See Note)	$ 79.58	$ 79.58	$ 57.00	$ 57.00	$ 70.13	$ 70.13
Balance of Capital Expenses Applicable to Rooms Operations	$ 310.84	$ 314.86	$ 106.67	$ 98.11	$ 169.09	$ 162.13
Total Direct, Indirect and Capital Expenses Applicable to Rooms Operations	$1,283.10	$ 982.47	$ 656.88	$ 486.79	$ 983.48	$ 720.18
Sales and Income:						
Average Yearly Rental Income per Available Room	$1,483.04	$ 985.26	$ 825.49	$ 570.72	$1,202.03	$ 856.52
Store Rentals Income	52.07	38.46	24.49	23.10	39.42	28.27
Other Income and Minor Operated Departments	97.39	71.93	34.71	37.61	60.74	41.02
Total Sales and Income	$1,632.50	$1,095.65	$ 884.69	$ 631.43	$1,302.19	$ 925.81
Net Rooms Operations Profit per Available Room	$ 349.40	$ 113.18	$ 227.81	$ 144.64	$ 318.71	$ 205.63
Percentage to Total Sales and Income as Above	21%	10%	26%	23%	24%	22%

Note: Capital Expenses for Restaurant and Depreciation of Restaurant Equipment have been estimated at 5% and 2%, respectively, of 1942 food and beverage sales, which are used as the standard for this illustration.

STATEMENT 2

ANALYSIS OF COSTS APPLIED TO FOOD AND BEVERAGE OPERATIONS

Food and Beverage Operations	Transient Hotels All Sizes		Transient Hotels 50 to 100 Rooms		Transient Hotels 101 to 300 Rooms	
	1945	1942	1945	1942	1945	1942
Food and Beverage Sales per Available Room	$1,820.20	$1,136.87	$1,206.04	$ 814.32	$1,629.82	$1,011.80
Food and Beverage Direct Expenses	1,378.16	893.59	921.01	668.98	1,252.66	811.77
Food and Beverage Profit before Overhead, Indirect and Capital Expenses	$ 442.04	$ 243.28	$ 285.03	$ 145.34	$ 377.16	$ 200.03
Deductions:						
Estimated Overhead and Indirect Expenses (10% of Food and Beverage Sales)	$ 182.02	$ 113.69	$ 120.60	$ 81.43	$ 162.98	$ 101.18
Estimated Capital Expenses (Real Estate Taxes—Interest—Depreciation of Building)	56.84	56.84	40.72	40.72	50.09	50.09
Estimated Depreciation of Restaurant Equipment	22.74	22.74	16.28	16.28	20.04	20.04
Total Deductions	$ 261.60	$ 193.27	$ 177.60	$ 138.43	$ 233.11	$ 171.31
Net Food and Beverage Operations Profit per Available Room	$ 180.44	$ 50.01	$ 107.43	$ 6.91	$ 144.05	$ 28.72

STATEMENT 3

SUMMARY ANALYSIS OF HOTEL OPERATING RESULTS AFTER ALLOCATION OF COSTS AS ABOVE

Combined Operations	Transient Hotels All Sizes		Transient Hotels 50 to 100 Rooms		Transient Hotels 101 to 300 Rooms	
	1945	1942	1945	1942	1945	1942
Profit per Available Room per Year After Real Estate Taxes But Before Other Capital Expenses	$ 805.43	$ 441.62	$ 450.77	$ 261.04	$ 631.62	$ 398.30
Less: Estimated Interest and Depreciation	275.59	278.43	115.53	109.49	168.86	163.95
Profit per Available Room Before Federal Income Taxes	$ 529.84	$ 163.19	$ 335.24	$ 151.55	$ 462.76	$ 234.35
Sources of This Profit as Computed:						
Rooms Operations, Statement 1	$ 349.40	$ 113.18	$ 227.81	$ 144.64	$ 318.71	$ 205.63
Food and Beverage Operations, Statement 2	180.44	50.01	107.43	6.91	144.05	28.72
Total	$ 529.84	$ 163.19	$ 335.24	$ 151.55	$ 462.76	$ 234.35

Fig. 3. Statements Showing Allocation of Overhead and Capital Expenses to Rooms and Food Operations.

Club

Comparative Statement of Operations

	Schedule	Month of (Current Month)	Month of (Previous Year)	Year to Date (Current Year)	Year to Date (Previous Year)
Operated Departments and Other Income:		$	$	$	$
Rooms Department	"B-1"				
Food and Beverages	"B-2"				
Telephone	"B-3"				
Golf Course	"B-4"				
Golf Shop	"B-5"				
Golf Beverage Stand	"B-6"				
Beach	"B-7"				
Beach Fountain and Cigar Stand	"B-8"				
Locker Room	"B-9"				
Trapshooting	"B-10"				
Tennis and Squash	"B-11"				
Swimming Pool	"B-12"				
Garage	"B-13"				
Newsstand	"B-14"				
Cigars	"B-15"				
Valet	"B-16"				
Club News Magazine	"B-17"				
Special Activities	"B-18"				
Other Income	"B-19"				
Gross Operating Income		$	$	$	$
Deductions from Income:					
Administrative and General Expenses	"B-20"	$	$	$	$
Publicity and Promotion	"B-21"				
Heat, Light, and Power	"B-22"				
Maintenance of Buildings and Equipment	"B-23"				
Maintenance of Grounds	"B-24"				
Total Deductions		$	$	$	$
Net Operating Income		$	$	$	$
Store Rentals	"B-25"				
Income before Capital Expenses		$	$	$	$
Capital Expenses (Real Estate Taxes, Mortgage Interest, etc.)	"B-26"				
Deficiency before Crediting Dues and Initiation Fees		$	$	$	$
Income from Dues etc.:		$	$	$	$
Dues					
Other					
Total		$	$	$	$
Less Membership Expense	"B-27"				
Net Income from Dues etc.		$	$	$	$
Net Income for Period		$	$	$	$

Fig. 4. Comparative Statement of Operations for Clubs.

Rooms

The cost system applicable to rooms operations will, in the main, be contained within the general accounting system. Analytical and statistical records can be maintained over the revenue from the sale or rental of rooms to the extent of each room separately, by groups of rooms, or for the total operation, and such records can be kept to show the results for one day, week, month, and for the accounting period. Similarly, when the operating expenses are kept according to the standard account classifications, it will be possible to compute the direct operating costs by ratios to sales or on the basis of the total number of rooms or the number of rooms sold. In most operations, it is not considered feasible to attempt to break down, on the general books, the operating costs and expenses according to the identity of each room or unit. However, specific costs or operating expenses can be computed in the form of separate studies and analyses.

As shown in the section "Statistical and Cost Data Records," costs of many phases of the rooms operations can be computed, such as the costs of direct labor, laundry, linen, and other direct departmental expenses.

Food

The purchase of raw food and its preparation into a meal for sale in a hotel or club is analogous to a manufacturing operation and adaptable to various forms of cost accounting systems. The principal functions of food cost accounting are:

1. To determine the cost of prepared dishes or meals.
2. To determine the gross profit on dishes or meals and to permit adjustments of sales prices in relation to changes in costs.
3. To provide data for regulation of production and to determine overproduction.
4. To set up standards of preparation to control waste and excessive costs.

The proper basis for food cost accounting is an adequate system of ordering, receiving, storing, and issuing of the raw materials used in food preparation. With such a system it is possible to record the cost of all raw materials issued to the kitchen from the storeroom, and the cost of perishable materials received by the kitchen directly from the receiving station, which are known as direct purchases. After appropriate credits for the cost of food used for employees' meals and for transfers to other departments, it is possible to arrive at the net cost of food sold each day. This net cost compared with the sales for the day will permit the computation of the food cost or, conversely, the gross profit on food sold. A simple form for these computations is given as Figure 5. Under the foregoing simple system of determining food costs, there will be some variance from day to day to the extent of the remaining foodstuffs on hand in the kitchen, as no provision is made for inventorying "leftovers." However, in well-operated kitchens, such fluctuations should not be great and should offset each other from day to day. When the figures disclose unusual variations, particular attention should be directed to this factor to ascertain possible waste, and control overproduction.

In larger operations, the quantities of raw food materials used in the kitchen can be analyzed and costed in individual food classifications in order to permit a closer control and identification of costs. Under the more extensive food cost accounting systems, proper credits and transfers are made with respect to various types of food materials used in mixed dishes, such as soups, stews, combination

FOOD COST SUMMARY SHEET

——— – – HOTEL • MONTH of ——— 194—

DAY	DIRECT PURCHASES	ISSUES FROM STORE ROOM	TOTAL FOOD TO KITCHEN	LESS CREDITS: EMPLOYEES MEALS	LESS CREDITS: TRANSFERS TO OTHER DEPARTMENTS	NET COST of FOOD SOLD: TODAY	NET COST of FOOD SOLD: TO DATE	FOOD SALES: TODAY	FOOD SALES: TO DATE	PERCENTAGE COST of FOOD SOLD TO DATE TO FOOD SALES TO DATE: THIS MONTH	LAST MONTH	SAME MONTH Last Year
–	$	$	$	$	$	$	$	$	$	%	%	%
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												

TOTAL OF DIRECT PURCHASES TAKEN FROM RECEIVING RECORD.

REQUISITIONS FROM THE STORE ROOM TO KITCHEN EXTENDED AND TOTALED DAILY; TOTAL ENTERED IN THIS COLUMN.

TOTAL OF COLUMN 1 AND COLUMN 2.

MAY BE SET UP ON ESTIMATE BASED ON TOTAL CREDIT FOR PRECEDING MONTH.

THIS COLUMN PERMITS RECORDING OF DAILY TRANSFERS FROM KITCHEN TO BARS OR TO OTHER DEPARTMENTS.

FIGURE IN COLUMN 3 LESS CREDITS SET UP IN COLUMNS 4 AND 5.

ACCUMULATION OF "TODAY" FIGURES

TAKEN FROM DAILY EARNINGS REPORT.

ACCUMULATION OF "TODAY" FIGURES

Fig. 5.

dishes, salads, etc. After making such adjustments to the food costs, a comparison of the sales is made under similar classifications by analyzing each individual sales check on a portion distribution sheet thus permitting a computation of costs and

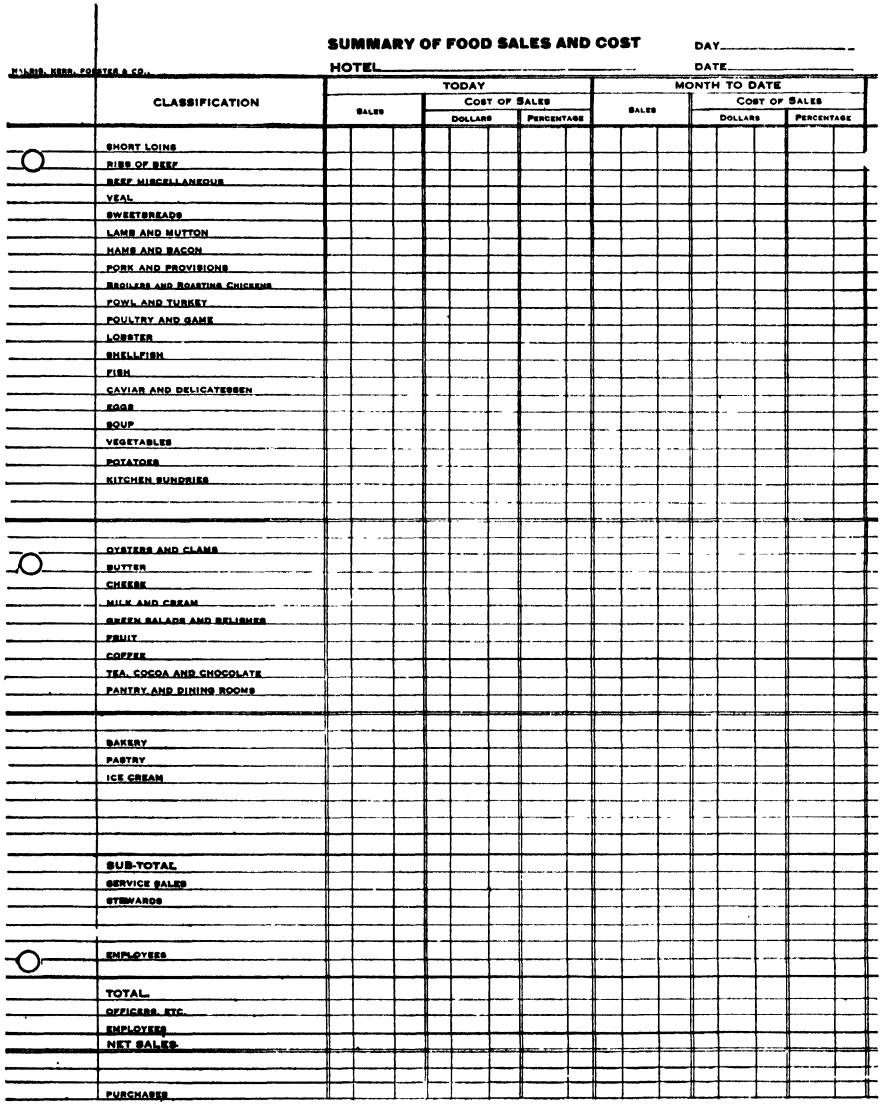

Fig. 6.

percentage of costs and gross profit to be made accordingly. A form for this type of food cost accounting is given as Figure 6.

A modified form of cost accounting to compute costs in relation to sales of specific types and classes of food may be maintained, such as for all dishes using lamb,

beef, pork, fish, foul, etc. Under this system attention is concentrated on those classes of higher cost food items which represent the largest volume and the detailed work of completely analyzing all costs and sales is avoided.

An effective procedure for determination of costs and for quantity control in specific instances consists of the actual weighing or measuring the quantity of raw food put into production and the compilation of the cost thereof, which is followed through the various production processes and accounted for by the quantity and sales value of the food products sold. This is particularly applicable to meats purchased in carcass form, which are butchered in the kitchen into various cuts and

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HOTEL_____

Date_____ Portion

Food Item _____

Ingredient	Quantity Used	Cost Price	Per Unit	Ingredient Cost
Total Cost				
Per Item Cost				
X Mark Up				
Menu Price				

Fig. 7.

related food material. The over-all raw material cost can be apportioned to the various cuts and other products. The total quantity can be reconciled with the portions sold according to the standard weight assigned to the various types of dishes produced. After due allowance for trimming and normal waste, a reconciliation can be made to determine excessive waste. A comparison of the sales value with the cost will show whether the margin of gross profit was in accordance with the expected standard.

Another form of food cost accounting is to set up cost records for all of the regular items offered for sale and to compute the costs according to the standard ingredients thereof. These costs are kept on cards (Figure 7) and are adjusted as costs of materials fluctuate. The selling price is also shown on this record and

adjusted to yield the expected markup when market conditions change. As these are predetermined costs, it is necessary to make frequent test checks of actual production costs against the standard used in the cost computation.

In general, food cost accounting has been directly concerned with computing only the raw material cost and it has not been found feasible to attempt to compute the labor costs involved in the preparation and service of the specific food items or of the meal. Such labor costs for preparation, service, ware-washing, etc., are generally computed on the basis of the over-all business, in the form of percentages of sales or of labor costs per cover or meals served. However, in individual cases, where warranted, specific costs can be computed to include labor as well as raw material costs.

Where a large volume of business is done on banquets, private parties, etc., it is advisable to determine the actual costs of all materials and labor of such functions in relation to the sales price received. Many hotels use a form of banquet contract, which specifies the menu and other services to be furnished. This form serves as a basis for computation of costs after the function has taken place when the quantities served and the actual labor and other costs can be accurately calculated.

It has been the general practice to compute the credit to the food cost for meals furnished to employees on the basis of a standard estimated cost. However, in large operations, particularly where a separate kitchen is used to prepare employees' meals, it is advisable to compute the actual cost of food used for employees' meals.

Beverages

The service of beverages, comprising both liquors and soft drinks, may be in the form of full bottle sales or involve some degree of preparation to produce mixed drinks such as highballs, cocktails, etc. The proper control of the sales and costs requires an integrated system of accounting control and cost accounting methods.

The sales of beverages should be controlled both as to cash and charge business by a system of waiters' or bar checks and cash registers or a combination of both. An efficient system for handling and controlling receipts from sales is particularly

Wm. Allen & Co., N.Y. Stock Form 7040 Printed in U.S.A.

BAR INVENTORY AND REQUISITION

Bar No._____ Date_____

List No.	Size	Description	Par Stock	On Hand	REQUISITION					INVENTORY	
					Quan.	Unit Cost	Total Cost	Unit Sale Value	Total Sale Value	Unit Cost	Total Cost

Inventory Taken By: Issued By: Received By:

Fig. 7a.

important to prevent distortions of costs if the full sales value is not realized for all of the beverages consumed.

In view of the readily disposable nature of liquor, it is important that there be a proper system for the storing of the stock and the issuing thereof to the dispensing stations. Careful inventories should be taken of the stock on hand in the storeroom and at the bars at least monthly and more often if required. Perpetual inventory records should be kept for the major stock in the storeroom and test counts made frequently to detect errors and shortages. As an aid in the control of the stock, a system can be established of issuing replacements from the storeroom to replenish the stock at the dispensing stations to a "par" quantity as previously determined as a standard for each item.

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Day_____
Date_____

		TODAY			TO DATE			
			Issues			Issues		
		Sales	Selling Value	Cost Value	Sales	Selling Value	Cost Value	Percentage
	OCEANIC ROOM							
	Room Service							
	Beer							
	Minerals							
	Bottle Sales							
	Other Sales							
	LOUNGE BAR							
	Beer							
	Minerals							
	FOOD TRANSFERS							
	MISCELLANEOUS PURCHASES							
	Total							

Fig. 8.

With a system of recording issues from the storeroom, it is possible to operate a standard selling price control over the dispensing stations after making due allowances for the inventory on hand at those stations. By computing both the selling value and the cost of all liquor consumed, the cost and/or gross profit can be computed from day to day or between inventory periods. Comparison of the selling value as computed for the liquor consumed with the actual sales as recorded in the accounting records, will determine overages or shortages of the actual receipts as compared with what should have been produced. Forms for these purposes are presented as Figure 8.

A form for computing costs and sales values applicable to individual mixed drinks or for quantities of drinks is given as Figure 9.

As in the case of food it is the general practice to compute only the raw material costs in relation to separate drinks or service to patrons. Labor and other departmental costs are generally computed in the form of ratios to total sales.

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Name of Drink: Selling Price:

Amount (ounces)	Ingredients	Ounce Cost	Total Cost		Ounce S. V.	Total Sale Value	
	Totals						
	Selling Price						
	Differential						

Fig. 9.

Merchandise Sales and Service Charges

Hotels and clubs sell a variety of merchandise such as cigars, cigarettes, candy, newspapers, flowers, jewelry, drugs, etc. In all such cases it is important that there be an adequate system of accounting control over the sales in the form of cash registers, sales vouchers, etc. It is equally important that inventories be taken regularly and in many cases it will be found desirable to operate a standard form of selling price control over the merchandise to be accounted for. Through the operation of a selling price control and the computation of gross profit ratios according to classes of merchandise it will be possible to determine that the sales and costs are in proper relationship.

Hotels and clubs render many services for which charges are made to guests and members, such as telephone service, valet, porters, etc. With respect to these services, a sales voucher form of control is generally preferable and, although cost accounting methods are not generally applicable, the accounting control and analysis of the component factors can be utilized to determine the proper relationship between the sales, costs, and expenses.

Engineering and Utility Costs

The activities of hotels and clubs generally require the operation of a building or buildings which entails a number of costs under the classification of heat, light, power, and other such utility services. In the engineering department, which supervises these services, a system of records and cost data should be maintained to measure, according to the applicable units, such costs as heating; electrical energy used for light, power, and other purposes; elevators; and various types of machines, motors, etc. Such records will be primarily for the direct use of the engineer but should be utilized as part of the subsidiary accounting cost records in a form suitable to the needs of the management.

Repairs and Maintenance

Maintaining the property and equipment in efficient operating condition is an important element of cost in hotel and club operation. Many types of activities are included under this broad classification, such as, painting and decorating; plumbing and carpentry work; reupholstering; repairs and mending of furniture and equipment, and miscellaneous repairs to building, machinery, etc. The nature of the work done involves the use of both labor and materials for which a system of cost records is desirable. Such cost records should be in the form of a job cost system under which the cost of each job is computed with respect to the direct labor and materials applicable thereto. Where work is done by outside contractors on a cost plus basis, it is particularly important that the work done be carefully checked and costs verified.

Payroll Controls

The various forms of personal services rendered by hotels and clubs require the employment of a large staff. Labor generally constitutes the largest item of expense in hotel and club operation. The accounting system should include provisions for the checking of time worked, by time cards, time clocks, or departmental time books, which data serve as the basis for the computation of the wages for the payroll records. The management should be provided with a form of payroll report on a daily, weekly, or monthly basis which should show the number of employees and wages thereof in each classification in every department. This report should show, in particular, changes in the regular payroll with respect to employees added or eliminated. It should also show payments for extra wages and for overtime. It should provide for comparative data with previous periods or against established standards. Various statistical ratios and units of production can be computed to determine labor costs and to measure work performance.

Where special services are required which involve identifiable payroll costs for banquets and special events, repair and maintenance jobs, etc., separate computations should be made of the actual direct payroll costs and a report made to the management relative thereto.

STATISTICS AND RATIOS OF INCOME AND EXPENSE ITEMS

	Ratio To		Cost Per	
	Total Sales and Income	Rooms Sales	Occupied Room per Year	Available Room per Year
Rooms Department Expenses	12.30%	29.39%	$473.81	$435.91
Telephone Department—Net Cost	.20	.47	7.67	7.06
Administrative and General Expenses	7.94	18.98	306.03	281.55
Advertising and Business Promotion	1.58	3.79	61.06	56.17
Heat, Light and Power	4.24	10.13	163.24	150.18
Repairs and Maintenance	5.75	13.74	221.44	203.72
Real Estate Taxes	3.24	7.74	124.82	114.83
Fire Insurance and Franchise Taxes	.56	1.33	21.40	19.69

Fig. 10. Hotel Statistics.

Statistical and Cost Data Records

Systematic keeping of statistics and cost data is an important aid to management in measuring efficient performance of the many varied activities involved in hotel and club operation. Such data may be stated in many forms, such as statistical ratios based on the total amounts and costs of sales, and according to various units of measurement. As an illustration of some of the statistics and cost data used in hotel and club operation, a summary thereof is presented as Figure 10.

OTHER STATISTICAL DATA

Rooms Department Statistics:	
Number of Available Rooms for Period	15,000
Number of Rooms Occupied	
Transient	10,350
Permanent	3,450
Total Rooms Occupied	13,800
Percentage of Occupancy	
Transient	69.00%
Permanent	23.00
General Average	92.00%
Average Daily Sale per Occupied Room	
Transient	$ 4.80
Permanent	3.04
General Average Sale per Occupied Room	$ 4.36
Number of Guests for Period	20,700
Number of Guests Daily	690
Number of Guests per Occupied Room	1.5
Average Daily Sale per Guest	$ 2.90
Number of Rooms Department Employees	98
Average Monthly Wage per Employee	$ 135.00
Pieces of Rooms Linen Laundered	197,340
Pieces of Laundry per Occupied Room	14.3
Per cent of Room Sales	100.00%
Direct Room Department Expenses	
Salaries and Wages	20.88%
Laundry	3.02
Linen, China, and Glass	1.57
Other Expenses	3.92
Total Direct Expenses	29.39
Departmental Profit	70.61%
Rooms Expenses per Occupied Room per Day	$ 1.30
Rooms Expenses per Available Room per Day	$ 1.19

Food and Beverage Department Statistics:	
Percentage of Food Sales	
Cost of Food before Employees' Meals Credit	41.89%
Cost of Food after Employees' Meals Credit	36.39%
Gross Food Profit	63.61%
Percentage of Beverage Sales	
Cost of Beverages Sold	34.11%
Gross Beverage Profit	65.89%
Percentage of Combined Food and Beverage Sales	
Gross Food and Beverage Profit	64.48%
Cover Charges and Sundry Income	1.39
Total Revenue	65.87%
Departmental Expenses (Salaries and Wages, Employees' Meals, Laundry, etc. itemized separately)	38.71%
Other	2.54
Total Departmental Expenses	41.25%
Departmental Profit	24.62%
Number of Food and Beverage Department Employees	230
Average Monthly Wage per Food and Beverage Employee	$ 150.00
Number of Food Covers Served	
Dining Room	7,500
Grill	10,650
Cocktail Room and Bar	2,950
Room Service	7,400
Banquets	2,800
Total Covers Served	31,300
Average Receipt per Food Cover Served	
Dining Room	$ 1.27
Grill	2.53
Cocktail Room and Bar	1.36
Room Service	1.29
Banquets	2.35
General Average Receipt	$ 1.80
Food and Beverage Wage Cost per Food Cover Served	$ 1.10
Pieces of Food and Beverage Linen Laundered	145,000
Pieces of Laundry per Food Cover Served	4.60
Payroll Statistics:	
Average Number of Employees	380
Average Wage per Employee	$ 155.00
Percentage to Total Sales (Exclusive of Store Rentals)	33 %
General Statistics:	
Electricity Consumed (K.W.H.)	140,000
Cost per Kilowatt-Hour of Electricity	$ .017
Steam Consumed (Pounds) (Fuel Oil, Coal)	354,000
Cost per M Pounds	$ .90
Water Consumed (Cubic Feet)	461,200

Note: The data contained herein are presented for illustrative purposes and were based on conditions prevailing in 1946-47.

Fig. 10 (continued). Hotel Statistics.

COST ACCOUNTING IN THE MANUFACTURE OF ICE CREAM

By
O'NEAL M. JOHNSON *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

In 1946 some three billion quarts or 750 million gallons of ice cream were sold to the American public. In addition, there were many millions of gallons of sherbets and ices, also ice milk, manufactured and sold. Such special items as frozen custards, frosted malted, Eskimo pies, popsicles, and many other novelties and specialties are also manufactured by the ice cream manufacturer and consumed by the public. While the industry is an industry of many products, by far the greatest part of it, more than 90%, or possibly even 95%, of the total products made are ice cream.

Essentially a Local Industry

Even the largest companies, when sales are made in more than one city, customarily have individual plants in each city, manufacturing the product for use in the immediately adjacent territory. Ice cream manufacturing is also a branch of the dairy industry. Most of the plants that manufacture ice cream are combination dairy plants processing or manufacturing other dairy products in addition to ice cream. Only about 20% of the plants manufacturing ice cream manufacture only ice cream. Because the delicate flavor of ice cream easily can be lost or ruined if ice cream is stored too long, deliveries are frequent and close supervision is maintained over the retail dealers. This is to make sure that only fresh products will be sold and that the products will be handled properly.

Source of Raw Materials

The primary raw materials, milk and cream, of course, come from the farmer, and the 80% of the ice cream manufacturers who process or manufacture other dairy products in addition to ice cream as well as a large proportion of the 20% who manufacture only ice cream, purchase their milk direct from the farmer. The milk is brought in by contract haulers or by the farmers themselves to the receiving platform at the plant. In the dairy industry the buying of the raw product from the farmer is as competitive as are the sales to the dealer or to the consumer.

Production of milk on the farm is quite seasonal; much more milk is produced in the spring and early summer than is produced in the fall and winter months. Most dairy products also have seasonal peaks in sales; but of all the products ice

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cream is the most seasonal. However, its peaks and valleys follow very closely the peaks and valleys in the production of milk. Since the ice cream industry normally pays a higher price for milk than most of the other dairy products, this makes it possible for the farmer to obtain a higher price for his milk during the season of flush production.

The demand of the consuming public for various dairy products has established prices for these products which in turn reflect different values for the actual milk or cream used in these products. As a result of this, the farmer normally is paid for his milk depending upon the use to which the milk is put. The milk is classified according to the form it took when sold and each class is then paid for, usually a different price for each class. When the price paid for each class is averaged, this average is known as the blended price. This general industry practice is reflected in the various Federally supervised Milk Marketing Agreements. An analysis of some twenty-six of these Federal Milk Marketing Agreements shows that in no case is there only one class of milk. In many cases there are two, three, or four classes of milk and in some few cases even more.

This problem is further complicated by the fact that fluid milk and cream are processed in the early morning for deliveries that same day or in the afternoon for deliveries the following morning. In the case of ice cream all wholesale sales are made within a limit of two or three days following the manufacture. This practice of manufacturing for immediate sale rather than for inventory requires flexibility in plant procedure so that shifts can be quickly made at any time from one product to another. It is an actual fact that in many plants when the first milk is received in the morning and started through the receiving processes it is not known what form the milk will take before it is sold.

Organization of Plant

The cost accounting methods for ice cream manufacturers described here pertain to the ice cream plant which is part of a combination plant also processing other dairy products. In the case of an ice cream plant that manufactures ice cream only, the costing problems would be somewhat simpler and there could be some combination of the departments as described later. To describe in detail the costing of a combination plant that produced every dairy product would run into so many complications that it is not deemed feasible in this instance. However, in most instances the costing of each individual dairy product is similar enough so that the description of a separate procedure is hardly necessary. The processes and their grouping into cost centers or departments are shown in the following tabulation:

Service Departments

Heat
Light
Power
Water
Refrigeration
Steam
Repair shop
Laboratory
Plant management
Personnel Department

Many of the departments are listed here because it is possible to distribute the total cost of these departments to the various operating departments on some unit basis based generally upon the services which the service department renders. For instance, power is distributed on the basis of the power used; refrigeration, steam, water, heat, and light are distributed on unit bases dependent on the use made in each department of the services.

Productive Departments	*Processes*	*Equipment and Facilities*
Receiving	Receiving the milk direct from the farmers.	Located on a platform to which farm trucks can drive and unload their cans of milk easily. Using large tanks into which the milk can be poured and as soon as all the milk from one farmer is poured in, the total can be weighed. Also equipment for sampling and sending samples of each farmer's milk to the laboratory and a large sheet on which each farmer's name is listed. Opposite the farmer's name is listed the total pounds of milk received from him. In the laboratory one receptacle is provided for all of the daily samples of each farmer for the semimonthly period. This composite sample is then tested to determine the average amount of butterfat and solids not fat in each farmer's milk.
Mixing	Mixing the ingredients from which the ice cream "mix" is made.	Using a large mixing tank equipped with paddles or any other device for agitating the mix and also equipped so that the mix can be heated to pasteurization temperature and pasteurized in this tank. Also cooling coils are used over which the heated mix is passed after pasteurization. After cooling to about 40 degrees F. on the coils the mix is pumped into holding tanks. If several grades of ice cream are made, as for example in a 10%, 12%, or 14% butterfat ice cream, the mix must be made separately for each percentage of fat ice cream. Often only one and seldom more than two basic mixes are ever made for each test of butterfat. When the mix is made, it is usually plain mix containing only dairy products and the sweeteners, not the flavors. Sometimes a vanilla mix is also made, and sometimes a chocolate mix is made. Vanilla and chocolate are the only two flavors that it is practicable to add when mixing.
Freezing	Freezing of the ice cream mix into semi-frozen ice cream.	Two types of ice cream freezers are used in the industry—the continuous freezer and the batch freezer. The continuous freezer is a new development and is gradually replacing the batch freezer. The batch freezer, as the name implies, is a freezer which must be filled, the batch frozen, and then the ice cream run from it. In the continuous freezer the mix continuously flows into one end of the freezer and the semi-

frozen ice cream out of the other. In both the continuous and the batch freezer the temperatures are very low, usually 10° or more below zero F. and scraper blades are used so that the frozen mix is removed from the freezer walls and all mix is continually stirred until it is frozen. This process prevents large ice crystals from being formed and produces a smooth acceptably textured ice cream. Since the partly finished ice cream must flow from the freezer, it is not possible to freeze it solid in the freezer but instead it is only partially frozen so that it is still in a semi-liquid state, that is as nearly a solid state as is possible to have and still permit it to flow from the freezer. Later in the hardening room, this semi-frozen mixture is hardened to the consistency with which the public is familiar when they purchase ice cream. Fruits and flavors are added at the freezer except in those cases where vanilla and chocolate mixes are made, in which case all fruits and flavors except chocolate and vanilla are added at the freezer.

Filling	Filling containers, packaging, labeling, etc.	All large bulk containers containing 2½ or 5 gallons of ice cream are filled directly from the freezer in the case of both the batch freezer and the continuous freezer. In the case of the batch freezer, the packages and smaller items and novelties of various types are usually filled in a separate filling department arranged for this purpose. In some cases, this filling department is on the floor below the freezing department and the semi-frozen ice cream is allowed to flow through refrigerated types of large diameter pipes to automatic filling machines below. In other cases, where the filling department is on the same floor as the freezing department 5-gallon containers are usually filled and transported to the filling department for filling in the automatic filling machines. In the case of the continuous freezer, the filling is often done at the freezer. The filling department and the freezing department are actually separate departments with different employees working in each but the physical line of demarcation between them is almost impossible to find. In this case, the filling department consists usually of conveyors

		and employees who fill the smaller packages as well as the larger bulk containers directly from the freezer. As soon as they are filled, they are placed on the conveyor line and other employees along the line close the containers, place containers in larger packages, and place these larger packages on conveyors to be taken to the hardening room.
Novelty or Specialty	Manufacture of specialties or novelties, such as popsicles, Eskimo pies, cheerios, etc.	Using special molds which are filled with the semi-liquid ice cream and put in brine tanks or some other quick freezing medium to be frozen solid. Later these frozen molded pieces of ice cream are removed from the molds and put in the chocolate dipping machines in which they are covered with chocolate. After this, they are wrapped, counted, and placed in containers for storage in the hardening room. Likewise, such items as popsicles are frozen from the popsicle mix in the brine tanks in molds, later wrapped, counted, packaged, and sent to the hardening room.
Hardening Room	Hardening and the holding of ice cream until sold.	The hardening room is a low temperature room in which the semi-frozen ice cream is finally hardened in the container ready for delivery and sale to the dealer. Temperatures vary, but usually are below zero F. The average probably would be —20° F. The warmest winter clothing is essential equipment for work in this room. The word "room" is really a trade name and refers to several rooms. Often bulk ice cream is stored in one or two, packaged ice cream in another, specialties and novelties in a third or fourth. Since ice cream is sold the same day it is hardened or within one or two days of when it is hardened, it is always stored in the hardening room until sale. Automatic conveyors are usually used for putting the ice cream in the hardening room and getting it out.

Production Order System

Since ice cream is manufactured almost for immediate sale rather than for inventory, the production order system must be such that instructions for changes in processing or manufacturing can be given and carried out at any time. Usually, as manufacturing plants go, the ice cream plant is comparatively small. The plant superintendent watches the production and the inventories in the hardening room and issues the production instructions. The only semifinished product that is ever on inventory at the end of the day is the ice cream mix held in the mixing depart-

ment, in some few cases slabs of ice cream frozen in pans later to be sliced into bricks, and the semi-frozen ice cream packaged and being hardened in the hardening room. In some cases, ice cream plants do make special molds for parties for holiday celebrations etc.; but for all practical purposes, except in the very largest plants that do make a specialty of this type of work, this can be ignored since it is such a very, very small percentage of the total production that it normally is not profitable to obtain separate costs on these items. Thus, while there may be in some cases a small inventory of these semifinished items, ordinarily it is such a very small percentage that it can be ignored, and the items considered as finished product.

II. How to Design the Cost System

What Information Is Required

As in most industries, the cost system in the ice cream industry should be so designed that management will get the best possible information from it at the least possible cost of operation. Ordinarily, the following information should be yielded by the cost system:

The cost and efficiency of each operation or department.

The effectiveness of each department in the utilization of the materials and man power. (It is highly important in this industry that the loss of materials is shown for each department.)

The cost of each product and the income from it; in some cases, the cost of each class of product rather than of each product will be sufficient.

The data for cost and operating statements.

And finally, the data for the preparation of the profit-and-loss statement and balance sheet.

Information for management must be in as summarized form as possible in order to give the accurate type of data that management needs in order to form policy and know that each of the departments is producing efficiently.

Considerations in Designing the System

In the ice cream industry the price paid for the raw product is determined largely by competition. Likewise, the price at which ice cream is sold is determined largely by competition. There are very, very few, if any, territories throughout the United States where only one brand of ice cream is sold. Therefore, the cost system must give management the information it needs to be able to produce an ice cream that will sell at competitive prices and return a profit, even though the price which it must pay for raw products is also governed by competition. Therefore, the cost system must do two things: (1) It must be timely and point out inefficiencies and irregularities in operation so that corrective steps may be taken at once; and (2) it must indicate the products that yield the greatest profit and those that yield the least so that sales effort may be placed upon the most profitable items and the others may be sold as an accommodation only.

"Process" Cost Accounting Is Favored

While both job order cost systems and standard costs may be used, the industry itself is ideal for the use of process cost accounting. Compared with manufacturing plants generally, ice cream plants are usually small, and as a result there is not the

talent in the plant that can readily set standards which might be used in a standard cost accounting system. Possibly more important is the fact that the product does flow from its raw state to the finished state in one continuous process, never touched by hand until it is packaged and ready for sale.

Because of the operations involved and the way the product is made, the ice cream industry is an ideal industry for the use of cost ledger sheets, which collect the cost of the product in each department, and transfer this cost into the next department. On the final cost ledger sheet, usually in the ice cream industry the cost ledger sheet for the hardening room, is shown the total cost of each product for which it is designed to obtain total cost. Cost ledger sheets must show in quantities the complete flow from raw materials to finished product with plant shrinkage or departmental loss on each operation. While the ice cream industry is seasonal, statistics collected over a long number of years make it possible to forecast with great exactness the proportion of the total year's sales that will be produced each month. Since production is for sales, and in the industry production and sales are almost synonymous, there is very little variation in inventories from one month to another.

III. Description of the Cost System

The most important steps in establishing a process cost system in the ice cream industry, are as follows:

1. Design the profit-and-loss statement for management (Figure 1).
2. Design the product cost ledger sheet for each department (Figure 2).
3. Design the reports and statements to be used for junior executives.

Examples are:

Daily receipts and use of milk.
Departmental loss of butterfat and milk solids (Fig. 3.)
Departmental Transfer of Products, showing the amount of product transferred from one department and the amount received by another.

4. Establish the departments or cost centers that will be necessary in order to obtain the material that has been listed as needed.
5. Establish the procedure for carrying out the cost system and producing the required information.
6. Set up the classification of accounts necessary to obtain the foregoing.
7. Set up the unit basis of proration of service department expenses to operating departments.

Dollar and cents amounts are shown in Figures 2, 3, and 4 in order that the principles of operation can be followed more easily. However, costs have purposely been distorted. In no case should they be accepted as indicative of actual costs.

Profit-and-Loss Statement

Because of the seasonal nature of the ice cream industry, it is necessary that some recognition of this be given in the form which the profit-and-loss statement takes. Therefore, it is usual to compare the income and expense items this month with the same month of the year previous. Since the ice cream industry is so seasonal, and since the selling price for ice cream usually remains the same throughout

STATEMENT OF PROFIT AND LOSS

For the Month of _____ 19—

	Month of This Year	( ) Last 12 Months	Per Gallon This Year
Gallons Sold	x	x	x
Returns From Sales:			
Gross Sales:			
Sales—Ice Cream	$ x	$ x	$ x
Ice Cream Mix	x	x	x
Dairy Products	x	x	x
Trade Supplies	x	x	x
Miscellaneous	x	x	x
Consignments Outward	x	x	x
Total Gross Sales	$ x	$ x	$ x
Sales Deductions:			
Trade Discount	$ x	$ x	$ x
Sales Returns and Allowances	x	x	x
Total Sales Deductions	$ x	$ x	$ x
Net Sales	$ x	$ x	$ x
Cost of Products Sold:			
Ice Cream	$ x	$ x	$ x
Ice Cream Mix	x	x	x
Dairy Products	x	x	x
Trade Supplies	x	x	x
Miscellaneous	x	x	x
Consignments Outward	x	x	x
Total Cost of Products Sold	$ x	$ x	$ x
Gross Profit or Loss on Sales	$ x	$ x	$ x
Distribution Expenses:			
City	$ x	$ x	$ x
Suburban	x	x	x
Shipping	x	x	x
Branch	x	x	x
Total Distribution Expenses	$ x	$ x	$ x
Distribution Profit or Loss	$ x	$ x	$ x
Administration Expenses	x	x	x
Operating Profit or Loss	$ x	$ x	$ x
Extraneous Income	x	x	x
Extraneous Expenses	x	x	x
Net Extraneous Income or Expenses	$ x	$ x	$ x
Net Income or Loss	$ x	$ x	$ x

Fig. 1.

ICE CREAM FREEZNG COST ACCOUNT

Line No.	Received: (Lbs.)	Total Quantity	Total Amount Product	Total Amount Expense	Bulk Ice Cream Quantity	Bulk Ice Cream Amount Product	Bulk Ice Cream Amount Expense	Pints Quantity	Pints Amount Product	Pints Amount Expense
1.	Mixing Cost Account - 15%	38 076	2 301 77	156 99	31 131	1 881 93	128 36	2 357	142 49	9 72
2.	10½%	10 647	643 10	38 36						
3.	Manufacturing Materials		329 13			210 89			15 98	
4.	Manufacturing Supplies		214 99			214 99				
5.	Freezing Departmental Expense			415 41			266 18			20 17
6.	Total Manufactured Cost - Gallons	10 299 5	3 338 99	610 76	6 599 5	2 307 81	394 54	500	158 47	29 89
7.	Unit Transfer Cost					.412146	.059783		.31694	.05978
	Transferred:									
8.	Hardening Room Cost Account	7 392	2 564 07	442 29	6 599 5	2 307 81	394 54			
9.	Packing Department Cost Account	2 907 5	774 92	168 47				500	158 47	29 89
10.	Total Transferred Cost	10 299 5	3 338 99	610 76	6 599 5	2 307 81	394 54	500	158 47	29 89

ICE CREAM FREEZNG COST ACCOUNT

Line No.	8 Oz. Cups Quantity	8 Oz. Cups Amount Product	8 Oz. Cups Amount Expense	3 Oz. Cups Quantity	3 Oz. Cups Amount Product	3 Oz. Cups Amount Expense	Brick and Sandwich Pans Quantity	Brick and Sandwich Pans Amount Product	Brick and Sandwich Pans Amount Expense
1.				849	51 32	3 50	3 739	226 03	15 41
2.	10 541	488 20	37 98				106	4 90	38
3.		71 18			5 75			25 33	
4.									
5.			89 84			7 26			31 96
6.	2 227 5	559 38	127 82	180	57 07	10 76	792 5	256 26	47 75
7.		.2511	.05738		.317	.059778		.323356	.06025
8.							792 5	256 26	47 75
9.	2 227 5	559 38	127 82	180	57 07	10 76			
10.	2 227 5	559 38	127 82	180	57 07	10 76	792 5	256 26	47 75

Fig. 2.

the year, the only costs that really mean anything are a whole year's costs. Therefore, it is customary to show a statement for the past twelve months rather than the year to date. This may or may not be compared with the statement for the previous twelve months. However, ordinarily this comparison of the two twelve-month periods is not made. It is also customary to carry out certain of the costs in unit figures. In the ice cream industry this means cost per gallon. It is also customary to supplement the profit-and-loss statement with a statement showing the unit cost of manufacture of each of the principal products.

Because of the large number of products manufactured, and because of the methods used in obtaining the costs, the information showing the detailed cost of

DEPARTMENTAL LOSS OF PRODUCT

Mixing Department:			
13 % Mix	458 lbs.	$ 29.58	
10½% Mix	1163 lbs. *(Unexplained Gain)	(58.03)	
Total Mixing Department			$ (28.45)
Frozen Sucker Department:			
Chocolate Suckers	202 Doz.	$ 48.48	
Butterscotch Suckers	15 Doz.*	(5.55)	
Kream Koolers	73 Doz.	18.52	
Fudge Pies	174 Doz.	52.20	
Total Frozen Sucker Department			$ 113.65
Hardening Room:			
Bulk Ice Cream	21 Gallons	$ (20.98)	
Pints	56 Pints	7.11	
8 Oz. Cups	60 Doz.	3.41	
3 Oz. Cups	4 Doz.*	(1.79)	
Orange Ice Pints	14 Pints*	(1.51)	
Sliced Brick	25 Quarts*	7.85	
Sandwiches	357 Doz.	285.60	
Total Hardening Room			$ 279.69
			$ 393.34

* Unexplained Gains should not be treated as profits but rather as an indication of errors. Gains are often the result of errors in inventories.

Fig. 3.

manufacture of each product in total rather than by unit is seldom of any great benefit to management. In obtaining cost of products in the ice cream industry, there are two devices of practically equal importance:

1. The cost ledger sheet.
2. Sheet allocating the service department cost to the operating department cost (Figure 4).

Cost Ledger Sheets

The cost ledger sheets, when taken all together, are, in effect, a word and numerical picture of what has happened in the plant during the past month. They trace, in both quantities and dollar and cents, the flow of the product from the

DEPARTMENTAL EXPENSE PRORATION SHEET

MONTH OF JUNE, 19XO

SERVICE DEPARTMENTAL EXPENSES	PRORATION ORDER	TOTAL DEPARTMENTAL EXPENSE LEDGER AMOUNT	STEAM	POWER	WATER	REFRIGERATION	LAUNDRY	HOSTESS DEPARTMENT	STOREROOM	GENERAL PLANT	AUTO TRUCK	MECH. CABINET	ICE CREAM CAN.	BRICK PAN	AUTO SHOP	CABINET SHOP	SIGN SHOP	
STEAM	8	13.00	13.00															
POWER	1	251.55	1.55	54.16		195.84												
WATER	2	34.62	.90		2.04	17.70				6.43					5.50	.70	1.35	
REFRIGERATION	9	168.36				168.36												
LAUNDRY	10	85.35					85.35											
HOSTESS DEPARTMENT	11	44.20						44.20										
STOREROOM	12	49.44							49.44									
GENERAL PLANT	3	92.91	3.98			7.94		3.98		53.18					7.94	11.91	3.98	
AUTO TRUCK	5	207.86									173.37					34.49		
MECHANICAL CABINET	13	189.24										189.24						
ICE CREAM CAN	14	.08											.08					
BRICK PAN	15	.25												.25				
AUTO SHOP	4	66.87									80.31				-13.44			
CABINET SHOP	6	530.54				29.20						457.22				44.12		
SIGN SHOP	7	141.64															141.64	
TOTALS		1,875.91	19.43	54.16	2.04	419.04	85.35	48.18	49.44	59.61	253.68	646.46	.08	.25		91.22	146.97	
OPERATING DEPARTMENTAL EXPENSES																		TOTAL OPERATING DEPARTMENTAL EXPENSE AFTER PRORATIONS
MIXING		153.62	15.15	17.63		86.10	9.48			7.94						70.40		360.32
FREEZING		284.31	.55	16.82		70.08	9.48		49.44	3.98			.08	.25		.42		415.41
PACKAGE AND CUP FILLING		136.91		1.41			9.48			3.98								151.78
HARDENING ROOM		16.75				122.06				3.98								142.79
FROZEN SUCKER MANUFACTURING		628.92	3.73	18.30		140.80	9.48			11.91						18.08		831.22
ICE CREAM SELLING		428.31						48.18		3.98	31.66						95.13	607.26
ICE CREAM DELIVERY		1,449.64					37.95			3.98	175.84	646.46					92.37	2,406.24
RETAIL STORE		174.30								3.98						2.32	9.47	190.07
SHIPPING PLATFORM		150.00					9.48			7.94								167.42
ADMINISTRATIVE		830.95			2.04					7.94	46.18							887.11
TOTALS		4,233.71	19.43	54.16	2.04	419.04	85.35	48.18	49.44	59.61	253.68	646.46	.08	.25		91.22	146.97	6,109.62
PRORATION ORDER			8	1	2	9	10	11	12	3	5	13	14	15	4	6	7	

Fig. 4.

receiving platform to the hardening room. They show the costs and they show the losses of the product in each department.

To the junior executives of the plant this tracing of quantities and materials through the plant is at least as important as the dollar and cents values placed upon these materials. By glancing through his cost ledger sheets a good plant operating man can tell in a moment whether or not the plant is operating at the highest possible efficiency. The sheets also trace inefficiencies and give credit to unusually efficient departments.

In the actual making up of the cost ledger sheets, the quantities should always be run through and balanced out on all the sheets before any attempt is made to figure cost and assign these costs to particular products. By doing this, a great deal of refiguring and correction of mistakes is avoided.

Departmental Product Losses

In balancing out quantities of the products on the cost ledger sheets before the costs are applied, there should always be entered in the upper section of the sheet the amount of product that was reported made. In the lower section of the sheet then is entered the amount of product that is reported as transferred. The department to which the product is transferred may not report as much received as was reported transferred from the first department. Whether these discrepancies are due to normal plant losses, carelessness, or dishonesty, corrections must be made. Daily investigations to determine departmental responsibility are preferable to monthly reconciliations. If the first department is determined not to have made the transfers, the amounts entered as transfers on its departmental sheet should be lowered to the correct amount. This will have the effect of increasing the unit cost of processing in that department. If the second department is found to have received the products reported as transferred the amounts received should be corrected on its cost ledger sheets. This will increase the unit costs of processing in this department.

If not carefully watched and checked such losses can run into considerable amounts of money. It requires only a few moments each day to check the previous day's reports from each department. Therefore, the plant superintendent should check these reports each day or require them to be checked by an assistant. When discrepancies appear they can then be followed up at once and responsibility for losses fixed. When this is done daily the monthly totals entered on the cost ledger sheets will automatically balance.

In determining costs the total cost of the products which were available for transfer are applied to the quantities that were actually transferred regardless of whether these quantities are smaller than the department reported as having been transferred. These discrepancies in quantities are corrected and the costs are never applied until after quantities balance. Then there will be no dollar and cents cost to be entered on the books or the statements as products lost.

However, on the cost ledger sheets themselves for each department there is a line which shows the quantity of the products lost. These amounts should be taken off in separate product loss statements and the total quantity of the product valued at the cost which was the cost to manufacture the product in that department. These product loss statements are very valuable to junior executives and

operating men generally. There is probably no other device in the industry quite as effective in cutting down departmental losses of product as these statements. Of course, these statements are memorandum statements only and do not find any place in the profit-and-loss statement except possibly as footnotes. The unit cost shown or the total cost shown is always the total cost of the final product obtained on the basis just described.

After all the quantities of the products have been entered on the cost sheets and balanced out, then and only then, the actual costs are written in on the cost sheets. Since the upper section of the cost ledger sheets is devoted to receipts and the lower section to transfers to other departments, it is simply a matter of arithmetic to carry these costs through one cost ledger sheet to another, until all of the raw material costs have ended up in the finished product or work in process costs.

Departmental Proration Sheet

This sheet is a device by which service department expenses can be prorated to operating department expenses with the least possible labor. Rather than do all of this work formally by journal entries, a proration sheet of the kind shown (Figure 4) will enable the accountant to make these prorations in outline form on these sheets. Finally from the summaries made up of the cost of products from the hardening room cost ledger sheet or the cost of sales summary the entries transferring all of the costs of raw materials, labor, and other expenses to the cost of sales can be made in one journal entry.

In the ice cream industry the aim is always to have as few service departments as possible and only those that have a really accurate basis of proration to other departments. For example, steam and refrigeration can be transferred on a unit basis very readily. It is a well known fact that half as much steam is required to wash one gallon of can in the can washing machine as is required to pasteurize one gallon of milk in the pasteurizer. Likewise, it is known that to freeze a gallon of sherbet or ice requires 1.8 times as much refrigeration as is required to freeze one gallon of ice cream, and so on through the other operations. Therefore, the establishment of the unit basis for proration before the actual work of prorating the departmental expenses is undertaken is of the utmost importance.

The departmental expense proration sheet is a sheet on which is listed across the top all of the service department expenses. Also in the upper section of the sheet and listed one for each line are each of these service department expenses. Totals are then obtained on the total line of the upper section of the sheet under each one of the service department expense headings totals that are to be prorated to each operating expense. These amounts are then prorated in the proper columns to each of the operating department expenses. The lines for each operating department are added across and the final amount of the operating expense to be entered on its appropriate cost ledger sheet is obtained. After these operating departmental expense totals are transferred to the cost ledger sheet, the procedure as outlined foregoing under the heading product cost ledger sheets is followed through until the cost of the products is obtained.

Inventory Variation

The inventories at the end of the month may be valued at the regular unit cost obtained for each product during the month. Particularly in those months when it is felt that, because of very small production, costs are unusually high or in those months when, because of a very large production, costs run unusually low, the procedure of carrying the current month's unit costs into the inventory is not always followed. Rather average unit yearly costs are applied to the inventories so that the unit costs of the products sold for the month reflect the variations from normal.

COST ACCOUNTING IN KNITTING MANUFACTURING

By
CLINTON W. BENNETT *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

A mill manufacturing three classes of products is used as the basis for illustrating cost accounting in the knitting industry. These products are (1) sweaters, (2) bathing suits, and (3) underwear. While a too extensive general classification can easily breed sizable defects, the mills in the knitting industry have so many things in common and possess so much uniformity of practices, one with the other, regardless of the great differences in physical size, that the methods illustrated here should be found to have wide application.

Kinds of Raw Material

The mill used for purposes of illustration purchases all yarn and consequently has no spinning or other yarn manufacturing operations. This type of mill is illustrated for two reasons: (1) Experience indicates many knitting organizations buy all their yarn, and (2) since the cost work with respect to yarn manufacturing will be outlined elsewhere in this book, repetition at this point would be superfluous.

Dyeing operations are also omitted because many mills send the yarn to commission dyers and those who do not may refer to other sections of this book for descriptive matter with respect to dyeing cost procedures.

Yarn is the most important raw material and usually consists of three kinds: (1) Wool, (2) cotton, and (3) rayon. It is normally purchased from the mills or from yarn dealers, either dyed or in the grey. If grey, shipment is made from the supplier to the dyer where the yarn is stored, dyed, and shipped to the mill on specific dyeing orders. In either event the yarn should come to the mill packaged properly.

Findings such as thread, buttons, binding material, and labels, are normally readily available in the market and are purchased in economic quantities as required.

Adequate and efficiently arranged storage facilities are important in this industry not only because of the importance of having materials when they are needed, but also to cut down waste. Too many mills regard a good physical stores system as so much red tape and experience shows that not infrequently those managements are out more than enough through loss and waste to pay for a good stores system.

Each day a definite part of the stock should be counted and reported to the

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perpetual inventory clerk so that all stock will be inventoried physically at least once each year and preferably oftener. Materials delivered to in process should be reported on requisitions or daily bills of material delivered. If the quantities carried of any class of material are small and deliveries frequent, monthly inventories may provide the best way to obtain the quantities used.

Organization of Plant

A typical list of operating departments and cost centers for a knitting mill of the type under consideration follows:

Production Centers:	Service and Indirect Centers:
Knitting	Power and steam plant
Pressing	Maintenance
Cutting	Building service
Seaming	General mill
Finishing seams	
Hemming	
Marking	
Putting on buttons	
Putting on labels	
Folding	
Packaging	

In large mills the production centers may be subdivided into kindred operating divisions to meet local conditions. Additions may also be made to the list of service and indirect centers to include such departments as research, personnel, purchasing, production control, and related activities. Some mills may not operate a power plant. In general, however, the centers listed are essential in organizing the cost work in even the smallest mill and will serve as the basis for expanding to any extent required by the problems of a specific mill.

Production Order System

All manufacturing orders should issue from one central point. This may be a production control department or perhaps one person, depending upon the size of the mill. The common practice in this industry is to manufacture for stock and not for special orders. The production control department should maintain perpetual inventory records of quantities (not values) for all finished goods and major raw materials, including yarn at the dyeing plants. These records should show the actual quantities on hand, quantities on order and available balances after providing for appropriated stock. Although the policy may be to ship from stock, exceptions arise in nearly every plant. But there should be no exception to the fixed rule that all production orders, whether for stock or for customers, must be issued from the production control department. It should also be the job of this department to plan and schedule all production and set all delivery dates.

A plan used by some small and medium sized mills provides a copy of the manufacturing order for each manufacturing department, the original remaining in the office as a control. As the daily production is reported, postings are made to the original and each departmental sheet is returned to the office when the order has been completed in that department. This simple plan provides control and the posting media for the perpetual inventory records.

II. How to Design the Cost System

Information to Be Furnished

The cost system should provide top management with the following data promptly at the end of the month.

1. The operating results for each class of product.
2. Analyses of the reasons for any differences between planned and actual performances.
3. The cost and ratio to normal of each department or center.
4. The effectiveness of material, labor, burden, and production capacity utilization.

Promptly at the end of each week, department heads should receive analyses of any differences between planned and actual performances in their departments.

Considerations in Designing the System

Three fundamental steps are usually involved in the design: (1) Determining upon the type of system, (2) devising the control structure, and (3) determining the cost of specific products. In this industry selling prices are dictated largely by competition and, although the costs provide essential guideposts to management, they are of even more value in helping management keep the operating results within the competitive price structure. The cost system must be regarded as (1) an instrument of cost reduction and cost control, (2) the means of making possible analytical monthly statements of profit and loss, and (3) the basis for checking or revising selling prices.

Type of System

The knitting mill lends itself particularly well to the so-called standard cost system and this type of system is recommended. Some mills manufacture relatively staple lines. Others produce seasonal products in which the style factor is of utmost importance, while still other mills operate in both fields. A well-devised standard cost system will serve any of these situations with satisfaction. The term "standard" cost is intended to reflect the normal cost of specific products over a period of several years if the line is a staple one, and the anticipated cost of seasonal or high style products. Even in very small mills the use of standard costs should be favored unless the output is of such a special nature that standards would not be feasible. While scientifically set standards are always to be desired, reasonable estimates may be used provided they are controlled in accordance with the procedure outlined.

III. Description of the Cost System

Pattern of Development

The development and installation of a standard cost system in a knitting mill may be said to follow this pattern:

1. Prepare the chart of accounts.
2. Determine the cost standards for material, labor, and burden.
3. Set up the standard costs for specific products.
4. Establish the accounting control procedure.
5. Prepare the profit and loss statement and supporting control data.

Chart of Accounts

The first cost accounting control step is that of revising the chart of accounts to provide in a simple and practical way the tie-in between the cost of operations as reflected by the cost data and the actual results recorded on the books of account. The basic arrangement indicated below which divides the general ledger accounts into three major divisions and nine classifications will usually be found adaptable.

A. Assets

1. Current assets
2. Fixed assets, other assets, and deferred charges

B. Liabilities

3. Current liabilities
4. Reserves
5. Fixed liabilities, capital stock, and surplus

C. Income and Expense

6. Sales, deductions from sales, cost of sales, and cost variances
7. Mill burden
8. Commercial burden
9. Other income and charges

Accounts indicated by the requirements of the specific mill should be inserted in each of the classifications. Three groups require special mention as described below:

Inventories (classification 1) will usually consist of the following control accounts:

Wool yarn
Cotton yarn
Rayon yarn
Findings
Other direct material
Supplies
Work in process
Finished goods at mill
Finished goods elsewhere

The minimum number of cost variances accounts are:

Material—quantity
Material—price
Labor
Mill burden
Unused production capacity
Commercial burden

Clearing accounts to transfer actual burden from the burden accumulation accounts to the burden cost variances accounts without closing the books prior to the end of the fiscal year are:

Mill burden clearing account
Commercial burden clearing account

Determining upon the Cost Standards

Material quantity standards for each product will be obtained from the specification sheets. An up-to-the-minute bill of material should be maintained for every product as a basis of manufacturing information and operating control. In setting the cost standards due allowance will be made for anticipated waste.

Material price standards will usually be based on a combination of experience and anticipation. In general they should reflect average prices which may be reasonably expected to exist for at least a year ahead.

Labor cost standards. Before any labor cost standards are set a study should be made of the methods of performing the work and the machine speeds. This is a mass production industry and success or failure of the business may rest on whether or not adequate and proper quantities of production are being turned out. Time studies by elements should be made to locate delays, if any, in the manner of (1) delivering work to the machines, (2) handling it in the operation, and (3) passing it along to the next spot. Careful experiments should be made to determine the proper speeds and methods for handling the specific yarns being processed. Standards of performance should follow and these will form the basis for the cost standards. No substitute procedure for setting up the labor standards is suggested because in the knitting mill margins are frequently so close that no management can afford not to provide these scientific performance standards.

Mill burden cost standards should be based on a mill burden operating budget. The first step in the preparation of this budget is to list at the left-hand side of a columnar sheet the name of each account in the mill burden classification of the chart of accounts. Columns should be provided at the right for each of the production centers and the service and indirect centers, also for the total amount. The budgeted amount for each account or burden class is inserted on the appropriate line in the total column and distributed to the centers on a predetermined basis. Suggested bases for this distribution follow:

Account	*Bases of Distribution*
Superintendence	Total mill payroll
Indirect labor	Direct from payroll analysis
Rent	Floor space occupied
Light	Estimated relative consumption
Heat	Floor space adjusted by usage factor
Power	Average horsepower operating hours
Repairs—machinery	Actual or by relative valuation
Repairs—buildings	Actual or by adjusted floor space
Supplies used	Actual
General mill expense	Actual
Insurance	On machinery according to valuation
Taxes	On buildings according to adjusted floor space
Depreciation	
Compensation insurance	Total payroll basis
Social security taxes	

If the mill operates a power and steam plant, the light, heat, and power costs would all be entered in the power and steam plant column and redistributed.

Charges for repairs may also be placed in the maintenance column for redistribution.

The service and indirect centers will be redistributed to the production centers on the following bases:

Centers	*Bases of Distribution*
Power and Steam Plant:	
Power	Horsepower hours
Steam	Pounds of steam used
Maintenance	Direct by requisition
Building service	Square feet of adjusted floor space
General Mill	Total payroll dollars

By adding the amounts in the columns for the production centers the burden budgeted to each one will be obtained. Next determine the number of production units to use in absorbing the burden and applying it to costs. These units will normally be machine hours in the knitting department and direct labor dollars in the other direct centers. These machine hours should be set on the basis of approximately 80% of the anticipated total departmental operating hours for the year ahead, to provide for down time and other contingencies. In the other centers the percentage on direct labor dollars will be found eminently satisfactory, particularly when direct labor standards will be used.

The mill burden cost standards will be obtained by dividing the production units into the budgeted dollars of each production center. These rates will be used to obtain the mill burden cost of the product for the cost sheet, Exhibit 1.

Commercial burden cost standards. This classification or cost element includes all costs beyond the mill door, and the cost standards should be based on a commercial burden budget. The first step in preparing the budget is to list at the left-hand side of a columnar sheet the names of each account in the commercial burden classification of the chart of accounts. A column should be provided at the right for each of the several classes of products produced, also for general commercial and total burden. The budgeted amounts for each account or burden class will be entered on the appropriate lines in the total column and distributed to the centers on appropriate bases in the circumstances. Items which cannot be logically distributed directly will be entered in the general commercial column and redistributed to the several classes of products on the basis of gross sales less returns.

By adding the amounts in the columns for the classes of products, the burden budgeted to each will be obtained. Next determine the anticipated factory cost of sales for the period being budgeted (usually a year) for each class of products and insert these cost of sales in each appropriate column under the total burden budgeted. The commercial burden standards will be obtained by dividing the budgeted cost of sales into the budgeted burden for each class of product. These rates will be used to apply and obtain the commercial burden cost of the product on the cost sheet, Exhibit 1.

Determining the Cost of Specific Products

A cost sheet, as illustrated in Exhibit 1, will be prepared for each specific product in the line. This sheet will reflect the standard or anticipated costs determined in accordance with the procedure outlined in the preceding paragraphs.

EXHIBIT 1.

COST SHEET

Description Style No.
Weight per Doz.

Date

Material	Quantity	Price	Amount	Quantity	Price	Amount
Yarn or Cloth:						
Findings:						
Packaging						
Total Material						

		Burden			Burden	
Labor and Burden	Labor	Rate	Amount	Labor	Rate	Amount
Knitting						
Pressing						
Cutting						
Seaming						
Finishing Seams						
Hemming						
Marking						
Put on Buttons						
Put on Labels						
Folding						
Packaging						
Total Labor and Burden						

Summary: Material	
Labor	
Burden	
Total Mill Costs	
Commercial Burden	
Total Cost	

The cost sheet is of prime value in a standard cost plan. As a matter of course it shows the standard cost of each product. But it also provides the standard cost figures to use as the basis for crediting the cost variances accounts and debiting work in process. Also from these sheets will come the data for pricing sales to obtain the standard cost of shipments with which to credit finished goods and debit cost of sales.

Cost Control Procedure

Material Quantity Variances.—Raw material used during the month will be priced at actual cost and transferred to the material quantity variances account. Production orders entered in process during the month will be priced from appropriate cost sheets at the standard cost of the material element and the resulting amount, the standard cost of material used, transferred from material quantity variances account to work in process.

Differences which may be located between the physical quantities of raw materials and the perpetual inventory records will be priced at cost, charged, or credited to the appropriate raw material inventory accounts with offsetting entry to material quantity variances account.

Material Price Variances.—Summarize the material used during the month by classifications and price at the standard cost prices for material as shown on the cost sheets. Transfer the difference between this total and the actual cost from the material quantity variances account to the material price variances account.

Labor Cost Variances.—Direct labor will be charged to the labor cost variances account from the payroll analysis. The units of production will be priced at standard labor cost and transferred from the labor cost variances account to work in process.

Mill Burden Cost Variances.—The total of the actual mill burden for the month will be charged to mill burden cost variances account and credited to mill burden clearing account. Mill burden absorbed at standard rates will be credited to mill burden cost variances account and charged to work in process account.

Unused Production Capacity Variances.—Each month the cost of unused or the credit for overabsorbed production capacity will be calculated by reference to the bases used in setting up the burden budget and transferred from mill burden cost variances account to unused production capacity variances account to remove the effect of volume from the burden cost variances.

Commercial Burden Cost Variances.—The aggregate of the actual commercial burden for the month will be debited to commercial burden cost variances account and credited to commercial burden clearing account. Absorbed burden, obtained by applying the standard rates to the factory cost of sales of product classes, will be credited to commercial burden cost variances account and debited to the commercial cost of sales accounts.

Cost Variances General.—The importance of the cost variances accounts as instruments of management control can hardly be overemphasized. They serve as continuous controls between the actual costs put into the plant in the form of material, labor, and expense and the results obtained in the form of profitably produced products. They are ever-present guides to the management and they should be watched carefully not only for the reasons why certain results may have occurred, but also for trends of unfavorable factors which may as a result be corrected before they become serious.

Revision of Standard Costs

The standard costs should be revised if and when changes have taken place in important fundamentals. Frequent or unnecessary changes will destroy much of the real value of the standards as devices for making performance comparisons with the result that the costs will be neither standards nor actuals—simply figures.

In general there are four basic situations which may provide cause for considering revisions of the standard costs. These are:

1. Material specifications change.
2. Methods of manufacturing change.
3. Material costs change substantially and with reasonable permanence.
4. Basic wage rates change materially.

Revision of standards should always be the result of decision by important management.

Work in Process and Finished Goods

Inventories of work in process and finished goods will be carried at standard cost. Production of the month will be priced at standard cost from the cost sheets and the total amount transferred from the work in process account to the finished goods account.

Cost of Sales

Shipments of the month will be priced at standard cost from the cost sheets and the total amount credited to finished goods account and debited to the appropriate cost of sales accounts by product classes.

Profit and Loss Statement

The profit and loss statement, Exhibit 2, is a basic cornerstone of the cost and operating control structure. This monthly statement can be prepared readily from the books of account if the procedure outlined has been followed. It shows by classes of products the profit that should have been made, the profit actually made, and the reasons for any differences. If these differences are of sizable proportions, they should be traced through the underlying cost variances records. If desired by management, detailed analytical cost variances reports can be prepared monthly in support of the profit and loss statement.

It will be noted that the cost variances are not allocated to classes of products on Exhibit 2. This is intentional. The standard costs are considered to be the real costs and the variances simply reflect the extent of departure from the planned performances. Allocation of variances to product classes, either as a separate item or in cost of sales, would confuse instead of enlighten.

Other Periodic Reports

Monthly balance sheets and burden statements, both factory and commercial, should be prepared for top management and such operating reports as may be found valuable in the circumstances should be provided. What these may be will depend largely upon the needs and wishes of the local management.

EXHIBIT 2.

PROFIT AND LOSS STATEMENT
(Knitting Manufacturing)

		Products		
	Total	Sweaters	Bathing Suits	Underwear
Sales	—	—	—	—
Less: Returns and Allowances	—	—	—	—
Transportation out	—	—	—	—
Cash discounts	—	—	—	—
Total Deductions	—	—	—	—
Net Sales	—	—	—	—
Cost of Sales—Mill	—	—	—	—
Gross Profit—Anticipated	—	—	—	—
Cost of Sales—Commercial	—	—	—	—
Operating Profit—Anticipated	—	—	—	—
Cost Variances:				
Material—Quantity	—			
—Price	—			
Labor	—			
Mill Burden	—			
Unused Production Capacity	—			
Commercial Burden	—			
Total Variances	—			
Operating Profit—Actual	—			
Other Income	—			
	—			
Other Charges	—			
Net Profit—This month	—			
To date	—			

COST ACCOUNTING IN THE LAUNDRY AND DRY CLEANING INDUSTRY

By
JOHN CARRUTHERS *

I. DESCRIPTION OF THE INDUSTRY

Nature of the Industry

The Laundry and Dry Cleaning Industry, the largest of the service trades in terms of employment and receipts, was originally two separate and distinct industries. They are still so regarded by the government and have separate National Trade Associations. From an accounting and cost point of view, however, their problems are so similar that they may be treated as a single industry.

Laundering is one of the most ancient of the service trades, the laundering of soiled clothing belonging to others as a means of livelihood having descended from remote antiquity. The first public laundries in America were established about a century ago, but have never completely superseded domestic laundering, for which reason customer competition has always been a deterrent to high prices. The Dry Cleaning Industry has never had this problem because of the hazards involved in attempts at home cleaning, but has enlarged its scope of service enormously as competition from within the industry has lowered prices of the more staple articles. Linen Supply and Industrial Laundering are of more recent origin, serving offices, barber shops, restaurants, hotels, and factories, usually in larger quantities and at lower prices than family services.

The similarity of processing methods and the obvious sales advantage of providing complete cleaning service to customers on a "one stop" delivery basis are tending toward consolidation of these industries, and, even when not merged, there is a certain amount of overlapping of services.

The work handled by these establishments may be classified into "specialties," "family services," and "commercial services." *Specialties,* which include practically all retail dry cleaning, together with curtains, blankets, and rugs, are priced by the piece, processed individually and sent irregularly by the customers, usually causing seasonal peak loads in production. *Family services* are made up of bundles containing many articles belonging to the same customer which are processed in bulk, some identification system being necessary to assure the return of such articles to their owners. *Commercial services* are usually obtained in such large lots that each shipment can be processed separately, the saving resulting therefrom being the principal reason for reduced cost to the customer as compared with family service. Both family and commercial services are sent to the laundry on regular schedules, which vary little from week to week, so that seasonal peak loads are of little importance except in summer or winter resorts.

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Linen supply work differs from family or commercial service in that the goods are owned by the laundry and are rented to customers at prices which include both laundering and linen replacement. In the laundry industry the cost of linen replacements are usually deducted from gross sales, the resulting "net sales" being regarded as income from laundering.

Diaper service, a relative newcomer in the industry, is really a highly specialized development of the linen supply business, usually operated independently or by family laundries. Its most unusual characteristic is an almost complete customer turnover every two years.

Types of Laundry Services

While specialties and commercial work are important elements in some laundries, the greater part of the work of the average laundry is made up of family services.

Quality and methods of washing are substantially uniform for the work of all customers in any given laundry. There are great differences, however, in the quantity and quality of ironing and finishing the articles in the laundry bundles, ranging all the way from work which is sent home damp, without any finishing whatsoever, to the highest quality of hand-finished work. Consequently, there are many possible combinations of laundry service which may be offered to the public. These combinations are commonly referred to in the trade as "services." Sometimes these services are given names which are somewhat descriptive and, at other times, names which, in the opinion of the laundry sales manager or his advertising counsel, are believed to have sales appeal. In this respect, laundry services are somewhat similar to life insurance plans or contracts in which various combinations of term insurance, straight life, and endowment have been put together in ways which enhance sales appeal, or may better meet the requirements of individual policyholders. The popularity of these laundry services has varied from year to year in accordance with economic conditions, styles of clothes, and improvements in laundry equipment.

The power laundry industry really began with the invention of the hard collar and the stiff shirt, and, in the nineteenth century, these two articles represented the vast majority of the work sent to public laundries. The first decade of the twentieth century saw the development of family flat work as a principal service. From 1910 to 1920, damp wash became increasingly popular and this, for the first time, brought laundry service within the reach of people in modest circumstances. During the ten years following 1920, the completely finished family bundle, in which a substantial portion of the finishing was done by hand, became popular at prices then considered dangerously low, but now looked upon in envy by present day laundryowners. The ten years preceding World War II were characterized by the increasing popularity of so-called economy or budget bundles, produced largely by machinery and, in many instances, sold at prices so near the cost of production that the profit margin was very thin and sometimes nonexistent. During the war years, price control has prevented the development of new services or pricing methods, and shortage of skilled labor, coupled with unprecedented demand for laundry service, has forced most of the laundries to concentrate their efforts on washing and ironing of flat work and shirts, for the processing of which specialized machines are available, requiring a minimum of hand work.

Influence of Uniform Accounting

Conventional accounting methods, as taught in accounting and commercial schools and designed for manufacturing and merchandising establishments, do not fit the laundry and cleaning industries. For this reason and because laundries are so widely dispersed geographically and made up of many small units, it was logical that laundryowners should have been among the first to call upon their National Association for the development of uniform methods. The first step was taken in 1914, when a uniform system was approved and a Department of Accounting was set up in the National Association. While the early systems lacked flexibility and were, therefore, not generally accepted, they were improved by time and experience until in 1933, in anticipation of the establishment of a code of fair competition under the N.R.A., a committee made up of representatives of leading accounting firms specializing in laundry accounting and officials of the American Institute of Laundering agreed upon a Uniform Expense Classification for the Industry, which is now almost universally accepted in the industry.

In the same year, the National Association of Dyers and Cleaners adopted a uniform classification which is so closely comparable to that of the Laundry Industry that either classification with minor changes can be used in both branches of the industry.

These uniform classifications are very helpful in cost accounting because the accounts are arranged in the same order in which they would logically be grouped for cost analysis. Perhaps, however, because the early laundry bookkeeping systems were misnamed "cost accounting systems," the vast majority of laundryowners who have adopted such uniform methods are of the firm opinion that they have cost accounting systems in their plants and that they "know their costs." The universal practice of expressing these so-called costs in the form of percentages of expenses to sales for comparison among laundries, and for control purposes within a plant, has led most laundryowners to believe that these "percentage costs" are all that is necessary or desirable for management control purposes, or for the establishment of a profitable price structure.

Except for differences in production methods and greater regularity of sales, the laundry industry may be regarded as typical of the group which includes laundries, dry cleaners, linen supply, and diaper service and, because its operations are more complex and accounting methods better established, it is used in this chapter for explanation and illustration of cost procedure, which with some modification is applicable to the other allied industries.

Special Problems of the Industry

The laundry industry has several accounting problems peculiar to itself. First, it manufactures nothing, yet more than half of the sales dollar is expended for production. The industry sells nothing tangible, yet it has a sizable sales organization, maintains an elaborate distribution system, and spends about one quarter of its sales dollar for delivery and selling expenses.

Production and sales departments must be closely coordinated because laundry work cannot be produced any faster than it is brought in, and the production department must at all times be ready, without notice, to meet whatever demands are made upon it by the public. The industry operates on a cycle of a week, therefore an accounting unit consists of either four or five full weeks. For this reason, a thirteen month calendar is commonly used in the industry, and, when not used, each

quarter of a year consists of two four-week months and one five-week month. Even a comparatively small laundry plant may serve several thousand customers regularly every one, two, or perhaps three weeks. The unit of sale is the laundry bundle, ordinarily averaging between one and three dollars.

Organization of Plant

Laundries and dry cleaning plants range from the "one man" business with a handful of employees offering a single service to the large metropolitan establishment with hundreds of employees rendering complete cleaning service to thousands of customers. A large proportion of the total number of plants are so small that they have little organization, although the larger plants, while fewer in number, account for the bulk of sales volume, particularly in the larger cities. These plants are usually divided into three major departments: (1) Production, (2) sales or delivery, and (3) office. Heads of each of these departments are usually responsible to the general manager.

The productive department in a plant handling both laundering and cleaning will be divided into two separate divisions occupying different parts of the plant. In both divisions, the work is divided into three functional groups and several subdepartments usually under the direction of working supervisors. The three functional divisions are: (1) Identification, which has to do with the maintenance of identity of work belonging to the several customers; (2) the washing or cleaning process, and (3) ironing or finishing process which restores the goods to usable condition. Each of the subdepartments process a particular type of work. Washing, flat ironing, and shirt ironing are quite highly mechanized and operators are machine tenders. In the other departments, machines aid and increase the productive capacity of operators.

Typical functional organizations of laundry and cleaning plants are as follows:

Productive Department

Laundry	*Cleaning Plant*
Identification	Identification
Marking	Marking
Net Identification	Packaging
Net Assembly (after washing)	
Sorting	Cleaning
Packaging	Dry Cleaning
	Wet Cleaning
Washing	Spotting
Washing and Extracting	
Hand Washing	Finishing
	Wools
Finishing	Silks
Tumbler Drying	Household
Flat Ironing	Curtains
Handkerchief Ironing	Blankets
Shirt Ironing	
Collar Ironing	
Stocking Ironing	
Wearing Apparel Ironing	
Blanket Finishing	
Curtain Finishing	

Indirect Plant

Janitors, Porters, etc.
Engineers, Firemen, and Mechanics

Sales

Routemen
Branch Stores
Service (Orders, Complaints, Claims, etc.)

Office

Bookkeepers
Pricing Clerks
Telephone Operators, etc.

II. How to Design the Cost System

What Information Is Required

In addition to the operating statement, prepared at the end of each four-week accounting period, which shows the sales, costs, and profits of the business, usually with costs arranged in accordance with the Uniform Expense Classification, and percentages computed to show the portion of each sales dollar charged to each account, management should also require either regularly or at intervals the following:

1. A weekly statement showing the unit cost and production of the various production operations.
2. A breakdown of the operating statement for each four-week period showing the profit or loss from laundry, dry cleaning, storage, and other specialties.
3. A survey to determine the cost and profit from each laundry service whenever changes in prices or services are contemplated and at sufficiently frequent intervals to provide a basis for pricing special jobs or commercial service.

Considerations in Designing the System

The margin of profit in the laundry industry is very small, the national average of operating profits before interest and Federal taxes, as shown in statistics published by the American Institute of Laundering, being 1.30% of sales in the last prewar year of 1939.

The census of 1939 disclosed that laundry and allied industries expended 48½ cents out of each sales dollar for wages, an amount much higher than that of any other major industry in the country. Productive labor ranges from 30% to 35% of sales, being the largest and most controllable item of expense. It is, therefore, particularly important to maintain current reports of labor cost and productivity as the best means of controlling costs and assuring profits.

Prices in laundry and allied industries are changed very infrequently, and in the past have had little relationship to the cost of production. A knowledge of costs of producing various services can be of great value, however, in directing sales efforts toward the expansion of more profitable service and guiding management in the development of long term pricing and sales policies.

Cost Analysis from Monthly Operating Statements

Many attempts have been made in the industry to establish monthly detailed cost reports, showing the cost and profits of the various services. These have usually been abandoned after a few months of operations, partly because the changes of cost and profits of the several services from month to month are so slight as to have little significance to management, but principally because the burden of regularly maintaining production records broken down into services has been out of proportion to the value to management of the information obtained therefrom.

It has been found desirable, however, to separate the sales and cost of laundry, dry cleaning, storage, and other specialties on operating statements for each four-week accounting period. This is not too difficult because of the fact that these major divisions of the work are processed in separate departments of the plant. The results of such separation are that: (1) by eliminating the effect of seasonal fluctuation in production of dry cleaning and specialties, a much more accurate statement of laundry operations is obtained, (2) the inclusion of the costs of laundry and dry cleaning operations in a single statement may conceal from management a persistently unsatisfactory profit situation in one of these departments.

Surveys to Determine Cost of Services

As a substitute for continuous detailed cost systems, the cost survey has been accepted as the most practical way of determining costs of the various services in laundries. As a part of these surveys, records are accumulated showing the production and cost of each operating department and the allocation of these costs to the various services processed therein. The final result is a report showing costs of the various operations and profits from the several laundry services.

The Department of Cost Accounting of the American Institute of Laundering and accountants specializing in the industry have worked together very closely in developing uniform principles for the conduct of such surveys and the determination of service costs, and the American Institute of Laundering has published a manual describing cost survey procedure in minute detail. The methods outlined in this chapter follow the principles described therein, but deviate toward simplicity whenever possible in order to reduce the record keeping and the clerical work involved, without materially impairing ultimate accuracy and usefulness of the final results.

III. Description of the Cost System

The most important steps necessary in conducting a laundry cost survey are as follows:

1. Prepare forms for the accumulation of sales and production data for each service for the period of the survey.
2. Arrange for a detailed analysis of productive labor cost in the various operating departments for the period of the survey.
3. Prepare forms for the accumulation of pounds or pieces processed in the various departments for the period of the survey.
4. Prepare a statement of actual or approximate operating expenses for the period of the survey.

5. Compile the data, enter totals on the survey forms, and tabulate results.
6. Prepare the report to management from the survey forms.

The accumulation of production data is usually the most difficult problem of a cost survey, because such data are not regularly accumulated in laundry plants, and employees are neither qualified nor experienced in the compilation of even the most simple type of cost records. Therefore, if accurate records are to be obtained, the cost accountant conducting such a survey should either have an intimate knowledge of laundry production methods or study the operating methods of a laundry thoroughly before attempting a survey.

The detailed procedure for the conduct of a laundry cost survey is illustrated in the series of survey forms used by our firm as a part of cost survey procedure, which are prepared as follows:

Sales and Production by Services

A cost survey may cover a laundry sales week, in which case sales data and some production data, such as number of bundles and pounds of each service, can usually be obtained from current office records. Certain data, such as number of shirts, collars, handkerchiefs, socks, pounds of flat work or wearing apparel in each service, can usually be obtained from analysis of laundry lists as they pass through the office.

If it is decided to use the production week, which may differ from the sales week, as a basis for the survey, all sales and production data must be accumulated separately from laundry tickets, and sales records as shown on the books should be disregarded.

Services should be listed on Form C-1—Sales Summary—and listed in the same order (with same line number) on Forms C-4 and C-5 and at the head of the columns of Form C-8. Prices should be noted on Form C-1, and sales, bundles, and pounds of each service should be posted from detailed records to columns A, B, and C of this form.

Other production data accumulated in the office will be used to check or supplement similar data obtained from the laundry plant and recorded on other survey forms.

Payroll and Production Analysis

If the survey week coincides *exactly* with the payroll week, columns A and B of Form C-2 can be compiled from the payroll or time cards. Usually, however, it will be necessary to prepare a separate set of time cards and record time for each employee in each department for the time during which work included in the production of the survey week is being processed. A special payroll record should be computed for this survey week from which required data will be posted to Form C-2.

Records should also be kept of production of each department expressed in pieces or pounds, which should be tabulated and posted on Form C-2, and the resulting hourly production and labor cost per piece or pound computed.

Determination of Operating Costs for Survey Period

Operating statements prepared currently in accordance with the basic expense classification for the laundry industry, usually provide the necessary basic data for

SALES SUMMARY FOR SURVEY PERIOD

No.	Name of Service	Description	Prices	Min. Chg.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
12	Curtains			
13	Blankets			
14				
15	Dry Cleaning			
16				

SUMMARY FOR WEEK ENDING _____

		A • Sales	B Bundles	C Pounds	D •• Income per bundle	E Pounds per bundle	F •• Income per pound
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11	Total Laundry Services						
12	Curtains						
13	Blankets						
14							
15	Dry Cleaning						
16							
17	Totals						

• In all dollar figures (except unit costs), cents may be omitted.

•• In all unit costs (per pound, piece or bundle), carry to four decimals.
Cross references to form, column, line, as 4F21 = Form 4, Column F, Line 21.

Form C-1.

PAYROLL AND PRODUCTION ANALYSIS

		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
		PAYROLL		PRODUCTION		HOURLY PROD.		LABOR COST	
	Account	Hours	Amount	Pieces	Pounds	Pieces	Pounds	Per pc.	Per lb.
11	Marking								
12									
13	Netting								
14									
15	Net Assembly								
16	Packaging								
17									
18	Sort and Bundle								
19									
Total	IDENTIFICATION								
21	Washing - Flat								
22	" - Shirts								
23	" - Wearing App.								
24									
Total	WASHING								
31	Tumbler Drying								
32	Ironing Flat								
33	" Handkerchiefs								
34	" Socks								
35	" Shirts								
36	" Collars								
37	" Wearing Apparel								
38									
Total	FINISHING								
40	Total (to 7A40)								
42	Curtains								
43	Blankets								
45	Dry Cleaning								
Total	PRODUCTIVE								
6.1	Indirect Labor								
7.1	Delivery Wages								
	Other Wages								
Total	PAYROLL								
				To 7J	To 7L				

Form C-2.

DETERMINATION OF OPERATING COSTS FOR SURVEY PERIOD

		(A)	(B)		(C)	(D)	(E)	(F)	(G)	(H)
Account No.	Account	From Books of Account				•	Costs for Period of the Survey			
		%	____ weeks		Average Week		Total	Adjustment	Net	Group Total
1.1	Prod. Labor - Laundry					P				
1.2	Prod. Labor - D. C.					P				
1.31	Outside Work - Laundry					A				
1.32	Outside Work - D.C.					A				
2.2	Nets & Marking Supplies					%				
2.3	Washroom Supplies									
2.4	Water & Softener Sup.									
2.5	Iron. & Finish. Sup.					%				
2.6	Packaging Supplies									
2.7	Dry Cleaning Supplies									
3.1	Power Wages					Av				
3.2	Fuel									
3.	Power Overheads					Av				
3.6	Purchased Power					%				
4.2	Rent					A				
4.3	Bldg. Maintenance Wages					Av				
4.	Bldg. Overheads					Av				
5.3	Mchy. Maintenance Wages					Av				
5.	Mchy. Overheads					Av				
6.1	Indirect Wages					P				
6.2	Plant Supervision					Av				
6.	Indirect Overheads					Av				
6.6	Social Security Tax					A				
7.1	Routemen's Wages					P				
7.2	Route Supervision					Av				
7.	Truck Expense					Av				
7.61	Agents' Discount					A				
7.62	Branch Office Expense					Av				
7.7	Advertising					%				
7.8	Sales Salary & Expense					Av				
7.9	Claims					%				
8.1	Office Wages					Av				
8.	Office Expenses					Av				
8.5	Executive Salaries					A				
8.	Other Adm. Expense					Av				
	TOTAL COST									

• Indicates figures used. % = Percentage of Sales P = Payroll of Period A = Actual Av = Average
Omit cents in Columns C thru J.

Form C-3.

COST ALLOCATION TO DISTRIBUTION BASES

No.	Account Group	Totals (A)	Allocation to Distribution Bases (B)	(C)	(D)	(E)	(F)
		from 3H	Production	Direct	% of Sales	Per Stop	Per Bundle
1.	Productive Labor						
1.3	Outside Work						
2	Supplies						
3	Power Plant						
4	Building Overhead						
5	Machinery Overhead						
6	Indirect Overhead						
7a	Delivery						
7b	Sales						
8a	Office						
8b	Administrative						
9	TOTAL COST						
Service	Distribution of Direct Charges		Per Bundle	Total Direct			
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11	Total Laundry						
12	Curtains						
13	Blankets						
14							
15	Dry Cleaning						
16							
17	TOTAL SALES						
18	Delivery Commission (%) = 5C						
19	Executive Salaries (%) = 5F						
20	Total Stops (from 5B17)						
21	Average Cost per Stop - (4E9 ÷ Total Stops)						
22	Total Bundles (from 1B17)						
23	Average Cost per Bundle - (4F9 ÷ Total Bundles)						

Form C-4.

DISTRIBUTION OF % AND PER STOP COSTS

DISTRIBUTION OF % COSTS

		(A)	(B)	(C)	(D)	(E)	(F)	(G)
No.	Service	Sales	Commission			Executive Salary		
		(from IA)	%	Amount	Per Bundle	%	Amount	Per Bundle
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11	Total Laundry Services							
12	Curtains							
13	Blankets							
14								
15	Dry Cleaning							
16								
17	TOTALS							

DISTRIBUTION OF PER STOP COST

Service No.	(J) Packages per Bundle	(K) Pounds per Bundle	(L) Ratio K : K17	(M) Extra Delivery	(N) J+I÷2	(P) Std. Stop L+M+N	(Q) Total Bundles	(R) Total Stops P x Q	(S) Cost per Bundle P x 4 F 21
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									

Form C-5.

COST DISTRIBUTION TO SERVICES AND SPECIALTIES

		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
		Totals from Form 4	Laundry Services to Form 7	Distribute to Specialties					
				Curtains	Blankets		Dry Clean.		
				(11)	(12)	(13)	(14)	(15)	(16)
	Gross Sales								
	Less Linen Replacement								
	Net Sales								
1.	Productive Labor								
1.3	Outside Work								
2.	Supplies								
3.	Power Overhead								
4.	Building Overhead								
5.	Machinery Overhead								
6.	Indirect Overhead								
	Total Production								
	Direct Charges								
$	Delivery Commission								
Stop	Delivery Expense								
Bdl.	Office & Administrative								
$	Executive Salaries								
	TOTAL COST (=4A9)								
	Profit								
	$ Profit								

Form C-6.

the making up of an operating statement for the survey week. This classification shows accounts arranged as follows:

GROSS SALES
Less Linen Replacements

NET SALES
Less Operating Costs

PRODUCTIVE LABOR

1.1 Laundry
1.2 Dry Cleaning
1.3 Outside Work

PRODUCTIVE SUPPLIES

2.2 Nets and Marking Supplies
2.3 Washroom Supplies
2.4 Water and Softener Supplies
2.5 Ironing and Finishing Supplies
2.6 Packaging Supplies
2.7 Dry Cleaning Supplies

POWER PLANT

3.1 Power Plant Wages
3.2 Fuel
3.3 Repairs and Maintenance
3.4 Depreciation
3.5 Insurance (Other than Property)
3.6 Purchased Power and Light

BUILDING OVERHEAD

4.2 Rent of Laundry Building
4.3 Repairs and Maintenance
4.4 Depreciation
4.5 Insurance (Property)
4.6 Taxes

LAUNDRY MACHINERY OVERHEAD

5.3 Repairs and Maintenance
5.4 Depreciation
5.5 Insurance (Property)
5.6 Taxes

INDIRECT LAUNDRY OVERHEAD

6.1 Indirect Labor
6.2 Superintendence (Plant)
6.3 Supplies and Expense
6.5 Compensation and Other Insurance
6.6 Social Security Taxes

COLLECTION AND DELIVERY

7.1 Routemen's Wages and Commissions
7.2 Route Supervision
7.3 Delivery Equipment and Operating Expense
7.4 Depreciation (Delivery Equipment)
7.5 Liability and Other Insurance
7.6 Agency, Branch and Call Office Expense

SALES PROMOTION

7.7 Advertising and Publicity
7.8 Sales Promotion Salary and Expense
7.9 Claim Adjustments

OFFICE

8.1 Office Salaries
8.2 Stationery, Printing and Postage
8.3 Office Expense
8.4 Depreciation (Office Equipment)

ADMINISTRATIVE

8.5 Executive Salaries
8.6 Employee Free Work
8.7 Bad Debts
8.8 Dues and Subscriptions
8.9 Other Administrative Expenses

TOTAL COSTS

OPERATING PROFIT

It is usually impractical to prepare an operating statement from the books for as short a period as a week, therefore a statement for from one to several four-week accounting periods is used as a basis for the preparation of the statement for the survey week. Figures from the books should be entered in column B of Form C-3, and the percentage of each item to sales and average weekly cost computed. Actual

DISTRIBUTION OF LAUNDRY COSTS TO PRODUCTION CENTERS AND PROCESSING COSTS PER POUND AND PIECE

		(A)	(B)	(C)	(D)		(E)		(F)		(G)		(H)	(J)	(K)	(L)	(M)	(N)	(P)	(Q)	(R)	(S)	(T)	(U)	(V)
		LAUNDRY PRODUCTION COSTS																Cost per Pound for Complete Processing							
	Production Centers	Productive Labor	Outside Work	Laundry Supplies	POWER		BLDG O H		MACH'Y O H		INDIRECT O H		TOTAL PRODUCTION COST	Pieces (from 2C)	Cost per Piece	Pounds (from 2D)	Cost per Pound	Damp Wash	Dry	Flat	Hand-kerchiefs	Socks	Shirts	Collars	Wearing Apparel
					%	Amount	%	Amount	%	Amount	%	Amount													
11	Marking																								
12																									
13	Netting																								
14																									
15	Net Assembly																								
16	Packaging																								
17																									
18	Sort and Bundle																								
19																									
	TOTAL IDENTIFICATION																								
21	Washing - flat																								
22	" - shirts																								
23	" - Wearing App.																								
24																									
	TOTAL WASHING																								
31	Tumbler Drying																								
32	Ironing - flat																								
33	" - handkerchiefs																								
34	" - socks																								
35	" - shirts																								
36	" - collars																								
37	" - Wearing App.																								
38																									
	TOTAL FINISHING																								
40	TOTAL (from 6 B)																								
41	Pieces per Pound																								
42	Production Cost per Piece																								
	PROOF																								
43	Units produced (pounds or piece)																			•					
44	Total Cost of Production - (Cross add to Column H)																								
45	- Variance - Estimate less than production cost (line 40)																								
46	+ Variance - Estimate more than production cost (line 40)																								

Form C-7.

AVERAGE PER BUNDLE COST OF VARIOUS SERVICES

	SERVICE NO. → / SERVICE NAME →	FROM	1	2	3	4	5	6	7	8	9	10
1	Handkerchiefs - per average bundle											
2	Pair Socks " " "											
3	Shirts " " "											
4	Collars " " "											
5	AVERAGE BUNDLE WEIGHTS											
6	Pounds - Damp											
7	" - Tumbled Dry											
8	" - Flat - Ironed											
9	" - Handkerchiefs "											
10	" - Socks "											
11	" - Shirts "											
12	" - Collars "											
13	" - Wearing Apparel "											
14	Total Pounds per Bundle	1E										
15	Average Income per Pound	1F										
16	AVERAGE INCOME PER BUNDLE	1D										
	COST ANALYSIS PER BUNDLE											
17	Damp Wash @ . per pound	7T40										
18	Tumble Dry @ . per pound	7P40										
19	Flat @ . per pound	7Q40										
20	Handkerchiefs @ . per piece	7R42										
21	Socks @ . per pair	7S42										
22	Shirts @ . per piece	7T42										
23	Collars @ . per piece	7U42										
24	Wearing Apparel @ . per pound	7V40										
25	Total Production Cost											
26	Routemen's Commission %	5D										
27	Delivery Overhead @ per stop	5S										
28	Sales, Office & Administrative @ . per bundle	4F23										
29	Executive Salaries @ . %	5G										
30	Direct Cost	4B										
31	Total Cost											
32	Profit											
33	% Profit											

	PROOF	Variance	Form 6B	Gross Total
34	Bundles (1B)	—	—	—
35	Total Sales			
36	Total Cost			
37	Profit			

Form C-8.

labor costs from Form C-2 and certain other items which can be accurately determined for the survey week should be entered in column E. The remaining items of expense for the week are determined on either a percentage of sales or average basis and entered in column E. Costs of supplies and fuel should be determined exactly for the survey week, if possible, otherwise computed on a percentage of sales basis.

The adjustment column is provided for the addition or elimination of any items which have been charged differently on the books than they should be on a cost statement, or for the elimination of abnormal expenses which might properly be regarded as distribution of profit. The net expenses for the survey week should then be grouped in column H for transfer to Form C-4.

Cost Allocation to Distribution Bases

In laundry cost accounting, production costs, including productive labor, laundry supplies, power, building, machinery and indirect overheads, are charged to processing departments and later distributed to services, while delivery, sales, office and administrative expenses are charged directly to services, there being no practical way by which these items can be accurately charged to laundry processes. For this reason, despite the opinion of some laundryowners to the contrary, it is impossible to determine the *complete* cost of laundering a single article, such as a shirt, without knowing the type and size of a bundle in which it was sent.

Laundry routemen are ordinarily paid on a commission basis, therefore, each service may properly be charged with the commission rate paid on that service. The rest of the delivery expense, consisting of supervision, truck expense and overheads, cannot be charged on either a percentage of sales or the somewhat more logical bundle basis because it becomes apparent from observation that it costs a great deal more to collect and deliver, for example, a large damp wash bundle than a small shirt bundle, both of which may be sold at the same price. Laundry cost accountants are not in complete agreement as to the most accurate method of allocating this important cost item, except to recognize the problem and the inadequacy of conventional methods of distribution.

In our own cost work we have used an empirical formula which gives consideration to three factors, which obviously influences delivery cost: (1) Weight of the bundle as received, (2) number of delivery stops, and (3) number of packages in which the bundle is delivered.

The formula is:

$$\text{Standard Stop} = \frac{\text{Av. Bdl. Weight of Service}}{\text{Av. Bdl. Weight All Services}} + \text{Extra Stops} + \frac{\text{Pkgs. per Bdl.} + 1}{2}$$

The application of this formula to several typical bundles is illustrated as follows:

Service	Pkgs.	Av. Bdl. Weight (Lbs.)	Av. Bdl. Wt. 1 ÷ 16	Extra Del'y	Pkgs. + 1 ÷ 2	Std. Stops per bundle
1. Damp-flat Ironed	2	19	1.18	1	1.5	3.68
2. Finished Family	3	18	1.12	0	2.0	3.12
3. Damp Wash	1	21	1.31	0	1.0	2.31
4. Flat Work	1	11	0.67	0	1.0	1.67
5. Shirts and Collars	1	4	0.25	0	1.0	1.25
All Services		16				

The above schedule shows how to determine the number of standard stops for an average bundle of any service. The cost per stop can be determined readily by dividing the total delivery overhead by the total number of standard stops for all services, which can be converted into a cost per bundle for any service.

Costs of the office are always apportioned to services in proportion to bundles because each bundle represents a laundry list which is the unit of laundry office work. There appears to be no completely satisfactory basis for the distribution of the remaining administrative cost, the major item of which is executive salaries. The cost of this group is sometimes distributed on a bundle basis, sometimes in proportion to productive labor, and sometimes on a sales basis, the latter method being, as always, a confession of failure to find a more accurate unit of measurement. Fortunately, the group is usually of minor importance as a cost factor, so that any distortion of cost of each service and consequent profit or loss is of slight importance. We usually apportion executive salaries in proportion to sales, and other administrative expenses on a bundle basis.

Forms C-4 and C-5 are used for the allocation of expenses, as shown in Form C-3, into distribution groups as shown in column A of Form C-6.

Cost Distribution to Services and Specialties

Form C-6 is designed to separate sales, costs, and resulting profits of laundry services from specialties, such as curtains, blankets, dry cleaning, etc., which are processed separately but share some of the laundry overhead and a proportionate part of delivery, sales, office, and administrative expenses.

In some cases this separation will be unnecessary because of the absence of specialties, and sometimes the separation will have been made on the books of account. It will cause little difficulty in any case because the overhead distribution schedules, which must be prepared for the allocation of overhead to production centers and to services, will furnish the basis for making the cost distributions in this schedule.

The cost analysis of specialties shown in this schedule should be included in the report to management. This is the only part of cost survey procedure which can ordinarily be incorporated into statements of current operations.

Allocation of Laundry Costs to Production Centers

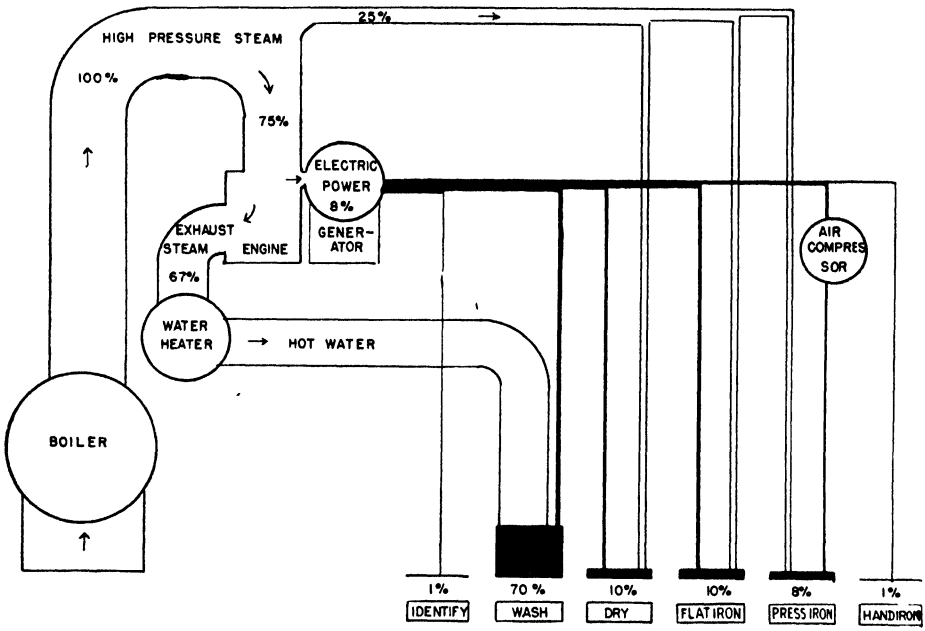
Total costs of laundry services as shown in column B of Form C-6 should be transferred to line 40 of Form C-7. Productive labor should be posted to column A from column B of Form C-2. Any charges for outside work, that is, laundry work performed by other laundries, either because of emergency or absence of necessary equipment, should be charged against the appropriate center in which the work would have been processed had facilities been available.

If practical, a record should be made of the value of supplies used for each production operation. Water is charged to the washroom either by meter reading or by estimate. Ironing and finishing supplies which consist principally of machine coverings should be estimated and allocated to processing departments. Packaging supplies can usually be charged directly to the departments in which they are used.

The allocation of power costs to production centers is quite difficult as it involves an amount of engineering knowledge not possessed by the average accountant. Modern laundry power plants utilize steam so effectively that very little is

wasted, exhaust steam from the engine being used to heat water for washing. The power cost charged against the several production centers is made up of mechanical or electrical power, hot water, process high pressure steam and compressed air. The cost problem involved in the allocation of power costs to production centers is illustrated in the accompanying chart. The allocation percentages shown are for illustration only, as power distributions vary greatly in different plants. Some assistance from a mechanical engineer is very helpful in making an accurate allocation of power costs.

CHART ILLUSTRATING TRANSFER OF STEAM COST TO PRODUCTION CENTERS
THROUGH HOT WATER, HIGH PRESSURE STEAM, ELECTRIC POWER & COMPRESSED AIR



A floor plan of the plant showing space used for each productive department should be prepared, and allocation of building overheads should be made to departments including office, delivery, and specialties, in proportion to space occupied.

Machinery overheads should be allocated in proportion to the values of equipment in each department. Indirect laundry expenses should be allocated in proportion to labor hours shown in column A of Form C-2.

After all laundry costs have been allocated to production centers in columns A to G of Form C-7, total costs should be computed and entered in column H. It will usually be impossible to break down washing costs directly into flat, shirts, and wearing apparel, as a physical separation usually does not exist in this department. Tests should be made as a basis for the breaking down of total washroom costs into these three divisions as it has been found that the cost of washing wearing apparel is usually at least twice as great per pound as flat work.

The number of pieces and pounds produced in the various productive departments are taken from columns C and D of Form C-2 and inserted in columns J and L of Form C-7, and unit costs per piece and per pound computed to four decimal places and entered in columns K and M.

Determining Unit Costs of Complete Processing

All per pound unit costs in column M should be distributed to columns N to V, which, when added, will show the cost per pound for processing the various classifications of work sent to the laundry.

Per pound costs of processing handkerchiefs, socks, shirts, and collars may be converted into piece costs by multiplying pound costs by the ratio between total pieces and pounds of these articles.

To check against the possibility of error in computation of per piece or per pound costs, the total unit costs in columns N to V may be multiplied by the number of pieces or pounds of the various items, and the total compared with the actual total cost on line 40 in column H. These totals will not exactly agree because of the limitation of decimal accuracy but the difference should not be of material importance.

Determination of Costs of Services

The unit cost figures, computed on Form C-7, provide all data necessary to determine the cost of any service, any proposed service, or any special job, provided that the number of pounds or pieces in the bundles that compose the service are known.

In a complete cost survey, these production data should be determined from office or plant records and the component parts of an average bundle of each service determined accurately, if possible, or otherwise estimated from tests made by weighing a sufficient number of bundles to constitute a representative sample of each service.

These counts and weights for average bundles of each service should be entered on lines 1 to 16 of Form 8. If per bundle costs are to be representative of averages of each service, lines 14, 15, and 16 should be substantially in agreement with columns D, E and F of Form C-1. Costs per bundle are determined by applying production costs per pound or piece as computed on Form C-7. Routemen's commissions and executive salaries are applied to average bundles of each service on a percentage of sales basis, Delivery overhead on a standard stop basis, and sales, office, and administrative expenses on a per bundle basis.

If average bundles, for which costs are determined, covered all laundry services for the survey week, the proof obtained by multiplying average bundle sales, costs, and profits by the number of bundles of each service should closely approximate the corresponding items in columns B of Form C-6. Any material difference indicates a probable error in calculations.

Costing of Commercial Work

Costs of commercial work cannot be separated from family services in the same way as dry cleaning and specialties in the average laundry, as washing, flat ironing, and sometimes other departments process both types of work, and cost separations cannot be made until the costs of these processes are determined.

Therefore, commercial work should be treated as one or more services in making a cost survey. Costs of each commercial account, or any new or proposed account may be easily determined. Usually, commercial work is handled in separate lots, so that there is no identifying cost, and frequently, delivery cost can be separately computed. Otherwise, costing of this work may be determined in the same manner as family services. Since prices of the larger commercial contracts are usually separately negotiated, cost determination may be of greater immediate practical use to the laundryowner than in family services in which prices are uniform and are changed very infrequently.

Costing of Dry Cleaning Services

The same cost principles and methods used to determine the costs of family laundry services may be applied to the determination of the cost of dry cleaning various types of articles, such as men's suits, overcoats, women's coats, silks, etc. The forms used for laundry surveys can easily be re-designed to fit dry cleaning plants. While production centers are somewhat different, the groups into which costs are separated for distribution are the same except that power costs are about half as great as in laundries, the cost of distilling and filtering solvent for re-use being much less than that of heating water for washing.

The "Two-Price" policy of many dry cleaners injects an interesting cost problem, because a substantial part of the work may be sold at lower than standard prices, the principal differences in cost being savings in inspection, spotting, less complete pressing, and less expensive garment bags and hangers.

While dry cleaning plants handle an almost infinite variety of articles, a very large proportion of total revenue is derived from the cleaning of men's suits and coats, and women's suits, coats, and dresses.

A cost survey in a dry cleaning plant should never be made in a period of peak production, during which, because of over-utilization of all plant facilities, costs will be abnormally low and profits so high as to have little significance as guides to management.

COST ACCOUNTING IN LEATHER MANUFACTURING

By

ARTHUR T. CARUSO *

I. DESCRIPTION OF THE INDUSTRY

General Background

One of the oldest industries developed by man is the tanning or preservation of hides or skins to produce leather for the protection and comfort of mankind. A tour of museums would disclose considerable evidence that the technique of hide preservation, although crude in comparison with modern processes, has been practiced for thousands of years.

In contrast with the simple requirements of pre-modern times, today's demands for leather are both many and varied. Leather must be made to fit into the many and constantly changing style patterns of such items as shoes, gloves, luggage, handbags, and clothing, using leather as basic material. Naturally, present-day demands for such a wide variety of leather products have brought about the establishment of specialization within the tanning industry.

The tanning industry as a whole is concerned with the manufacture of leather from many types of raw materials. The greater part of these raw materials represents the hides and skins of domesticated animals, such as cows, sheep, lambs, goats, kids, pigs, and horses. In addition, alligator skins, sealskins, and skins of other water animals are utilized to provide the products required by the various segments of the leather market.

Leather produced from cattle hides constitutes the greatest single product classification in the industry. Carrying the breakdown further, cattle hide leathers are divided into two broad divisions: First, that portion of the industry which utilizes the whole hide in order to produce a heavy quality of leather suitable for shoe bottom stock and industrial leathers; and second, that portion of the industry concerned with the use of raw material suitable for shoe uppers and other leather products requiring lighter weight stock. Of the latter group, using such materials as cowhides, calfskins, and sheepskins, the most interesting, as well as the most important from a volume standpoint, is that branch of the industry dealing with cowhides.

Because it is felt that an understanding of the cost accounting methods indicated for this branch of the industry—by far the most complicated—would enable one to carry the knowledge through to other branches of the industry, the methods outlined herein are related to the manufacture of the lighter weight leathers from cowhides.

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Classification of Products

The products manufactured from cowhides divide themselves into two main groups—namely, grains and splits. To the uninitiated the label "genuine leather" carries a great deal of inferential prestige and high quality acceptance. The fact is, however, that leather so labeled could well be inferior in quality. An average cowhide weighs about 50 pounds and may run to a thickness of an inch. Obviously, if lightweight leathers are to be produced from such a hide it must be split down to the thickness required. This is accomplished with a splitting machine which cuts across the hide thus separating it into two parts, the top or grain side and the bottom or flesh side, known as a split. Obviously, the top side of the hide, exposed to the weather and toughened by the sun, is the most durable and desirable. The split or flesh side, not possessing the strong tough fibers present in the top side of the hide, is processed into less expensive leathers. There is nothing, however, to prevent a manufacturer from labeling the split product "genuine leather."

An unusual situation occurs in cowhide tanning in that the hide itself is a by-product of the slaughter house while the hide tanning process develops still another important by-product in the form of splits.

Top-grain products are used mostly for upper leather in shoe manufacturing. They go into medium-priced dress shoes and lower-priced sport shoes. Split leathers find their way into soft sole stock for slippers, shoe linings, upper stock for work shoes, and certain types of suede leathers.

Origin of Products

Substantially, the products of a leather manufacturer are few and fairly stable up to the point of finishing. Various methods of finishing are utilized in order to produce a glaze or luster or color to fit into the current style patterns demanded by the trade. The leather manufacturer's research facilities are usually directed toward improvement of quality rather than the development of new products, although it is obvious that considerable research and experimentation are necessary in order to produce exactly the weight, color, and flexibility called for by the style demands of the particular period.

Except for the relatively few large cowhide tanners who maintain well-equipped and well-staffed laboratories, research activities of the average tanner are carried on under the direction of the tannery superintendent mainly through experimentation. Ordinarily, the cost of materials and labor involved in such experimental work is charged to cost as an element of manufacturing burden.

Sources of Raw Materials

Practically all the cowhides used in manufacturing upper leather are obtained domestically from the various large meat packers and from recognized independent slaughterers. There is usually a slight price differential in favor of the packer hides which is ordinarily overcome, however, by their greater footage yield. Some cowhides are imported from Canada and South America, but the quantity from these sources is not normally important.

If a manufacturer decides on a policy of processing the split by-product into finished leather it may be necessary to obtain additional split stock from outside sources to reach an efficient production volume. The source of split raw material

is represented by other cowhide leather manufacturers who have adopted a policy of selling their split by-products rather than processing them.

Size and Type of Enterprise

It is necessary for the sake of this discussion to make a basic assumption concerning the size and type of the manufacturing enterprise. It follows, of course, that the larger companies require a more detailed breakdown of organizational functions pertaining to administrative and service activities, while the smaller companies, which are in the great majority, would find it adequate and satisfactory to combine many such activities into a single division. It is considered desirable to gear this discussion to the needs of a moderate-sized establishment processing grain leather from purchased hides and, in addition, processing its own split by-products together with splits purchased from outside sources.

Departmentalization of Manufacturing Activities

As is the case in any manufacturing establishment, one of the essential steps in developing adequate cost accounting and cost control data is the determination of appropriate cost centers. This is necessary from two points of view. First, to establish the cost accounting plan in line with responsibilities set forth in the company's over-all organization plan. Second, to provide suitable points in the manufacturing process at which costs, particularly manufacturing burden costs, can be applied most accurately to the products processed. In developing the required cost centers, the usual distinction is made between service departments and producing departments.

Service Departments

These service departments are commonly found essential to maintain the producing functions of a typical leather manufacturer's plant at a reasonably high level of performance:

Steam Plant
Power Plant
Repair Shop
Factory Administration

In addition, there may be found the service departments of Building Service and General Factory Service which, although not actually part of the operating organizational structure, are necessary to suit the convenience of the cost accounting plan.

Worthy of mention is the fact that a tannery utilizes a great deal of steam and hot water in its processes, thus making it necessary even in the smaller manufacturing establishments to set up an efficient boiler plant. While the average tannery consumes a great deal of electrical power to maintain its operations, the policy as to whether or not it should operate its own power plant is primarily one to be decided by management in the face of its power requirements as against available supply, with consideration of comparative costs. Many tanneries are located in country areas where it is not possible to purchase all their power requirements, in which case the decision to generate their own electrical energy is chiefly one of necessity rather than cost.

The factory administration center simply brings together in one place the salaries and expenses of the hide buyer, the purchasing agent, superintendent, and equitable portions of top-management and office salaries and expenses. Obviously, some of these functions would be set up as separate centers in large companies, but in the average tannery the amounts involved are not of sufficient size to warrant such treatment. The same sort of comment can be made regarding the personnel relations function. In the average tannery this function is handled by the superintendent with the assistance of the controller with respect to interpretation of government regulations, record keeping, etc. Here, again, large companies might find it desirable to establish an entirely separate personnel relations department in order to centralize that activity for better coordination and direction.

Producing Departments

The operations of an average tannery may be divided into five major departments as follows:

Hide House.—Here, hides are received, checked, and stored. On receipt of production authority, draw hides from stock and deliver to hide trimmers who cut the hide down the back from head to tail thus producing two sides for every hide. The reason for this operation is to facilitate the handling of stock. Obviously, the handling of the entire hide weighing around 50 pounds would place a definite handicap on the efficient movement of materials through the various operations.

Beam House.—This function prepares the stock for tanning by soaking it, removing hair, removing loose flesh, and pickling for the purpose of preservation.

Tan House.—In this area the hides are split so as to produce the proper weight of top grain leather and the split by-product. The stock is then placed in large revolving drums containing basic tanning agents and operated for a length of time necessary for the chemicals to penetrate the stock, thus converting it in a relatively short time from raw stock into leather.

After the stock is removed from the tanning drums and allowed to drain, it is subjected to an alkaline solution necessary to set the tannage and prepare it for the coloring process. Basic coloring is also done in large revolving drums containing the required dye solutions.

It should be noted that there are many variations of the foregoing process, the choice of which depends on the type and quality of leather desired. For example, the splitting operation may be done after tanning rather than before tanning. It should also be pointed out that many tanners have worked out a process whereby the tanning and basic coloring may be done in a single operation rather than separate operations, and they have found the result to be acceptable to the trade which they supply.

Finishing.—The finishing operations include a number of mechanical steps which are performed to obtain softness and pliability, luster, and the desired surface color of finished leather. These operations are commonly known as toggling or tacking, staking, buffing, embossing, and seasoning.

Shipping.—The so-called shipping department takes the finished leather and proceeds to sort it into types, weights, and grades. The leather is then measured piece by piece on a measuring machine to obtain the number of square feet. It is then bundled into half-dozens (grains) or dozens (splits) to await shipment to customers.

Production Planning

Efficient manufacture of leather requires that the entire process be carried out continuously from beginning to end with the numerous intervening operations properly balanced to produce a predetermined volume. There are two principal reasons for this need. First, the raw material itself is subject to decay until it has gone through the tanning process. The second important factor is one of inventory control. Even the shortest period of time for converting the raw stock into finished leather covers a number of weeks, whereas in the case of certain types of leather the conversion period may run into months. With such a low turnover of inventory having a high raw stock cost, there is obviously a great premium on the ability of management to maintain an inventory of work in process that is no more nor less than is needed to keep all operations performing on an efficient level. Clearly, if there is delay in putting stock into process there will be corresponding delay at a later date throughout the entire process. The production plan is geared, therefore, to the objective of turning out a daily volume of finished leather equal to the yield from a daily volume of raw stock put into the works. Because of the foregoing conditions, the planning and scheduling of production is quite simple, once the desired capacity of the plant has been decided upon and all operations and equipment are balanced in accordance therewith.

Up to the point in the process where the surface coating of shade or color is applied, not much attention need be given to customers' orders except to draw therefrom a general impression of the weights of leather desired. The usual plan is to place orders with the seasoning (or coloring) department specifying the shade or color actually required by customers' sales orders. When customers' demands are low and it is desired to operate on full schedule, two courses are open. One course is to arrest the production in the seasoning room and finish it to customers' color specifications as they are received. Another course, as a supplement, is to go ahead and color the leather in anticipation of customers' requirements, using the trend of color demands reflected by orders received as a basis and leaning toward the more staple colors.

It is fairly common practice in tanneries to use a tag system to control the movement of the stock from one operation to another. All stock going into the process is given a lot number which identifies it through all operations until it is measured and put up into bundles, at which point it constitutes finished leather production. The use of the lot number is essential for the physical control of the stock itself as well as for certain cost and yield information of importance to the hide buyer.

II. How to Design the Cost System

Objectives

In designing a cost system for a leather manufacturer producing various types of leather from purchased raw stock as well as from its own by-products, these requirements should be met:

1. Obtain accurate product unit cost as a basis for establishing pricing policy.
2. Provide for determination of operating results and financial condition on a monthly basis without recourse to the taking of physical inventories with its attending delays and cost.

3. Provide timely and adequate reports of operations for company executives for the purpose of pointing out existing strengths and weaknesses.

4. Set up internal checks and balances designed to make sure that value is received for all disbursements and to protect the assets of the company against theft or misappropriation.

Major Factors To Be Considered

During the past few years when raw materials and finished products were under the control of government both as to quantity and prices, the main problem of cost accounting was to provide data helpful in maintaining efficient operation within the profit margins permitted by government regulations. Normal, free competition within the industry was entirely lacking, with the result that no pressing problems existed requiring a company to reduce costs in order to place it in a position to sell equivalent quality of product at a lower price than competitors. Again, the wide fluctuations normally inherent in the hide market were not present with the result that practically all the speculation concerning the ultimate value of the inventory was nonexistent.

In a free economy, however, the leather manufacturing business is extremely competitive and exceptionally risky. A plunge into the history of tanneries over a long period of time would provide ample evidence of the speculative nature of their operations. A necessarily high and slow-moving inventory of work in process purchased at high prices, with the probable advent of lower hide prices from day to day, gives but an indication of the unenviable position in which a tanner constantly finds himself. The risks entailed in carrying such an inventory are, unfortunately, of the one-way street variety. In a free competitive market an immediate increase in hide prices cannot be entirely reflected in the prices of finished leather to customers—any attempt to do this usually brings the retort from customers that orders were placed at a given price and delivery is expected on that basis. On the other hand, if hide prices go down, the pressure from customers for lower prices is almost immediate, no mention being made then of the prices at which orders were originally placed.

It will be seen from the foregoing that a successful leather manufacturer must be alert and resourceful at all times. He depends to a considerable extent on a dynamic cost accounting system which will be useful to him as a tool for coordinating and controlling the many factors of his business.

Type of Cost System Required

As has been stated, production of leather is accomplished through a continuous process from one operation to another. Obviously, then, the most desirable type of cost plan indicated for such an enterprise is one dealing with costs from the viewpoint of process as contrasted with one dealing with specific jobs. This statement does not mean, however, that all types of leather travel through the same operation or in the same sequence. It means, rather, that every kind of leather travels through predetermined or standard operations, using varying facilities according to its nature.

Except for the handling of raw materials, which is best accomplished on an actual cost basis, all other manufacturing cost elements lend themselves to the effective use of standard costs. These elements are tanning materials, direct labor, and manufacturing burden.

With a hide market subject to violent fluctuations outside the control of the hide buyer, and with the raw material cost component of total manufacturing costs representing 50% to 60% of the total, it is essential and important to consider raw material as an entirely separate factor on an actual cost basis. The cost of sales for a given month would thus consist of the actual cost of raw materials plus the standard cost of all other manufacturing costs. With respect to manufacturing cost elements other than raw material, desirable data on variances of actual costs from standard costs are obtainable for study and corrective action.

III. Description of the Cost System

Before proceeding with an explanation of the major operating and control statements produced by the cost system, it is advisable to point out some of the unusual problems posed by the leather industry together with suggested methods of treatment.

Unit of Manufacture

Both grain leather and split leather are put through the manufacturing process as "pieces." It is probable that this practice may have developed partly from the fact that the "piecework" method of wage payment has been employed in the industry for many years, and partly from the fact that inventory control data are best expressed in terms of pieces. In recent years, chiefly at the insistence of labor that pieces put into process were not of an "average" size but were running larger than average, a new development has occurred to complicate the situation. Pieces must now be sorted according to size (surface area), the piecework rate increasing somewhat, but not entirely, in proportion to the increase in size. As a result of this development pieces may fall into as many as seven or eight size classifications.

The sales unit of leather is a square foot. Raw stock is bought on a pound basis. It is clear from this heterogeneous unit condition that considerable research work must be undertaken in order to develop reasonably accurate conversion factors to be used in obtaining the standard unit cost of a square foot of finished leather. Furthermore, such research work must be kept up to date to give cumulative weight to the latest actual conversion figures.

Some attempt has been made within the industry to change the unit of manufacture to a square foot basis so as to bring it into conformity with the selling unit. In most cases, however, such a procedure has been found costly and impracticable, and has eventually been abandoned.

Cost of Raw Material

Every purchase of raw material is assigned a lot number coded to provide significant information at a glance. This number is used as identification for cost purposes and for inventory control all through the process.

As already stated, raw material is treated in the cost accounting system on an actual cost basis. Aside from its tremendous importance as a cost factor, there is the need for constant comparison of actual cost with quoted market prices as a basis for policy decisions, relating to selling prices, production schedules, and financial requirements. There is also the added fact that raw material cost includes many

items which would make the determination of standard purchase prices, and purchase variances, largely arithmetical with little control meaning from the viewpoint of management.

The total cost for a given lot of raw material might include any or all of these items:

1. Invoice cost of raw material
2. Incoming freight
3. Cartage inward
4. Brokers' fees
5. Duty on foreign stock
6. Insurance and weighing charges on foreign stock
7. Warehousing charges

Treatment of By-Products

The most common by-products obtained from a hide during the manufacturing process include splits, heads and shoulders, bottoms, and offal.

Splits.—A record is maintained of the splits obtained from each lot of hides. The total weight of the splits thus obtained is priced at the current market price of comparable splits to obtain the raw material value of the split by-product. A monthly entry is made crediting the hide raw material account, and the hide lot producing the splits, and debiting the splits raw material account, also kept by lot number. The splits are then processed and handled in the same manner as if they had been purchased from outside sources.

Heads and Shoulders.—The value of the raw material hide lot producing the heads and shoulders is credited with the value of such by-products calculated at the current offal price. The debit is to the raw material account for heads and shoulders, kept by lot number. The method of arriving at the weight of heads and shoulders varies in different plants. In some plants the actual weight is obtained in the same manner described above for splits. In other plants, however, a basis for estimating the weight is worked out which simplifies the procedure and is usually sufficiently accurate to make it practical to use.

Bottoms.—After the flesh side is split from the grain side, it may be found that it is still too thick to be processed into desired leathers. In such a case a further splitting is made and a "bottom" is obtained.

The determination of weight and value for bottoms follows the same procedure stated above for heads and shoulders. The entry again sets up a debit for the bottom raw stock, kept by lot number, and credits the raw material hide lot from which the bottoms were obtained.

Offal.—This classification includes fleshings and trimmings accumulated during the entire manufacturing process. It is sold to manufacturers of glue and other gelatinous products.

The accounting treatment for the sale of offal is simply to debit accounts receivable and credit a special income account. This treatment is admittedly not good cost accounting from a technical standpoint. The proper method would be to credit the value received against the cost of the raw material lots yielding the offal. Such a practice is obviously very complicated and impractical, and is therefore rarely, if ever, followed.

Important Data Produced by the Cost System

The major results of the cost system from the viewpoint of managerial control are contained in these statements and records:

1. Profit-and-Loss Statement
2. Comparative Statement of Gross Profit on Sales
3. Manufacturing Burden Statement
4. Standard Cost of Product Sheet
5. Weekly Payroll Analysis
6. Monthly Production and Cost Report
7. Lot Record

Profit-and-Loss Statement

This statement, Figure 1, summarizes for management the results of all operations for the month and the year to date. Monthly and cumulative relations to net sales, expressed in percentage, provide management with a quick picture of the operating trend and indicate over-all strengths and weaknesses.

Somewhat unorthodox is the first item on the statement which shows the total gross profit on sales. This is done because its importance is such as to require many significant details which must be presented in a separate statement for clarity and completeness.

The total amount of variance from standard cost with respect to tanning materials, direct labor, and manufacturing burden is then shown on the statement.

CONDENSED PROFIT AND LOSS STATEMENT

Month of _____ 19__

	This Month		Year to Date	
	Amount	% of Net Sales	Amount	% of Net Sales
Gross Profit on Sales				
Cost Variances:				
Tanning Materials Purchased				
Tanning Materials Used				
Direct Labor				
Manufacturing Burden				
Adjusted Gross Profit				
Selling and Administrative Expenses				
Operating Profit				
Add—Sales of Offal				
Scrap Sales				
Interest Received				
Deduct—Interest Paid				
Net Profit				

Fig. 1. Profit-and-Loss Statement.

Adequate and detailed records are available for study in the event that any of these items appears to be out of line.

Obviously, the object of the profit-and-loss statement, as exhibited here, is to present the broad, over-all operating facts requiring a minimum of study time on the part of top management. Indicated variances from the norm are properly subjects assignable to the controller for intensive search into the detailed records for causal factors.

Comparative Statement of Gross Profit on Sales

This statement, Figure 2, breaks down the total gross profit by classes of product and provides considerable significant information having to do with sales volume, cost of sales, and relative gross profit margins.

The segregation of "returns" and "allowances" and their distribution to product classes (on the basis of actual analysis) are particularly useful in this industry. In times of free competition when quality must be maintained at a level commensurate with rival companies, a quick perusal of these columns shows the extent to which the company's quality has not been acceptable to customers and, further, the products mainly responsible for the unsatisfactory situation. Thus are guideposts set up for an orderly and constructive approach to the problem.

Cash discounts are deducted direct from sales in order to arrive at the correct net revenue arising from the sale of the respective product classes.

The presentation of units sold, dollar sales, and average selling price per foot for the various product classes, establishes a comprehensive reflection of sales activities. This is clearly invaluable as a basis for discussion of plans and policies with sales division executives.

A word about cost of sales. This figure represents the actual cost of raw material plus the standard manufacturing cost made up of tanning materials, direct labor, and manufacturing burden.

The production tag procedure makes it possible to determine the quantity and kind of leather produced from each lot of raw material. The actual total cost of raw material for each lot divided by the total pieces in the lot produces the unit cost per piece. The footage of each kind of leather produced during a given month is summarized according to raw material lot numbers showing the number of pieces used from each lot. It is then simply a matter of arithmetic to determine the actual cost of raw material used per foot of the different kinds of finished leather. This unit cost plus the standard manufacturing unit cost equals the total unit cost for each product, and is applied to the products shipped in order to obtain the cost of sales.

Manufacturing Burden Statement

This report, Figure 3, lists the elements of manufacturing burden with corresponding amounts for the month and the year to date. The total burden is compared with the burden earned at standard rates in order to arrive at the unearned or over-earned burden and variance.

Here again the object is to present management with a statement that is both simple and significant. Detailed departmental records are maintained in the cost department and these are used to break down the total variance between that attributable to volume and that attributable to inefficient expenditures. This over-all

ANALYSIS OF GROSS PROFIT ON SALES

Month of _____ 19__

Product Class	Gross Sales	Returns	Allowances	Sub-Total	Cash Discounts	Net Sales			Cost	Gross Profit	
						Amount	Feet	Ave. Per Foot		Amount	% of Net Sales
Grain Leather:											
Buck											
Gun Metal											
Elk											
Etc.											
Total Grain											
Split Leather:											
Lining											
Slipper											
Suede											
Etc.											
Total Split											
Grand Totals											

Note: Repeat Net Sales and Gross Profit Columns (last five columns) as extension of this form, or on separate sheet, to show "Year to Date" totals.

Fig. 2. Gross Profit on Sales.

type of burden statement is usually much more effective for top executives than a mass of detailed departmental information which is both time-consuming and difficult to interpret. Its purpose is solely to acquaint top management with the important factors concerning manufacturing burden, leaving detailed analysis and interpretation of abnormal situations to the controller whose training and knowledge are better able to cope with such detailed figures.

MANUFACTURING BURDEN

Month of _____ 19__

Expense Item	This Month	Year to Date
Supervisory Salaries		
Indirect Labor		
Fuel		
Electricity		
Supplies		
Repairs		
Social Security Taxes		
Insurance		
Local Taxes		
Depreciation		
Etc.		
Note: Above classification is rather basic—actual classification would provide much more detail if considered essential for better control.		
Total Manufacturing Burden		
Burden Earned at Standard Rates		
Unearned or Over-earned Burden and Variance		

Fig. 3. Manufacturing Burden.

Standard Cost of Product Sheet

A standard cost of product sheet, per 100 pieces, Figure 4, is compiled for every kind of leather manufactured, and includes the manufacturing cost elements of tanning materials, direct labor, and manufacturing burden. Separate cost sheets are compiled for different colors of the same kind of leather when there is an appreciable difference in manufacturing costs. In some cases, the substitution of one color for another to the same kind of leather does not make enough difference in the total cost to warrant separate treatment. A number of colors may therefore be grouped on a single cost sheet and that sheet used as standard for all of them.

The information called for in the upper right-hand corner of the cost sheet indicates, in the case of grain leather, the beaming process to be used since the process varies with different types of leather. When the cost sheet is used for split leather,

the type of split is shown here. If it is a "chrome" split, for example, certain operations essential to a "lime" or "pickled" split are not necessary.

The various cost columns are headed up with the different sizes of raw stock used to make a particular kind of leather.

A summary cost of materials used is entered against the operation listed. This is based on approved formulas which show the quantity and kinds of ingredients required to put through economical batches. The materials are priced at standard purchase prices, allowance is made for waste and shrinkage, and the total batch cost is converted to a 100-piece basis.

With the exception of seasoning or surface coating materials, required materials vary according to size and weight of stock. In the case of seasoning, the effect of size variation on cost is not practical to determine; therefore, seasoning costs are applied to all sizes on the basis of a "typical size" cost.

In the labor and burden section, the operations performed are listed in sequence of performance and each operation is priced at standard in the appropriate columns.

Direct labor standards fall into two classes. The majority of operations are paid on a piecework basis; therefore, the piecework rate per 100 pieces of the various sizes becomes the corresponding standard. In the case of direct labor paid on a daywork basis, appropriate analysis and time study are indicated in order to determine the standard number of man-hours required to process 100 pieces of the various sizes.

The total cost per 100 pieces is obtained at the foot of the standard cost sheet, for the various sizes, and is used for obtaining standard cost values throughout the entire process up to the point where finished products are measured for footage at the measuring machines.

Based on cumulative yield records, the average footage per 100 pieces for the different sizes is then inserted and the total cost per foot is obtained. This standard manufacturing cost plus the actual cost of raw materials is applied to shipments to form the basis for the entry debiting the cost of sales account and crediting the finished goods account.

Weekly Payroll Analysis

This is a report issued soon after the close of the payroll week. Of greatest importance is the summary it presents of the variance from standard direct labor cost. The report also shows the distribution of the entire weekly payroll. This statement is an extremely valuable one for the manufacturing executives as it gives them a clear and concise picture of the manufacturing operations and singles out those departments showing substandard performance.

The standard cost of direct labor is obtained by a calculation on employees' time slips which show the lot number, the number of pieces produced, and the elapsed time. A section of the time slip is reserved for showing the standard labor unit cost of the operation performed and the total standard labor cost. These slips are filed by employees from day to day. At the end of each week the weekly totals are summarized on the top slip and transferred to the weekly payroll report, Figure 5.

Monthly Production and Cost Report

The purpose of this report, Figure 6, is twofold. First, it provides top management and the manufacturing executives with a summary of the total production

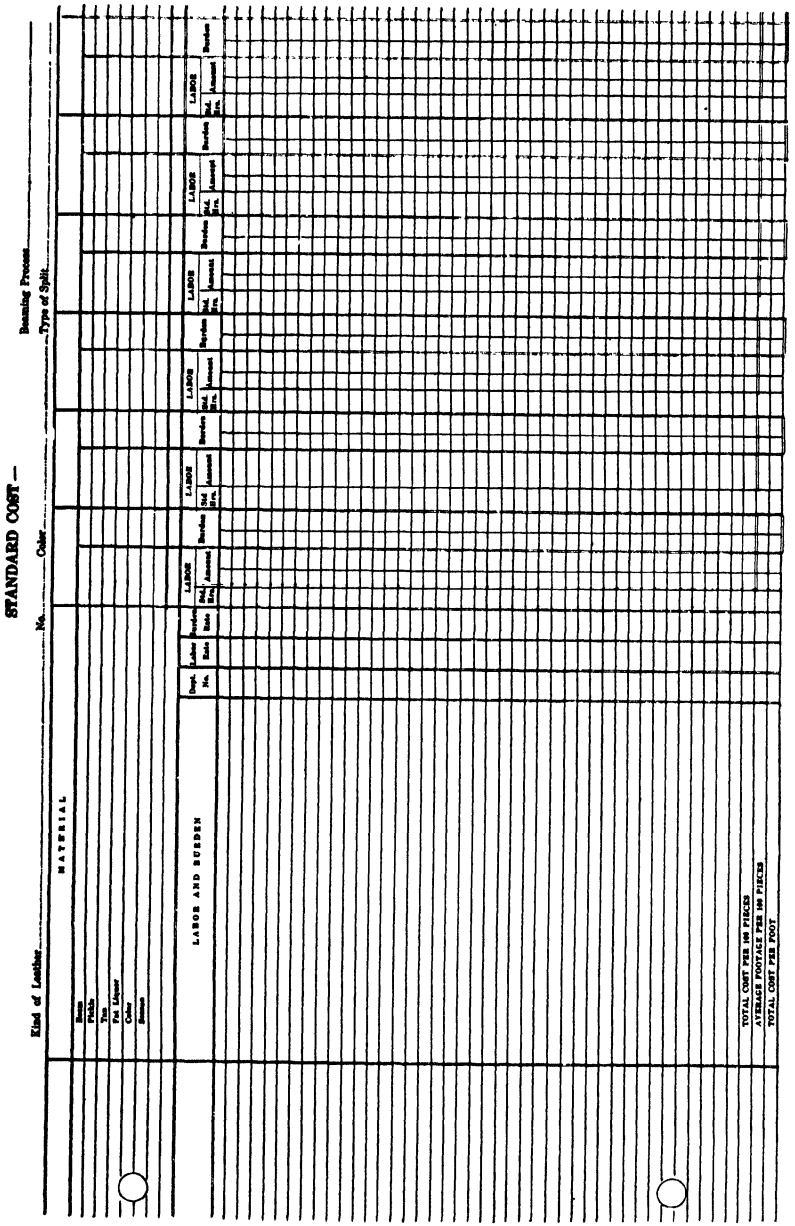
STANDARD COST —
Kind of Leather
No.
Order
Beaming Process
Type of Split
MATERIAL
Bows
Flicks
Ties
Toe Lifter
Other
Bottom
LABOR AND BURDEN
Dept. No.
Labor Rate
Burden Rate
LABOR
Std. Hrs.
Amount
Burden
TOTAL COST PER 100 PIECES
AVERAGE FOOTAGE PER 100 PIECES
TOTAL COST PER FOOT

Fig. 4.

PAYROLL ANALYSIS

Week Ended _____ 19__

Cost Center		Direct Labor			Supervisory	Indirect	Clerical	Overtime
Number	Name	Actual	Standard	Variance	Salaries	Labor	Salaries	Premium
1	Steam Plant							
2	Power Plant							
3	Repair Shop							
Other Service Centers								
11	Beam House							
13	Splitting							
14	Tan House							
—								
24	Stake							
25	Toggle							
—								
—								
30	Seasoning							
Other Producing Centers								
Totals								

Fig. 5. Weekly Payroll Analysis.

SUMMARY OF PRODUCTION

Month of _____ 19__

Product Class	Grade 1	Grade 2	Grade 3	Rejects	Table Run	Total Feet	Total Cost
Grain Leather:							
Buck							
Gun Metal							
Elk							
Etc.							
Total Grain							
% of Total						100%	—
Split Leather:							
Lining							
Slipper							
Suede							
Etc.							
Total Split							
% of Total						100%	—
Grand Totals							

Note: Repeat above form as extension of this form, or on separate sheet, to show similar data for "Year to Date."

Fig. 6. Monthly Production and Cost Report.

by classes of product and by grades for a given month and the year to date. It is possible to observe fairly quickly from this report the quality trend of production as a whole, as well as specific classes of product in connection with which quality problems may be particularly acute. With this information before them, responsible executives are in a constructive position to hold conferences of a specific nature and to deal with facts that may form the basis for appropriate corrective action.

The second purpose of the report is to summarize the total cost of production. including actual cost of raw materials and standard cost of manufacturing. This total cost is the basis for the monthly accounting entry debiting the finished goods accounts and crediting the work-in-process accounts.

Lot Record

This important record, Figure 7, serves two principal purposes. First, it serves as a subsidiary lot inventory ledger in support of the control accounts—raw material and work-in-process—which are carried in the cost ledger. Second, it provides a wealth of significant statistics pertinent to a given lot of grain or split stock.

It is filed by lot number until the lot has been completely processed and closed out. Thereafter, the form is filed by vendors and affords an excellent background of information used by the hide buyer to determine the most profitable sources of supply.

In addition to the general and basic data shown in the top section, the front page of the record is an ordinary ledger form with two sets of ledger columns—one set used for raw material entries and the other, for work-in-process entries. Space is provided for showing the number of pieces of stock against the corresponding money entries. The money balances from each of the two classifications are drawn off at the end of each month and compared with their respective control account balances. Pieces are entered in the single column so headed (black ink for debits, red ink for credits) and the net balance is used for progressive check with actual inventories. Thus is provided an effective control over an inventory that represents a considerable financial investment.

The back page of the form provides vital information regarding the profitableness of a given lot of stock. The wise purchase of raw stock—suitable for particular kinds of leather, and providing satisfactory yields from footage and quality standpoints—is one of the best assurances for profitable operation in the leather industry. The data provided here are designed to aid the hide buyer in fulfilling that basic objective.

Tanning Material Purchase Variance

A standard purchase price is established by the purchasing department for each of the numerous oils, chemicals, and dyestuffs used in the manufacturing process.

When invoices are received from vendors, they are verified in the usual manner. In addition, the standard purchase prices are applied and the total standard cost is determined and noted thereon. The tanning materials inventory account is carried on the books at standard cost. Therefore, the entry in the voucher register is a debit to the inventory account for the standard cost, a debit or credit to the purchase variance account for the difference between the actual and standard costs, and a credit to the account payable control account.

LOT RECORD

(Front)

Lot No._____

Vendor_____ No. Pieces_____ Weight_____ Price_____ Total Cost_____

Ave. Weight per Piece_____ Ave. Cost per Piece_____ Size Breakdown_____

RAW MATERIAL					WORK-IN-PROCESS				
Date	No. of Pieces	Dr.	Cr.	Bal.	Date	No. of Pieces	Dr.	Cr.	Bal.

(Back)

PRODUCTION					SALES		
Kind of Leather	No. Pieces	Feet	% of Total	Total Cost	Selling Price	Sales Value	% of Total Cost to Sales Value
Brown Smooth				—			—
White Elk				—			—
Etc.				—			—
			100%		—		

Ave. Feet per Piece_____ (Feet ÷ No. Pieces)

Yield_____% (Feet ÷ weight)

Quality:	Feet	% of Total
Grade 1		
2		
3		
Rej.		
T.R.		
	—	
		100%

Fig. 7. Lot Record.

Tanning Material Usage Variance

Standard quantities of the various materials required to produce a given batch of mixture for beaming, tanning, etc. (see Figure 4, standard cost sheet), are established on the basis of formulas created by the chemical laboratory. Due allowance is made for waste and shrinkage, and the standard cost per 100 pieces of the different kinds of leather by sizes is calculated.

Monthly summaries are compiled showing the standard cost of tanning materials required for the production at appropriate points in the process. The total thus determined is compared with the standard cost of materials actually drawn from stores. An entry is then made debiting the work-in-process account with the standard cost value, crediting the inventory account with the actual cost (at standard prices) and debiting or crediting the usage variance account with the difference between the standard and actual costs. If an important material usage variance arises, reference is made to the monthly summaries to localize the source of undue waste as a basis for discussion and remedial action.

Determination of Standard Burden Rates

An annual budget of manufacturing expenses by cost centers is developed in cooperation with department heads. The total budgeted expense for each cost center is compared with the annual budget of direct labor for each of the respective cost centers to obtain the percentage of burden to direct labor. The "percentage of direct labor" method for applying burden to the cost of product is usually satisfactory in this industry. The fact that a large proportion of direct labor is paid on a piecework basis, which inherently considers the time element in its construction, makes it possible to secure reasonably accurate product costs by using such a method.

PUBLISHERS OF ANNUAL AND LOOSE-LEAF VOLUMES

By
T. REGINALD CLOAKE *

I. DESCRIPTION OF THE INDUSTRY

Classification of Publications

The title of this chapter is inclusive and embraces a number of different types of publications. Although each has its own cost accounting peculiarities, all have basic cost accounting similarities. Descriptions of the types considered in this chapter are presented below.

First, there are bound technical volumes issued annually and prepared for professional purposes, that is, in medicine, engineering, etc. These publications are similar in form each year with much of the material repeated exactly as in the previous volumes, but with some of the material revised and brought up to date, and with new material added. Another type, perhaps the most familiar to accountants, is the annual and loose-leaf volumes of the tax services, which consist of a separate set of services for each different type of tax, that is, as for Federal income tax, state taxes, etc. In this type of service, loose-leaf volumes are similar in form each year but with the material brought up to date. At intervals during the year, perhaps weekly, insert sheets are provided which furnish additional new sheets or take the place of material furnished at the beginning of the year for which pages are to be deleted. Thus the volume is kept up to date from week to week.

Catalogues or directories are types of annual volumes and in some instances represent a very substantial cost. Catalogue cost may be part of sales expense, as in the case of the Sears Roebuck publication; or it may represent the cost of a commodity, as in the case of stamp catalogues. Stamp catalogues or albums are published either in bound volumes, or in loose-leaf editions that are available for arrangement at the user's pleasure. The telephone directory is, of course, one of the best known of the annual directories, although there are many others issued for cities, associations, etc. The above types are only some of the annual and loose-leaf volumes; there are numerous others not described here.

Origin of Publications

Some of these publications developed as the need for professional memoranda in volume form occurred. To keep the information up to date, it became necessary to revise the issues each year. With currently changing statutory laws and court opinions, it was advisable in some fields to revise the data much more frequently; hence the scheme of adding or changing pages was put into practice and the loose-leaf services were born.

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It is usually not necessary in the case of catalogues or directories to revise them more frequently than annually. Where the issue of current information is desirable, but also where it need not be specifically indexed and cross-referenced for immediate access by subject groupings (as in the case of loose-leaf legal and tax services), a system of periodic supplements, say quarterly, in magazine form is sufficient. The disadvantage of the annual volume plus magazine supplement arrangement over the loose-leaf system lies in the absence of cross-referencing. In such instances, it is necessary to scrutinize not only the master volume but also the magazine supplements in order to ascertain definitely that all information on the particular subject is considered.

Sources of Materials

Materials for the publications consist of the tangible items of paper, print, binders, etc., as well as the important and costly intangible item of professional information. With the exception of the sales catalogue, these volumes actually represent the sale, through the medium of a publication, of the services of professional advisors. The commodity sold therefore represents time of the experts (perhaps well-organized research staffs) with all the accumulations of salary costs for assistants, and applicable overhead expenses.

In some instances publishers create only the text material, and contract for the entire printing and binding operations. There is naturally a simplification of cost accumulation and analysis in such cases; however, the costs of preparing the text material should be accurately accounted for. In this chapter, we shall be mainly concerned with the publisher that not only develops the text material, but does its own printing, from setup through binding.

Organization of Plant

The production organization of the annual and/or loose-leaf volume publisher (excluding the overhead departments such as accounting, personnel, etc.) has a logical pattern as follows:

1. Research staff consisting of experts and their assistants.
2. Writing and editorial staff (frequently combined with the research staff).
3. Setup and display or illustration staff.
4. Printing, proofreading and binding department (no binding in loose-leaf editions other than insertions in original edition).
5. Inspection section (partially performed by proofreading as in four).
6. Folding, inserting, wrapping, packing, sealing, and mailing division (where required).

The overhead pattern presents problems of cost distribution inasmuch as certain types of overhead are applicable only to printing shop operations (printing shop indirect expenses), whereas other overhead items are applicable to all operations. In industries other than publishing, selling expense is sometimes grouped with general and administrative expense for distribution, but for the type of publishers considered by this chapter selling expense should be treated as a separate item. Selling expense can be substantial for publishers of annual volumes and may include salaries of sales personnel, commissions, traveling expenses, advertising, circulars, mailing lists, overhead of the sales department, etc.

Obviously, the entire cost of the sales catalogue type of annual volume repre-

sents selling expense, but it should be noted here that the printing operation in many such instances is entirely performed by an outside contractor. Cost accumulation in such cases is therefore greatly simplified.

Most of the organizations publishing annual and loose-leaf editions are pretty large firms, and they usually publish more than one type of volume or loose-leaf edition. In those instances, sales as well as costs should be accumulated by publication so that results may be obtained by product. Columnar arrangement by publication may be found desirable for operating statement purposes.

Production Order System

The research, writing, and editorial staffs do not operate by production orders in the same sense that the term may be applied to a factory job order. However, they do plan their work and it is essential that time records be maintained so as to make possible accumulation of their time and other costs by publication. In a large organization, a staff might devote its entire time to a particular publication, as in the case of a continuous loose-leaf service, whereas another staff might devote its entire time to a different publication. In such a situation, each separate staff would represent a distinct cost center.

Printing for all publications is most frequently performed in one printing department and should be controlled by printing (production) orders which are issued by the editorial staff. A publication planning department is necessary only where volume is considerable and priority of issuance is important as in the case of up-to-the-minute loose-leaf services.

II. How to Design the Cost System

What Information Is Required

The purpose of the cost system is to develop reasonably accurate costs by publication with sufficient analysis to enable management to make useful comparisons by periods. Analytical costs by publication are desirable, total costs by departments are essential. Because the printing, binding, folding, etc., department most likely will operate as a printing shop, doing many different publication jobs, the costs for that function may be adopted from the printing industry or they may be planned to meet the especial needs of the annual and loose-leaf volume publisher. The printing plant represents a combination of departments, each of which performs a part of the job.

Considerations in Designing the System

If the annual and loose-leaf volumes are similar in setup or form each issue, and if the same illustrations or displays are used repeatedly, as in the case of stamp albums where expensive engravings are used over and over, then much consideration should be given to the proper amortization of the plate costs (setup) over more than one issue. Plates for directories and catalogues may also be used again and again with corrections for additions, deletions, and alterations.

To charge the entire plate (setup and illustration) cost to the original issue would most likely give a warped operating result on an accrual basis. Difficulty in arriving at a proper amortization rate arises from the fact that the circumstances are entirely different from those existing in the case of the usual published book

where it may be possible to spread the original plate costs over the estimated sales volume period on the basis of experience.

Original setup and plate costs therefore might be reasonably amortized on an estimated basis over a period of several years, say three to five, and current alteration costs for additions or deletions (rearrangement using same basic form and illustrations) might be acceptably absorbed in current expenses. The matter of amortization is entirely one of accounting opinion, and the cost accountant should make every effort to be reasonable in his decision. All factors should be well considered so that the decision is not entirely conjecture.

The "Standard" Cost System Is Favored

For the printing department the use of standards is desirable. The standards for the allocation of costs to the various jobs (publications) running through the department may be developed on some common-sense basis, such as square or linear inches of print. If found adaptable, machine-hours might lend themselves as a standard unit base. For other operations, such as folding, inserting, binding, etc., standards may be developed in hundreds of units, or in some other acceptable measurement. Paper stock and other materials can be charged at standard rates or at actual cost if found more workable in the particular circumstance. For a large printing plant the methods of cost application described in next to the last paragraph of this text might be practicable.

All standard cost variances should be observed monthly in order to ascertain that they are reasonable and not excessive. Unusual variances may indicate that standard rates require adjustment or that waste may be occurring in the printing department.

Research, writing, and editorial departments are more adaptable to the distribution of costs on an actual basis. Salaries and wages may be distributed to the various publications on an actual time record basis, and actual overhead determined as a result of a study might be applied on a labor dollar or hour basis.

III. Description of the Cost System

Introduction

Management will be interested in results by publication, or by types of publications where the organization is a large one. In Figures 1, 2, and 3, such analyses of results are presented. The statements have been modeled after those of a specific publishing concern and thereby have the value of a practical illustration. Changes in, or additions to, the actual statements have been made where the author considered it desirable to illustrate points which might concern other types of annual or loose-leaf volume publishers. In adopting any of the suggestions made herein to a particular situation, the cost accountant should endeavor to apply only those which are pertinent.

Methods of cost accumulation and application are discussed herein, however illustrations of forms for the detailed application of the methods are not included. It is believed sufficient to describe the procedures, in a manner which will enable the cost accountant to develop the form which, in his judgment, is most adaptable to the particular circumstance. Otherwise this treatment would be burdened with general cost accounting forms such as clock cards, job time cards, printing (produc-

tion) orders, payroll distribution sheets, material issue orders, supplies requisitions, machine hour records, paper inventory records, etc.

Figures 1, 2, and 3 with textual explanations will serve to demonstrate the operation of the cost system and they should be scrutinized at this point.

A. B. C. COMPANY

STATEMENT OF PROFIT AND LOSS

Year ended December 31, 1946

	Actual Income or Expense	Variance Actual over Standard	Publications		
			A	B	C
Sales	$980,000		$147,000	$175,000	$658,000
Cost of Sales (per statement)	710,500	$ 21,000	106,400	114,000	469,100
Gross Profit on Sales	$269,500	$ 21,000	$ 40,600	$ 61,000	$188,900
Selling Expense:					
Salaries and Commissions	$ 33,000		$ 5,700	$ 5,400	$ 21,900
Circulars—Mail Campaign	9,500		2,100	1,300	6,100
Other Selling Expense (including Overhead)	8,700		1,800	900	6,000
	$ 51,200		$ 9,600	$ 7,600	$ 34,000
Selling Profit	$218,300	$ 21,000	$ 31,000	$ 53,400	$154,900
General and Administrative:					
Officers' Salaries	$ 47,000				
General Office Salaries	84,000				
Pensions	4,500				
Telephone and Telegraph	4,700				
Stationery and Printing	2,100				
Postage	1,300				
Legal and Accounting	10,500				
Insurance	2,000				
Taxes other than Federal Income	4,000				
Miscellaneous	1,500				
	$161,600				
Operating Profit	$ 56,700				
Other Income—					
Interest and Dividends	3,100				
	$ 59,800				
Other Deductions—					
Interest Paid	1,500				
	$ 58,300				
Provision for Federal Taxes on Income	21,000				
Net Profit	$ 37,300				

Fig. 1. Statement of Profit and Loss.

A. B. C. COMPANY
COST OF PUBLICATIONS SOLD
Year ended December 31, 1946

	Total Actual Cost	Variance Actual over Standard	Publications A	Publications B	Publications C
Research Staff	*$ 90,000		$ 21,500	$ 29,500	$ 39,000
Editorial Staff	* 60,000		10,700	18,300	31,000
Total Research and Editorial Costs (per statement)	$150,000		$ 32,200	$ 47,800	$ 70,000
Printing Department Costs					
Materials:					
Purchases	$200,000				
Inventory—Beginning	100,000				
	$300,000				
Inventory—Ending	50,000				
Materials Consumed	$250,000	$ 17,000	23,000	27,000	183,000
Direct Labor	$125,000	5,000	19,000	14,000	87,000
Overhead:					
Indirect Labor	$ 37,000				
Rent	36,000				
Power and Light	12,000				
Insurance	2,000				
Depreciation	19,000				
Supplies	3,500				
Miscellaneous	2,500				
Total Overhead	$112,000	(3,000)	17,000	13,000	85,000
Plate Cost Absorbed (Setup and Illustrations)	$ 40,000		10,000	7,000	23,000
	$677,000	$ 19,000	$101,200	$108,800	$448,000
Work in Process (Printing):					
Add—Inventory—Beginning	21,000		5,000	5,000	11,000
	$698,000	$ 19,000	$106,200	$113,800	$459,000
Less—Inventory—Ending	23,000		7,000	6,000	10,000
	$675,000	$ 19,000	$ 99,200	$107,800	$449,000
Binding, Folding, Inserting, Etc.	27,000	2,000	6,000	5,000	14,000
Work in Process (Bindery):					
Add—Inventory—Beginning	3,500		700	800	2,000
	$705,500	$ 21,000	$105,900	$113,600	$465,000
Less—Inventory—Ending	3,000		500	600	1,900
	$702,500	$ 21,000	$105,400	$113,000	$463,100
Finished Volumes:					
Add—Inventory—Beginning	37,000		9,000	8,000	20,000
	$739,500	$ 21,000	$114,400	$121,000	$483,100
Less—Inventory—Ending	29,000		8,000	7,000	14,000
Cost of Publications Sold	$710,500	$ 21,000	$106,400	$114,000	$469,100

* Overhead included and applied on an actual basis monthly as a percentage of direct labor—see Figure 3.

Fig. 2. Cost of Publications Sold.

Statement of Profit and Loss

An explanation of Figure 1, Statement of Profit and Loss, illustrates how operations by publication are determined. Where the issues published by one concern are numerous, it would be impracticable to develop costs by each issue and therefore, in such instances, similar types of issues might be grouped. The cost accountant should consult with top management in order to ascertain the refinement of operating results required.

In the illustration, selling expense is a significant item and therefore it is desirable to provide suitable detail in the accounts for the accumulation of this type of cost by issues. Overhead applied to the selling division, such as space, light, telephone, depreciation, etc., is not shown separately in this example but is included under "Other Selling Expenses." Where overhead is substantial and the detail

A. B. C. COMPANY
ANALYSIS OF RESEARCH STAFF AND EDITORIAL STAFF COSTS
Year ended December 31, 1946

	Total Actual Cost	Publications		
		A	B	C
Research Staff				
Salaries and Wages	$ 70,000	$ 16,716	$ 22,939	$ 30,345
Overhead Applied:				
Rent	$ 11,200)	(Applied at the rate of $0.2857 per labor dollar)		
Light	400)			
Insurance	800)			
Depreciation	1,200)			
Supplies	3,500)			
Miscellaneous	2,900)			
	$ 20,000	$ 4,776	$ 6,554	$ 8,670
Research Staff Cost	$ 90,000	$ 21,492	$ 29,493	$ 39,015
Editorial Staff				
Salaries and Wages	$ 45,000	$ 8,025	$ 13,725	$ 23,250
Overhead Applied:				
Rent	$ 7,600)	(Applied at the rate of $0.3333 per labor dollar)		
Light	350)			
Insurance	250)			
Depreciation	1,000)			
Supplies	3,000)			
Miscellaneous	2,800)			
	$ 15,000	$ 2,676	$ 4,575	$ 7,749
Editorial Staff Cost	$ 60,000	$ 10,701	$ 18,300	$ 30,999
(A) Combined Research and Editorial Staff Cost	$150,000	$ 32,193	$ 47,793	$ 70,014
(A) Per Statement of Cost of Publications Sold, Rounded Out to		$ 32,200	$ 47,800	$ 70,000

Fig. 3. Analysis of Research Staff and Editorial Staff Costs.

thereof is desired, a schedule showing the allocation as in Figure 3 is necessary. For a nonmanufacturing department, such as the selling department, it is impracticable to use standard costs. Distributions of actual overhead should be made each month on the basis of a study which would reveal the amount of space used for the allocation of rent, similarly for light, depreciation on furniture and fixtures, split of telephone services, etc.

Operating results by publication are developed only through selling profit in Figure 1, although conceivably some distribution of general and administrative expenses could be made. In the opinion of the author, such further distribution would serve no useful purpose to management since it would most likely be made prorata on the basis of sales, costs, or profit up to that point. Such distribution would be in a large measure arbitrary. Up to the point of selling profit, allocations were specific and would readily indicate whether the operations by issues were satisfactory.

Cost of Publications Sold

Referring to Figure 2, the operations in which standards were used can be readily recognized, since they are the ones for which variances are shown. It may also be observed that the printing shop and bindery operates as a separate division with several types of standard cost application.

The research staff and editorial staff, being nonmanufacturing departments, take distributions of overhead on an actual basis. The rates were developed after study as explained above for the selling department. Detailed time records consisting of time sheet forms prescribed by the cost accountant should be maintained by the research and editorial staffs in order to provide accurate monthly salary distribution data.

Figure 3 furnishes management with information regarding the type and amount of overhead applied to the research and editorial Departments. Since the distribution of overhead in the illustration given is made monthly on an actual basis, the rate per labor dollar each month will vary. The rate of application shown in Figure 3 represents the average rate for the year. Variations by month ought not to be large where the payroll is about the same each month and therefore, for cost purposes, it should not be necessary to revise the rate to a yearly basis and change all the monthly distributions.

Printing Department Costs

Materials used would consist mainly of reams or rolls of paper. Standards may be developed by types of paper stock with an addition for other materials such as inks, cleaners, etc.

Direct labor standards might include workmen's compensation insurance, social security expense, and allowance for (normal) overtime where at reasonably regular recurring intervals deadlines must be met and overtime incurred. These extra payroll type charges are sometimes considered as part of overhead and in such case they would be provided for in the overhead standards.

Overhead standards can be applied as a percentage of labor dollar, on a machine hour basis, or any other practical base.

Binding, folding, inserting, etc., standards lend themselves to a unit basis such

as hundreds or thousands of items. Depending upon the refinement of cost, standards may be broken down by operations such as cutting, stamping, sewing, etc.

Plate Cost Absorbed (Setup and Illustrations)

As hereinbefore explained, setup and illustration or display costs may represent a deferred charge to operations to be amortized over a period of several years. Where it is decided to defer such costs, accounts should be provided for their accumulation in the research, editorial or printing departments. The deferred amount, in the author's opinion, might be properly shown in the balance sheet under two classifications. That portion to be amortized within one year (similar to an inventory) might be included under "current assets," and the remainder shown under "other assets."

Variances

When it is observed that variances are becoming excessive, investigation should immediately be made in order to ascertain that waste is not developing. If material changes have occurred in the basic data upon which the standards were set, such as increases in wages, materials cost, etc., then revision of standards is in order.

Alternative Standards for a Large Printing Plant

Where the printing plant is very large, it may be found desirable to accumulate costs by production centers as practiced by some large industrial printing establishments. Cost centers might consist of divisions as: Composition, presswork, binding, etc. Hourly costs by centers could be established and charges to publications made upon a machine hour basis. Where the production consisted of handwork, a standard would be developed and applied on a labor hour basis.

Code of Accounts

In order that a cost system may be established successfully, much consideration should be given to account classifications. Where possible, account titles should follow their descriptions in the operating statements, thus facilitating their arrangement at statement time. All accounts should be coded in a flexible manner thereby allowing for additional account refinement and cost analysis if later found desirable.

COST ACCOUNTING IN LOGGING AND LUMBER MANUFACTURING

By

HARRIS E. SMITH *

I. DESCRIPTION OF THE INDUSTRY

The lumber business is the oldest business in America. Stanley F. Horn, in his book, "This Fascinating Lumber Business," points out that the first cargo of manufactured goods shipped from this country (in 1609) was lumber. Colonel F. G. Sherrill of the U. S. Army Engineers, during World War II, stated that lumber was "the most vital material for successful prosecution of the war." No business in the world is as widespread as the lumber business, since trees, from which lumber is manufactured, are found around the globe. Estimated lumber production during 1945 was 27,951,000,000 board feet, enough to build 2,795,100 five-room houses, using an average of 10,000 board feet per house. At 30,000 board feet per railroad car, this would have required 931,700 railroad cars for transportation purposes. These figures cover lumber only; they do not include the many other products from logs, such as poles, piling, shingles, plywood, fuel, etc.

Classification of Products

"Lumber," to the average layman and homeowner, means boards, siding, framing, flooring, ceiling, etc. To the industry, the products from the trees mean logs, lumber, plywood, shingles, lath, and hundreds of items that go into the building of a house, barn, airplane hangar, railroad car, and a myriad other uses. The logger who sells logs only, classifies the logs by species and by grades under each species. The lumber manufacturer classifies the items manufactured from the logs, such as boards, dimension, timbers, flooring, ceiling, etc., by grades under these items. Some of the lumber manufacturers produce a great number of the items, both green and dry; others produce only green items. The latter are known as "green" mills. This term usually indicates the mills that do not have facilities for either airdrying or kiln drying items of lumber before they are sold. The size of lumber manufacturing operations varies a great deal—from the small mill requiring four or five days to produce a carload of lumber, to the large mill producing twenty to twenty-five carloads a day. Manufacturing plants vary as to equipment and machinery. Different plants have different facilities for manufacturing lumber from logs, and also for subsequent refining of the items. Such refining includes surfacing (also called planing), and drying and running to specific patterns, as in the case of flooring, car siding, etc.

* Certified Public Accountant, Washington and Oregon; Secretary, West Coast Lumbermen's Association, Portland, Oregon.

Source of Raw Material

Lumber is manufactured from logs. Logs are cut from timber. The trees are felled by "fallers" and then trimmed and cut into lengths by "buckers." Logs going to the commercial log markets are usually transported by trucks or railroads to storage and rafting grounds for sorting and grading. Logs going direct to mills are dumped into log ponds or hauled to log yards. They may or may not be graded before leaving the woods. In the log ponds they are customarily sorted as to specie, size, and grade before they are moved to the log slip for sawing.

In some cases the mill buys "cants." These are timbers which have been squared up by green mills. The "cant" mill, or remanufacturing unit, as it is more often called, then manufactures the cant into the usual lumber items, such as boards, flooring, ceiling, etc.

Organization of Plant

The cost of manufacturing, selling, and shipping lumber begins in the woods. A company which logs its own timber will have, as part of its lumber cost, the cost of the timber cut (stumpage), the labor, material, and other cost of producing the logs and getting them to the mill. The company which buys logs will have the log purchase cost as the beginning cost of its lumber operation.

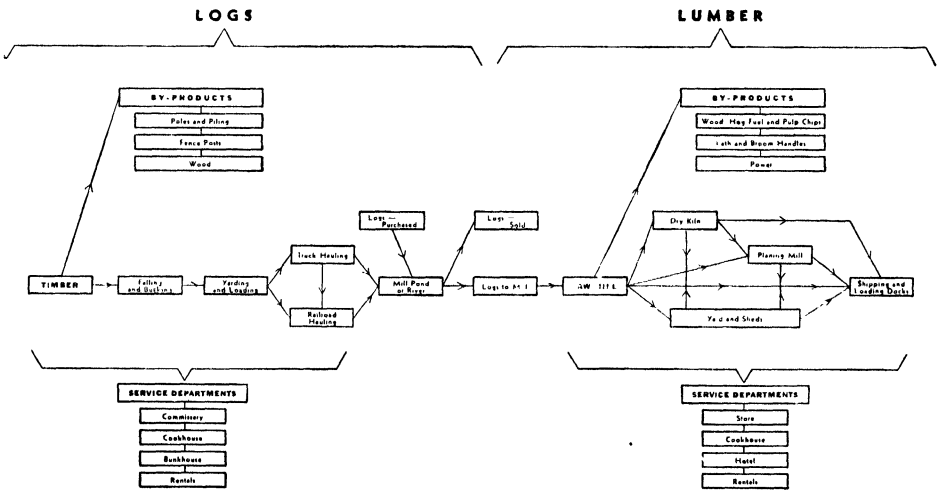

Exhibit 1. Flow Chart of a Logging and Sawmill Operation. Courtesy of West Coast Lumbermen's Association, Portland, Oregon.

Included as Exhibit 1 is a flow chart, published by courtesy of the West Coast Lumbermen's Association, Portland, Oregon, showing the usual breakdown of a logging and sawmill operation. Not every logging operation or sawmill will have all of the operating breakdown shown. Some will have less and some more, depending on the size of the operation and the refinement of manufacture the particular operation follows.

Production Order System

Generally speaking, the average sawmill does not produce lumber to specific cutting orders. The principal reason is that there is no way of telling in advance as to the exact grades or items which can be cut from a log. The "sawyer" will have in front of him a list of the items wanted on specific cutting orders and after the log is "opened up," he will try to get from the logs as many of the items as he can. Each log, because of its individual characteristics, determines the items to be cut. As illustration, one log may produce largely structural items, another largely common items, another a greater percentage of flooring, ceiling, and other clear items. Since this is the case, many of the better managed companies, instead of cutting to specific orders, "get the most out of the log." This means they try to obtain the highest or most profitable grades the log will yield, and then secure orders for the stock produced.

II. How to Design the Cost System

What Information Is Required

In addition to usual payroll and material records needed in connection with establishment of any cost system, a logging or lumber manufacturing company, to get the most out of any accounting system, must have a means of securing promptly the footage volume of production, inventories and sales. This applies to both logs and lumber. The footages used must of course be accurate, as the use of an improper footage means an erroneous per thousand unit cost or sales realization figure. Records should reflect daily footages so that total footages for the period can be determined. The footage used for the various operations will vary, that is, falling and bucking footage will not be the same as that used for transportation of logs from the woods. Likewise, the footage used for the sawmill will not be the same footage used for the dry kiln operation, because it would be a rare case in which the entire lumber production would be sent through the dry kiln operation.

The proper footage to use is the one which applies to the particular departmental operation. As an illustration, the footage for "falling and bucking cost absorbed" is the net final log scale, after considering felled and bucked log inventories. The footage to use for "planing mill cost" is the tally of lumber to or from the planer, net board measure, after excluding re-runs. In addition, the cost accounting system should be designed to keep the costs by departmental operations. A glance at the flow chart in Exhibit 1 will show that the designer of the system should bear in mind the advisability of breaking down unit costs by the various operations. Thus labor and material costs will need to be distributed to the various departments, and the cost system must be designed so that this can be done readily.

Consideration in Designing the System

The system should be designed to give the unit cost of manufacture through the various departments, since it is not practicable to design a cost system which will give unit costs of the many items manufactured from a log. It should be designed also so that the current month's costs can be compared readily with the previous month, the year to date, and with previous years. The final statement should furnish management with information that can be used as a basis for check-

ing the efficiency of the operation. This means developing the system so that each department can have the cost information from month to month. In this way, the superintendent of the mill and the various foremen can keep a close check on departmental production costs.

Use of "Standard" Costs

It is not practicable in the logging and lumber industry to develop "standard costs," as commonly known, since it is impracticable to determine cost for the items manufactured in the various sizes, grades, and lengths. Nor is it practicable to work out costs for items such as flooring, ceiling, timbers, etc. Instead, unit costs are determined by departments or kind of operation, such as the sawmill, dry kiln, planing mill, yards, etc.

It is the practice of some of the larger operations to set up, by departments, what is commonly called "normal costs" and then compare the actual costs of the department with these normal costs. The normal costs are usually set up by taking the unit costs for what is considered a normal operating period and allowing for such changes as managements think are proper. These may include changes in wage scales, production programs, etc. Some companies using a budget system work out in advance a budget for each department and compare the budget with the actual transactions for the period. In a sense, the "normal costs" or "budgeted costs" might be considered as a "standard cost." Use of a "normal" or "budget" cost system is very limited. Most companies depend instead on comparison of unit costs for current period with prior periods to determine the efficiency of the operation.

Other companies have established what they consider a normal operating crew for each department for a normal work week. A daily report shows the variance between the actual crew and the normal crew. This report gives the management a daily picture as to what each department is doing as far as employment is concerned.

III. Description of the Cost System

The most important steps in establishing a unit cost system in the logging and lumber industry follow:

1. Design the Profit-and-Loss Summary for use of management.
2. Design the Summary Cost Statement and Departmental Profit-and-Loss Statement for use of management and departmental executives.
3. Design the detailed cost statement, for use of the departmental and operating heads, superintendents, foremen, etc.
4. Establish the procedures for carrying out the cost system and procuring the desired data. Particular attention should be given to development of reports that will supply the necessary footage figures for the various steps in the manufacture of lumber from the time the log is cut from the timber until the manufactured lumber is loaded in the car, truck, or boat.
5. Set up the required chart of accounts.

Profit-and-Loss Summary and Departmental Profit-and-Loss Statements

These three statements (Exhibits 2, 3, and 4) are the most important statements from management's viewpoint in that they give a summary of what has

happened in each department during the current month and for the period to date. These statements are usually worked out in such manner that they can be readily compared also with prior year figures.

These statements bring out clearly:

1. Where the profits or losses occurred.
2. Where the budget figures do not agree with actual results.
3. The clear "go ahead" or red "danger" signal as far as previous operating plans for individual departments are concerned.

The statements, used in connection with the individual departmental statements, will prevent management unknowingly continuing unprofitable departments indefinitely. An analysis of the statements will give management information it can use in determining future operations. As an illustration, since log and lumber costs are worked up on a unit basis, a sudden increase in a department's costs will be the danger signal for management to review this department's operation for the past month carefully to ascertain the reason for the increase. This may be due to increased labor or material costs, or to a reduction in the footage produced or handled by the department.

Where management uses some form of budgeting of costs and realization, the actual figures are compared with the budget and major differences are accounted for.

Costing of Individual Items and Grades—Logs and Lumber

While in theory it would appear that a cost system could be set up to cost individual items of lumber manufactured from a log, no practicable method has been worked out for doing this. The grades and items are too numerous and the method and cost of manufacture, up to time that refinement in manufacture such as drying and surfacing occurs, is the same whether the saw is sawing common or clear grades.

Some time studies have been made to determine costs of running specific orders or a particular item, such as flooring or car lining, but such studies are usually separate and apart from the unit cost system. Thus, in setting up a cost system for a logging operation and a lumber manufacturing operation, the system is planned to produce unit costs for a particular department or kind of operation. As an illustration, the logging costs are broken down as to:

1. Falling and Bucking
2. Yarding and Loading
3. Transportation
4. General Logging Costs
5. Booming, sorting, rafting, and scaling

The actual operations may be further broken down as to kind of operation, such as tractor, steam, or Diesel operation. The unit cost for each operation is ascertained by taking the footage applicable to the particular operation and dividing this into the total costs for the period.

Included are Exhibits 5, 6, 7, and 8, showing the usual manner in which unit costs by departments are determined. No attempt has been made to include a complete departmental cost statement for a logging and lumber manufacturing operation. As an illustration, under Woods Operation is shown Unit Cost Statement for Falling and Bucking and Yarding and Loading. In addition, department costs would be

EXHIBIT 2.

PROFIT-AND-LOSS SUMMARY

Items	Acct No.	Month of			Months Ended		
		Quan.	Avg.	Amount	Quan.	Avg.	Amount
Departmental Profit or (Loss)							
Logs M Ft. Log Scale							
Lumber M Ft. Lbr. Scale							
Lath and Broom Handles—M Pcs.							
Wood, Sawdust, Hog Fuel—Units							
Shingles—Squares							
Pulp Chips—Units							
Poles and Piling—Lineal Ft.							
Total Dept. Profit or (Loss)							
		Detail			Detail		
Add: Miscellaneous Operating Income							
Cookhouses							
Bunkhouses							
Stores and Commissaries							
Power and Light							
Rentals							
Lumber Sundries							
Cash Discount on Purchases							
Total Misc. Oper. Income							
Deduct: Misc. Operating Charges:							
Timberland Taxes and Expense:							
Taxes							
Fire Patrol (Ass'n. Assmts.)							
Cruising							
Bad Debts							
Cash Discount on Sales							
Total Misc. Oper. Charges							
Net Profit or (Loss) from Operations							
Add: Nonoperating income							
Interest Earned							
Profit or (Loss) on							
Land and Timber Sales							
Capital Assets Sold							
Total Nonoper. Income							
Total Down							
Deduct: Nonoperating Charges							
Interest Expense							
Casualty Losses							
Income Taxes							
Total Nonoper. Charges							
Net Profit or (Loss) for Period							

EXHIBIT 3.

LOGS—SUMMARY COST STATEMENT AND DEPARTMENTAL PROFIT OR (LOSS)

Month of					Months Ended		
M Ft. LS	Amt.	Per M	Acc. No.	Items	M Ft. LS	Amt.	Per M
				Log Sales and Transfers			
				Outside Sales			
				Less: Towing, Trucking, Handling and Marketing Cost			
				Net Outside Sales			
				Transfers:			
				Sawmill			
				Total Sales and Transfers			
				Deduct Cost of Sales and Transfers			
				Production Costs			
				Falling and Bucking Absorbed			
				Yarding and Loading			
				Contract Logging, Woods Cost			
				Transportation:			
				Railroad Haul			
				Branch and Spur Amortiz.			
				Truck Haul			
				Truck Road Amortiz.			
				Log Freight (Other than Own Railroad)			
				General Logging Expense			
				Booming, Sorting, Rafting, and Scaling			
				Insurance			
				Property Taxes			
				Depreciation			
				Subtotal			
				Cost of Contract Logs (Total Woods to Mill)			
				Stumpage			
				Total			
				Purchased Logs—Cost			
				Purchased Logs—Exp.			
				Inventory Beginning			
				Subtotal			
				Less Inventory Ending			
				Subtotal			
				Administrative Expense			
				Cost of Log Sales and Transfers			
				Profit or (Loss)			

EXHIBIT 4.

LUMBER—SUMMARY COST STATEMENT & DEPARTMENTAL PROFIT OR (LOSS)

Month of				Items	Months Ended		
M Ft. BM	Amt.	Per M	Acc. No.		M Ft. BM	Amt.	Per M
				Lumber Sales			
				Rail			
				Cargo			
				Local			
				Company Use			
				Subtotal			
				Less Returns and Allowances			
				Net Sales			
				Deduct Cost of Sales			
				Manufacturing Cost (Plant):			
				Sawmill (Includes Pond or Log Yard)			
				Timber Sizer			
				Dry Kilns			
				Planing Mill			
				Yards and Sheds			
				Transportation			
				Fire Protection			
				Insurance			
				Property Taxes			
				Depreciation			
				Manufacturing Cost—Total			
				Logs Sawn—Board Measure (Overrun . . . . .%)			
				Production Cost—Total			
				Lumber Purchased			
				Inventory Beginning			
				Subtotal			
				Less Inventory Ending			
				Total			
				Marketing Cost:			
				Shipping Expense			
				Selling Expense			
				Total Including Marketing			
				Administrative Expense			
				Total Cost of Sales Including Marketing and Administration			
				Profit or (Loss)			

shown for Contract Logging, Transportation (broken down between railroad and truck haul), Branch and Spur Amortization, and Booming, Sorting, Rafting, and Scaling.

In the sawmill, the exhibits show the unit costs for the Sawmill proper and for the Timber Sizer. In addition, unit costs would be determined for Dry Kilns, Planing Mill, Yard and Sheds, and Transportation.

Analysis for Supervisory Executives

Daily, weekly, and monthly reports are used to give management and supervisory employees the information necessary to determine the efficiency of the operation. Daily reports showing logs produced, hauled, and sawn, and lumber manufactured and shipped are kept, as well as daily reports showing the size of the crew in each department. Also shown is the time lost through breakdowns, the hours operated, etc. From these daily reports are accumulated the weekly and monthly reports.

At the end of month, the cost statements are worked up and furnished to the supervisory executives. Where a budgeted cost has previously been worked out, the actual costs are compared and major differences accounted for. In any case, the costs for the month and to date for the year are usually compared with the figures for the prior month and previous year. Since the costs are unit costs for each department, broken down as between labor, materials and supplies, payroll taxes and insurance, etc., management can determine quickly where particular costs are out of line.

The production figure is always shown in conjunction with the costs, and in addition many of the reports show hours operated and the time lost for the period. Having this information, a foreman for a particular department can determine the department's efficiency or inefficiency.

How the Data for the Cost Statement Are Obtained

Costs start with the logs. If a company is producing logs from its own timber, the various operations pertaining to felling the timber and bringing the logs from the woods will be set up in the cost accounts. Labor will be obtained from timebooks and reports of foremen or timekeepers. Materials and supplies will be obtained from requisitions and summaries prepared by shop and warehouse crews. At the same time these records are being accumulated, a report of timber cut will be prepared from reports turned in by the cutting crew. As the logs are brought from the woods, footage of logs hauled will be compiled.

If a company is buying logs from others, its costs will start with logs purchased. The purchase invoice will show footage, grade, and amount by species. In the sawmill a daily report of logs sawn, both as to footage and number of logs, is usually prepared. From this report can be calculated the daily lumber production. This is not usually the production figure that is used for cost purposes, as a more accurate production figure is determined at the end of the month by taking into consideration the beginning and ending inventory of lumber and the shipments during the month. Logs are scaled on a log scale basis of measurement, while footage of lumber is determined on a board measure basis of measurement. The difference in the two footages is known as "overrun" or "underrun" and it is the result obtained from converting the log scale figure to a board measure basis.

EXHIBIT 5.

LOGS—DETAILED COST STATEMENT

Month of			Acc. No.	Items	Months Ended		
M Ft. LS	Amt.	Per M			M Ft. LS	Amt.	Per M
				Woods Operation			
				Falling and Bucking:			
				Labor (Excluding Snag Falling)			
				Charges for Period			
				Inventory Beginning			
				Subtotal			
				Less Inventory Ending			
				Absorbed for Period			
				Snag Falling Labor			
				Supplies and Expense			
				Payroll Taxes and Insurance			
				Total			
				Yarding and Loading (Includes Rigging and Cold Decking)			
				Operating:			
				Labor			
				Wire Rope			
				Blocks and Rigging Material			
				Fuel			
				Other Supplies and Expense			
				Maintenance:			
				Labor			
				Supplies and Expense			
				Payroll Taxes and Insurance			
				Total			
				Departmental statement would follow covering:			
				Transportation			
				General Logging Expense			
				Booming, Sorting, Rafting, and Scaling			

EXHIBIT 6.

LUMBER—DETAILED COST STATEMENT

Month of				Items	Months Ended		
M Ft. BM	Amt.	Per M	Acc. No.		M Ft. BM	Amt.	Per M
				Sawmill (Includes Pond or Log Yard)			
				Operating:			
				Labor			
				Saws			
				Other Supplies and Expense			
				Maintenance:			
				Labor			
				Supplies and Expense			
				Power and Steam			
				Payroll Taxes and Insurance			
				Total			
				Timber Sizer			
				Operating:			
				Labor			
				Supplies and Expense			
				Maintenance:			
				Labor			
				Supplies and Expense			
				Power and Steam			
				Payroll Taxes and Insurance			
				Total			
				Departmental statements would follow covering:			
				Dry Kilns			
				Planing Mill			
				Yards and Sheds			
				Transportation			

EXHIBIT 7.

DETAILED COST STATEMENT

Month of			Acc. No.	Items	Months Ended		
Quan.	Amt.	Per M			Quan.	Amt.	Per M
				Shipping Expense			
				Direct Cost:			
				Labor			
				Supplies and Expense			
				General			
				Salaries and Other Labor			
				Supplies and Expense			
				Inspection Fees			
				Power and Steam			
				Payroll Taxes and Insurance			
				Transportation (Prorated)			
				Total to Distribute			
				Distribution to:			
				Lumber			
				Lath and Broom Handles			
				Shingles			
				Total Distributed			
				Departmental statement would be kept covering:			
				Selling Expense			
				Administrative Expense			
				Insurance, Property Taxes, Depreciation			
				Fire Protection (Plant)			

EXHIBIT 8.

POWER PLANT

Month of			Acc. No.	Items	Months Ended		
	Amt.					Amt.	
				Power Plant (Includes Steam)			
				Operating:			
				Labor			
				Fuel			
				Water			
				Supplies and Expense			
				Maintenance:			
				Labor			
				Supplies and Expense			
				Payroll Taxes and Insurance			
				Subtotal			
				Power and Steam Purchased			
				Total to Distribute			
				Distribution to:			
				Sawmill			
				Timber Sizer			
				Dry Kilns			
				Planing Mill			
				Yard and Sheds			
				Transportation			
				Shipping Expense			
				Lath and Broom Handles			
				Wood, Sawdust, and Hog Fuel			
				Shingles			
				Pulp Chips			
				Power and Light Income			
				Total Distributed			

Direct costs, such as labor, materials, and supplies, are usually charged directly to the proper departmental operating accounts, while insurance, property taxes, and depreciation costs are recorded in separate expense controls and then distributed to logs, lumber, etc.

Reference to the Summary Cost Statement covering Logs and Lumber will show that production and manufacturing costs are determined before inventory figures are included. Also that administrative costs are added after inventories, rather than before. Administrative costs and shipping and selling costs are also carried in separate expense controls and distributed to logs, lumber, etc.

Many companies have their own power plants. This is usually considered as a separate operation since many of the plants sell power and light to others.

By-products from the log, such as wood, fuel, lath, broom handles, etc., are usually treated as separate departments in order to determine the profit or loss on these items. It is not the usual practice to charge these departments with an estimated cost of the raw product used, but a record of all other costs, such as labor, supplies, taxes, etc., is kept.

Costs Peculiar to the Logging and Lumber Manufacturing Industry

Mention has been made previously that the first item of cost for a log producing company is the timber cut, commonly shown in cost statements as "stumpage." Depletion of timber takes place at the time the timber is felled. It is not the usual practice to determine the quantity of timber immediately after falling; instead, the depletion figure used for accounting purposes is determined after the final log scale of the timber felled is determined. The amount of the deduction for depletion with respect to a given timber account is the product of the number of units of timber cut, multiplied by the depletion unit for the period.

Depreciation allowance in the logging and lumber manufacturing industry is usually computed by two methods, that is,

1. The fixed percentage or straight-line method.
2. The unit of production method.

In the first method the amount of the deduction may be determined by dividing the cost or other basis (less salvage value) by the estimated number of years of useful life. The cost is charged to the operating costs in equal installments. Under the second method the rate of exhaustion of timber measures the useful life of the physical property. Thus, by dividing the cost or other basis, less the estimated salvage value, by the estimated available supply (M feet log scale) of timber, a unit cost is obtained. This unit cost multiplied by the number of units of timber cut during a given period gives the depreciation deduction for the period.

Where it is desired to use a unit of production method for depreciating a manufacturing unit such as the sawmill, the unit cost would be determined on a board measure basis and would consider other factors such as available log supply and the salvage value of the properties.

Many timber owning companies manufacturing lumber have found it desirable to use a combination of the two methods in computing depreciation allowance for a given period.

Inventories

The following methods of valuing inventories of logs, lumber, and manufactured products are used in the industry:

1. Cost—first in, first out.
2. Cost or market, whichever is lower.
3. Market.
4. Cost—last in, first out.

Some companies have worked out a method of using sales values to prorate cost values to the inventory items. As an illustration, assume that total cost per thousand for manufacturing lumber for the period was $40.00 and that the sales realization was $45.00. Cost is 88.888% of the sale value.

Inventory Item	Number of M Feet in Inventory	Current Sales Value per M Feet	Total Sales Value	Cost Value 88.888% of Sales Value
1	20	$35.00	$700.00	$622.22
2	10	40.00	400.00	355.56
3	5	60.00	300.00	266.67
4	3	75.00	225.00	200.00
5	2	87.50	175.00	155.55
Totals:	40 M		$1800.00	$1600.00
Average Per M			$45.00	$40.00

Only five items are shown in the example given. In practice a greater number would be included. For example, in the Douglas fir industry, twelve or fifteen items would be required for a very general grouping. A large mill might well use from sixty to one hundred items. The foregoing is shown as one method of allocating costs to inventory items where it is considered desirable to try and allocate costs by items and grades of lumber.

Realization from Sales

Returns and allowances are deducted from gross sales, while cash discount on sales is considered as a "miscellaneous operating charge" in the profit-and-loss statement. Commissions and wholesale discounts on sales are considered as part of selling expense.

As a means of determining a check on the grades produced from the logs, many companies have classified their sales accounts to show a breakdown of sales by specie and principal grades. As an illustration, a very general breakdown would be—

Clears
Shop and Industrial Grades
Structural and Select Merchantable Grades
Number 1
Number 2
Number 3

The sales invoices would be analyzed in the sales register to show both footage and amount. In this way the average unit return for the grades classified could be ascertained. This would permit comparison with prior periods. Further, by breaking the beginning and ending inventory down in the same manner, the production of the items for the month could be ascertained. This gives some check on the grades coming out of the logs. This information is invaluable whether a company is producing its own logs or is buying logs, since it gives management a picture of the lumber grades cut from the logs for the period. Some of the larger companies break the items down to sales by specie, grades, items, etc.

General

In designing a cost system for a logging or lumber manufacturing operation, it is of primary importance to give particular attention to the development of the procedure, reports, etc., to be used in accumulating the detail behind the final statements. This applies to both the footage produced, whether logs or lumber, and the amount of the expenditures for labor, materials, etc. Since the procedure and report forms to be used will vary with the size and extent of the operation, they must be designed to fit the particular operation. Therefore, no attempt has been made in this article to outline the detailed procedures and forms to be used.

COST ACCOUNTING FOR LARGE CUSTOM-BUILT MACHINES

By

A. J. BUCKENMYER *

I. DESCRIPTION OF THE INDUSTRY

Classification of Product

This chapter relates to the manufacture and construction of large specially-designed machines. It combines factory production with engineering and with manufacturing, construction, installation, or testing (or any combination of these) at the location of the customer's plant. The distinguishing characteristics of this type of product are that each complete unit sold (1) is designed to meet the customer's specifications as to work to be accomplished, and (2) is usually too large to be shipped from the factory as a complete unit. The specifications may be definite only as to the results to be obtained by the particular unit, permitting wide latitude to the designer in the selection of type, structure, size, and shape of the finished product. On the other hand, the specifications may be quite definite as to size, shape, design, and component materials, leaving only the design of the various parts to the discretion of the designers. The bulk of units sold falls between these two extremes, with few exact duplications of units (except where a single order calls for more than one unit), but a more or less continuous recurrence and adaptation of familiar principles and processes and of similar parts.

The factory manufacturing in this industry is principally low-volume work requiring skilled workers because of the special nonrecurring nature of the product. The field construction or installation differs from the construction industry in that the workers required resemble factory workers in their skills more than they resemble the usual type of construction worker. A difference must be noted in the product, too, in that the finished product must meet *operating* tests before final acceptance by the customer.

Origin of Product

The rise of this industry parallels the increasing industrialization of the country. The wide distribution and quantity production of precision articles, such as the automobile and airplane, have depended upon the development of suitable processes and machines, but they have also made possible the growth and development of industries and companies supplying such machines and of engineering knowledge by providing the market for their product.

For this reason, continuous and sometimes rapid changes in processes and techniques soon make today's designs obsolete. Continuous and relatively heavy ex-

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penditures for experimental and development work and a heavy investment in engineering personnel are the price of continued success in the industry.

Sources of Raw Materials

Raw materials are principally steel and alloy shapes of various kinds and degrees of hardness, castings, refractories, control equipment, and steel and alloy products, such as pipe fittings and bolts. The ordinary steel supplies and castings are purchased from the manufacturers or distributors and foundries and are readily accessible. Some of the alloys, refractories, and control equipment are produced by specialized manufacturers and their hardness, heat resistant or precision qualities are often the determining factor in selecting supply sources. Some manufacturers operate their own foundries, but other materials are usually purchased outside. A large variety of materials is required, and the vendors are numerous and scattered over a wide area.

Organization of Plant

The production plant for this type of manufacturer consists not only of the factory, but also of engineering and design departments and of the field construction department. All of these must necessarily work very closely with the sales engineers who have most of the contacts with the engineering and purchasing departments of the customers.

The typical departmental setup is listed below including some that are not considered as production departments where their work ties in closely with production departments.

Sales Engineers.—These men are specialized engineers usually trained in the other engineering departments of the company.

Their function is to keep informed on the customer's requirements and to keep the customer informed as to company products and developments. They make all preliminary contacts with the customer prior to the request for a proposal, assist both the customer and design department in writing specifications, and closely follow the job until final acceptance.

Their working tools and facilities are descriptions, drawings, and bills of material of prior jobs.

Sales Proposal Department.—This department consists of specialized engineers with much training in the company's product.

Upon request by the customer or sales engineers, they determine the kind of machine or equipment required, by conference with the design department, with sales engineers, and with the customer. They estimate quantities of the various materials needed, convert to cost values, add markup to arrive at sales prices, write up proposal, and submit proposal to customers, either direct or through sales engineers.

Their working tools and facilities are descriptions, drawings, bills of material, cost analyses, and prices of prior jobs, catalogues and vendors' materials.

Design Department.—The employees in this department range from special design engineers to detailers.

From the customer's order and specifications or statement of requirements they design the finished product including general and detailed drawings and bills of materials.

Their equipment and facilities are the customer's order and specifications and special conferences, assisted by reference to previously used designs, drawings, and bills of materials.

Factory-Fabrication Department.—The function of this department is to layout and fabricate component parts of special final products from steel or alloy shapes, castings, pipe, and similar raw materials by cutting, shaping, welding, and subassembly. Where the finished product is too large to ship as a complete unit, final manufacturing operations, assembly, installation, and tests take place in the customer's plant.

Its equipment and facilities are layout tables, benches, cranes, welders, cutting torches, metal saws, shears, shapers, and miscellaneous metal working machines and tools.

Factory Machine Shop.—The function of this department is drilling, milling, cutting, threading, and miscellaneous machine shop operation on castings, pipe, steel, and alloys.

Its equipment and facilities are lathes, drills, milling machines, and other usual machine shop machines and tools.

Factory—Other Productive.—This might include brick or any other department peculiar to the type of machine being produced.

In the manufacture of industrial furnaces, the brick department adds the fire-resisting refractory lining. Other type of product might require similar special productive departments.

Service Departments—such as receiving, stock, inspection, shipping, maintenance, factory management, purchasing, production control, product development, personnel, factory cost, and special cost.

The duties and facilities of these departments in this industry do not differ greatly from those in other industrial plants. However, purchasing procedures and problems are somewhat different because much of the material is special and ordered from special bills of material, requiring a broad technical knowledge of the company's products and close cooperation with the engineering department. Close cooperation is also required between the purchasing and stock departments so that there is no duplication in ordering materials and so that every item on the bill of material is ordered, if it is not already on hand or on order. Stock and receiving procedures differ somewhat due to the fact that much of the material received is ordered special for specific jobs and must be earmarked for particular orders.

Field Construction and Installation.—Their function is to complete the manufacturing, installation, and test at the location of the customer's plant where the product is too large to be shipped as a complete unit.

The equipment and facilities of this department are similar to those used in the fabrication department. The supervisor is a regular employee of the company. The other employees may be regular employees, or hired at the job site for the particular job only.

* * * *

As soon as bills of material are completed by the design department, copies are furnished to all interested departments including the factory, purchasing, stock, production control, factory cost, and special cost departments. Special materials are ordered immediately for delivery at the date required. The factory plans and

schedules the shop operations. The production control department schedules and follows up the progress of the job from the time the order is entered through all operations until final acceptance by the customer. The special cost department accounts for all items on the bill of material plus any other material costs and for all labor and burden costs on the job, including field costs at the job site.

The Production Order System

When the customer's order and specifications are received, a number of copies are immediately made for use of the various interested departments, especially the design department. A production order is entered and duplicated in sufficient copies to go to all interested departments except where one copy passes along to satisfy several needs. Purchases of materials common to numerous jobs are requisitioned by the stock control department based on anticipated requirements. Similarly, company produced materials common to numerous jobs are requisitioned by the stock department and the stock job orders released for production by the factory management. Orders for special materials for the particular job are placed with deliveries to be made to the company's or to the customer's plant at the dates required. Billings are released by the production control department if based on progress of the job, or by the special cost department if based on accumulated costs to date.

II. How to Design the Cost System

What Information Is Required

The cost system in this industry emphasizes the cost analysis of individual jobs, in addition to furnishing the usual information for operating and financial reports and control of plant operations. It should produce this information:

1. Detailed job costs—the detailed cost of each item on each bill of material showing comparisons with the estimated figures, both for costs and quantities used. This analysis is used for cost control, for guidance in design on future jobs, and for use in estimating future jobs.
2. The direct cost, sales price, and gross profit summarized for each job and by-product line showing costs by departments or types compared with estimates. This information is for management control.
3. The cost and efficiency of plant operations, both repetitive and special.
4. Data for operating reports, balance sheet, profit-and-loss statement, and government reporting requirements.

In this type of business the cost reports are designed primarily for the operating executive's immediate use. However, top management will receive copies of the summary reports and may check detailed reports closely in some cases. Top management is closer to individual jobs than in industries where volume production is the usual method.

Considerations in Designing the System

Since every job is individually estimated for quantities, costed and priced, analysis of actual performance and comparison with estimates is of great importance in order to control costs and to avoid duplicating errors on estimates of future jobs. Such analyses should cover both quantities and costs. Analyses must be in sufficient

detail to insure that offsetting errors in costs will be disclosed. The proposal department must be furnished continuous information to enable it to have on file current usable data on all phases of production and to continually revise and correct such data as conditions, prices, or labor rates change.

Small cost savings on individual parts, which can have such an important effect on profits in an industry having volume production, are of relatively less importance in this industry where the principal emphasis is on engineering and design and where repetitive operations in exactly the same form are relatively infrequent.

Because acceptance of this product is based upon satisfactory performance after completion, the completed contract basis is usually used in recognizing profits or losses on individual jobs. Accordingly, procedures must be set up to accumulate both billings and costs in "deferred" accounts until completion and acceptance of the job, and to coordinate the closing of these billings to "sales" and the costs to "cost of sales" in the same period.

Job Cost System Supplemented by Standard Costs

A job cost system, as already indicated, is the basic type of cost system used. Because each job is special and many parts are nonrepetitive, costs by jobs and continuous comparison with estimates are a necessity for successful operation. However, there are parts which recur in every unit produced or which are required in sufficient quantities to justify the use of standard costs for them, whether they are produced in the company's shop or purchased outside. Standard costs used in this way to supplement the job costs and to become a part of final job costs of the finished product present no particular difficulties and gain the usual advantages offered by standard costs to the extent that they can be adopted.

III. Description of the Cost System

Procedure in Design of Cost System

The design of the cost system should proceed in approximately this order:

(a) Design of statements and reports required:
   1. Sales and cost of sales by classes of product showing ratios of cost and gross profit to sales compared to standard ratios (Figure 1).
   2. Summary of costs by departments or by types of cost for each job of substantial size showing comparison with estimates (Figure 2).
   3. Detailed report of each job of substantial size showing comparisons of actual quantities and costs with estimates and calling attention particularly to substantial differences (Figure 3). This report is primarily for operating executives for cost control and for estimating purposes.
   4. Production reports of various kinds (not illustrated).
   5. Field Construction Progress Report (Figure 4).

(b) Procedures and records to be used to accumulate data required for statements, reports, and analyses and *of proving to control accounts.*
   1. Job Cost Summaries
      (a) For accumulating for each job the cost of design, factory, and field work and also a record of billings as they occur.
      (b) Closeout of job ledger to sales and cost of sales.

2. Method of accumulating the detail costs by items on the bills of material and comparing them with estimates.
3. Factory costs procedures for items earmarked for particular jobs and for standard materials used. Transfer of factory costs to job ledger.
4. Accumulating design costs by jobs.
5. Recording and reporting field costs (cost at the site of the customer's plant).

HEAVY MACHINE CONSTRUCTION CO.

SALES AND COST OF SALES BY CLASSES

MONTH OF _____ 194__ ____ ____

CLASSES OF EQUIPMENT SOLD	MONTH				YEAR TO DATE			
	ACTUAL	%	STANDARD	%	ACTUAL	%	STANDARD	%
Class 1								
Net Sales	$100,000	100	$100,000	100	$500,000	100	$500,000	100
Cost of Sales	80,000	80	75,000	75	390,000	78	375,000	75
Gross Profit.	20,000	20	25,000	25	110,000	22	125,000	25
Class 2								
Net Sales	$ 50,000	100	$ 50,000	100	$200,000	100	$200,000	100
Cost of Sales	33,000	66	35,000	70	130,000	65	140,000	70
Gross Profit.	17,000	34	15,000	30	70,000	35	60,000	30
etc.								

Fig. 1.

The Cost Statements

1. The statement of sales and cost of sales by classes (Figure 1) shows the gross profit amounts and ratios by major classes of the business or by major product lines. It is for the use of top executives in appraising the broad results of operations. Actual cost of sales and gross profits should be compared with calculated standard amounts based on standard ratios of these items to net sales. The standard ratios will usually be derived from past performance, but they may be estimates of anticipated results. The statement would be made periodically, probably monthly.

2. The report on individual jobs (Figure 2) shows the costs by major departments, total cost, sales price, and gross profit, each compared with the estimates for that job. It is for the major operating executives and is made periodically, usually monthly. Similar jobs or classes of product will be grouped and group totals or summaries shown. The report gives a good over-all picture of operations for the period covered, indicating where further attention should be given and what jobs or departments should be studied further or analyzed in detail.

3. Detailed bills of materials listing items and quantities are made by the design department as a matter of routine. At least one copy should go to the cost

JOB COST SUMMARY

Period_____

Order Number	Customer	Location		Design	Factory	Direct Material	Field Construction		Total Cost	Sales Price	Gross Profit	G. P. Ratio
							Labor	Expense				
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									
			Act.									
			Est.									

Fig. 2.

BILL OF MATERIAL

Order No. _____

Customer _____ Date _____ Page _____

Equipment _____ Compiled by _____

COST DEPARTMENT COPY

	Name of Article	Part or Dwg. No.	Specifications	Quantity		Purchasing			Estimate Amount	Actual		Vendor		Date	Location √	
				Each	Total	Ordered	Received			Amount	Quantity	Name	Ref.		Plant	Job
1								1								
2								2								
3								3								
4								4								
5								5								
6								6								
7								7								
8								8								
9								9								
10								10								
11								11								
12								12								
13								13								
14								14								
15								15								
16								16								
17								17								
18								18								
19								19								
20								20								
21								21								
22								22								
23								23								
24								24								
25								25								

(This column for the quantity for each unit on the order.)

(This column for the total quantity required for the order. Where the order calls for more than one unit, it is the number of units on the order multiplied by the quantity in the preceding column.)

(Purchasing Dept. record upon ordering. May consist of the date and purchase order number or other desired reference.)

(Purchasing Dept. record of receipts. May consist of the date and quantity or other desired reference.)

Fig. 3. Job Cost Detail.

FIELD CONSTRUCTION PROGRESS REPORT

Customer _____ Location _____ Order No. _____

Equipment _____ Supervisor _____ Week Ended _____

Type of Work or Job Section	Budget Total		Budget To Date			Actual To Date		Remarks
	Hours	Amount	%	Hours	Amount	Hours	Amount	

Fig. 4.

department (Figure 3) for recording on it the quantity and cost estimates, the quantities of material used and the cost by item as the basis for any detailed analysis which may be required, either as the job progresses or after it is completed.

4. The production reports for this type of business are of two kinds:

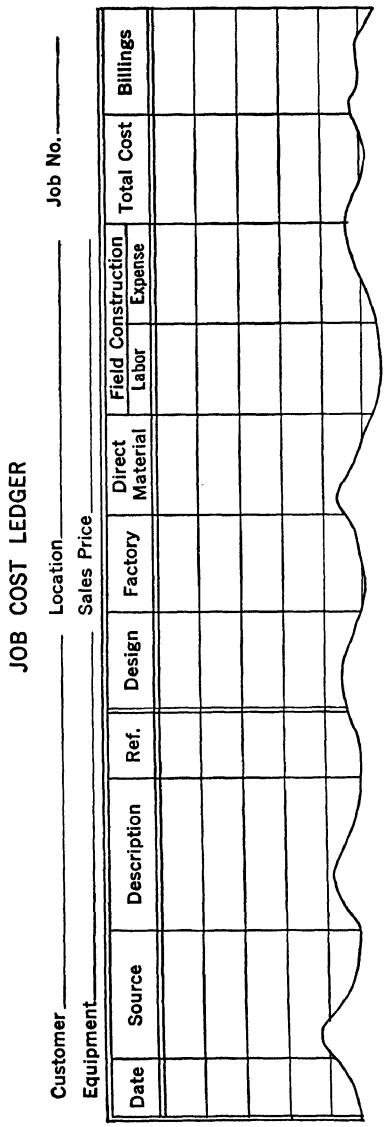
a. Factory reports for each job which are given to the special cost department for use in job analysis. The nature of these depends upon the final reports prepared for each job and the detail required when detailed analyses have to be made.
b. The usual production department's overhead, direct labor, and variance reports that have no features peculiar to this business.

5. The Field Construction Progress Report (Figure 4) is prepared for the use of the erection supervisor in charge of a job and for the chief erector. It should show the total estimated erection labor in process by job sections or by types of labor, the per cent of completion of erection of each section at the specific date and the labor cost estimated for the work actually done to date. It may be prepared at the job site or in the office, but its usefulness depends upon its being available promptly as the work progresses.

Cost Methods and Procedures

Job Cost Ledger.—A job cost ledger (or summary) is required for the accumulation of costs by departments or by types of expense. It should be designed to provide the information for the job cost report in the easiest way possible. It will include the record of billings or they will be listed on a similar separate summary. This record might be a ledger sheet, cost envelope, or folder for hand or machine posting (Figure 5) on which cumulative totals are kept up to date, or a summary of tabulated data. The sources of the entries are the usual billing, payroll, voucher, and cost journal summaries covering the activities of the various productive departments and the purchase of materials shipped direct by the vendor to the job location in the customer's plant.

At any time this record shows the costs (other than those still in the factory) and billings to date on the particular job in the general classifications desired. When the job is finished and accepted by the customer, the total billings (which should be the contract price) and the total costs, which have been deferred in liability and asset accounts up to this time, will be closed to sales and cost of sales, respectively. This may be done by a single cost journal sheet listing the billings and costs for a particular job in adjacent columns and summarizing the column totals to the proper sales and cost of sales accounts.



JOB COST LEDGER

Customer _____ Location _____ Job No. _____

Equipment _____ Sales Price _____

Date	Source	Description	Ref.	Design	Factory	Direct Material	Field Construction		Total Cost	Billings
							Labor	Expense		

Fig. 5.

The accumulated billings and costs on the aggregate of all jobs should be proved regularly to the liability and asset control accounts.

Job Cost Detail.—As costs are incurred they are accumulated by items and by sections or types of material on bills of material depending upon the manner in which the job estimates are prepared. Obviously, the estimates will not be detailed to the same extent as the bills of material, so the procedures for summarizing the cost detail must provide actual costs by the same classifications as covered by the estimates and for the same parts or sections. This is necessary both for controlling costs by having uniform bases of comparison with the estimates and for having available for future estimates the latest available information on actual costs. It also provides a uniform basis of comparison with the actual costs on similar jobs.

If this record is kept by hand posting, an extension may be added to the cost copy of the bill of material to provide one or more columns for entering the cost information opposite the items. Such information would include the date, vendor, posting reference, quantities, costs, and cost estimates. Where single items on the bill of material have a number of postings, a supplementary supporting form is used.

Proving the costs from this type of record to the control accounts in the general ledger for a large number of jobs is a big task and not practical as a regular monthly routine. This is true because cumulative costs cannot easily be kept on the individual jobs because the postings are not made in the order in which they appear on the Bill of Material. Accordingly, to obtain a cumulative total on a job, either every posting must be added each time a total is wanted or, if a cumulative total is maintained, it must be changed for each posting. For this reason, it is better to keep this as a memo record to support the Job Cost Ledger record and prove to it by individual jobs, rather than to attempt to substitute this detailed record for the Job Cost Ledger which is tied into the general books.

If, however, this cost detail by Bill of Material items is recorded on tabulating cards, it could very well become the supporting detail provable direct to the General Ledger Accounts and the job cost summaries taken off only when desired or to provide the closing information needed when a job is completed.

Factory Costs.—Factory costs may be accumulated by any of the methods commonly used for the standard cost items and for those incurred for a particular job. Materials purchased special for particular jobs will usually be charged at the actual cost with no variations segregated either for price or usage. On the other hand, both purchase price variations and use variations may be segregated in the production of standard materials. The amount of analysis desirable for these variations will depend entirely upon how important these costs are in relation to the cost of the final product. In this type of company they may be a relatively small item.

In recording the factory labor costs, standard departmental or cost center rates may be used, both for the production of standard materials and parts and for the work charged directly to particular jobs. The difference between the payroll charged to production at standard rates and the actual payroll gives the payroll rate variation by departments. In the production of standard materials a labor time variation will be segregated representing the difference between the standard production hours at the standard departmental rate and the actual production hours at the standard departmental rate. This variation will ordinarily be accumulated by department and by job within the department for any analyses required.

For production labor expended direct on particular jobs on special work, the job will ordinarily be charged for the actual hours at the standard departmental rate.

It should be pointed out that regular analyses should be made of variations of actual cost from estimates for the material and labor expended direct for particular jobs and charged at the actual cost rather than at standard cost. However, such analyses are made as a part of the job cost analyses rather than by analysis of variation accounts.

Production department overheads and indirect department costs are added to the product cost by rates set up for the various departments or cost centers. The rates may be based on labor hours, machine hours, labor cost or other method and will ordinarily be added to the costs at the same time the labor costs are charged. Since large items of material are often used which require little or no productive department's labor, some of the material handling cost may be absorbed by a burden applied on material cost. Equitable rates can be determined for various classes of material depending upon its bulk and value.

When the job materials are shipped out to the job locations in customers' plants as the factory work is completed, the factory costs are transferred to the Job Cost Ledger where they are accumulated, along with other costs, until the job is completed and the costs and sales closed to earnings. This is accomplished by cost journal entry charging the contracts in process account and crediting the various factory inventory accounts. Making these transfers as the shipments occur is desirable in order to keep the factory inventory accounts accurately reflecting the values in the plant at all times.

Design Costs.—Design costs may be charged direct to the Job Cost Ledger as they are summarized by jobs usually on a monthly basis. Time distribution may be made on a weekly, semimonthly or monthly card for each employee on which is listed each job on which work is performed and the number of hours worked on each, or time tickets may be used similar to those commonly used in the factory. Separate time tickets would be used each day, for each job, for each employee.

As in the factory, standard departmental rates may be used in charging jobs for design direct payroll. Different standard rates may be used for each grade of drafting or design employee or the departments actual rates may be bracketed and a standard rate set for each bracket at a point somewhere near the average of the top and bottom rate of each bracket. If standard rates are used, the difference between the actual total direct design payroll and the total amounts charged to jobs is charged to a rate variation account in the same way as for factory payroll.

Of course, the jobs may be charged at actual rates and probably will be in every case except where the design department is large and the use of standard rates will result in a substantial savings in clerical work.

Field Costs.—Field costs may be substantial in amount consisting principally of field labor, supervision and living expenses or allowances. If fixed crews of workers are employed and are paid from the home office, the accounting problem is mainly one of accurately recording time worked and comparing it with the estimates based on the progress of the work. Weekly time tickets by jobs provide a suitable record if combined with weekly progress reports by the supervisors.

If temporary crews are hired and paid at each job location, the job tickets should contain sufficient personal identification information, type of work, job section worked on, and any other information needed for adequate job analysis for these costs and for insurance and payroll tax reporting.

COST ACCOUNTING IN MACHINE TOOL MANUFACTURING

By
A. C. CHUBBUCK *

I. DESCRIPTION OF THE INDUSTRY

Products

The term "machine tools" embraces lathes, drilling and boring machines, milling, planing and shaping machines, grinding machines, and others. Machine tools are the foundation of all modern industrial production whether it be food, textiles, soap, building materials or automobiles for, in general, industrial processes are performed either on machine tools or upon equipment and machinery produced by machine tools. A machine tool frequently consists of several hundred parts, each of which requires several operations of a high degree of accuracy. To the extent permitted by the demand for a machine tool, such parts are each produced in lots and subsequently assembled, possibly into minor assemblies, thence into major assemblies, and finally into the completed machine.

It has been said that all machine tools have a common parent—the lathe. The general development of what are now recognized as basic machines, such as milling machines and planers, has taken place over many years. It may be said generally, however, that the demands of the mass-production industries, such as the automotive industry, with their constant emphasis on improved quality but with reduced cost have been responsible for most of the significant developments in machine tools, particularly along the lines of machines designed to undertake rapidly and accurately one operation or more on one particular part of which thousands may be produced in the course of a short period. On the other hand, demands of other manufacturers have stimulated the development of fast general purpose machines, with automatic features, which will accommodate a wide range of work. The machine tool builders have merely kept pace with the needs of their customer manufacturers. Many machine tools currently produced are in part a basic machine and in part (frequently more than half) designed to meet the peculiar needs of individual customers. Both the manufacturing and the marketing of machine tools require the services of able, engineering-trained individuals who are capable of interpreting the needs of potential customers and translating those needs into terms of their machine tool builder employer's products. Liberal appropriations for experimental work toward the end of constantly improved products are particularly vital to the success of the machine tool builder.

Raw Materials

Raw materials consist of steel purchased in various forms, sizes and kinds, forgings, castings (or pig iron, scrap iron, coke, and other foundry materials and

* Partner, Patterson, Teele and Dennis.

supplies, if the manufacturer operates a foundry), other metals, and purchased parts such as electrical controls, motors and bearings.

Organization of Plant

Shop organization will, of course, vary somewhat throughout the industry according to the nature of the product and its relative volume. Although the machine tool industry produces the machines for the mass-production industries it is not itself a mass producer. Probably the greater the degree of individuality in each machine produced the more nearly does the machine tool plant possess the characteristics of the jobbing machine shop and the more difficult it is to attain a balance of equipment usage. Vice versa, as the product is increasingly standardized the manufacturing equipment in the machine tool plant tends to become departmentalized around that product and assists production to flow in a straight line from one end of the shop to the other.

Many machine tool plants are of the jobbing machine shop variety and a plant organization typical of that variety is outlined below. If a product machine or group of machines becomes sufficiently standardized and there is sufficient volume to justify it, a production line may be established with departments or machine groups within it.

The departments of a typical machine tool plant are as follows:

Productive Departments:

- Major parts
  - Planers
  - Radial drills
  - Other equipment
- Minor parts
  - Chucking turrets—other lathes
  - Automatic bar machines
  - Bar machines
  - Heat treating
  - Gears
  - Drills
  - Mills
  - Surface grinders
  - Grinders
  - Other equipment
- Special tools
- Assembly and try-out

Service Departments:

- Shop management
- Materials receiving and inspecting
- Time study
- Planning (finished parts control, storage, etc.)
- Master mechanic (methods, etc.)
- Inspection
- Tool design
- Maintenance } Power and heat }

Purchasing (raw materials, storage, etc.)
Personnel
Painting
Boxing and shipping

Engineering and Development Department

Movement of product from operation to operation is generally by lift truck or crane. Individual completed parts are delivered either to finished parts storage and thence to assembly points or direct to assembly points. Storage of finished machines in any quantity is seldom a problem as generally machines are shipped immediately upon completion.

Production Order System

The foundation for production in a machine tool plant should be a Master Assembly List, extending into the future for six months or more, scheduling the contemplated production of basic machines, according to size and type. This Master Assembly List should be the product of the sales department's best estimates as to what the market will require and should be based upon the composite results of market research and surveys by the company's salesmen and sales organization. The Master Assembly List should constantly be revised, of course, in the light of current information.

Based upon the Master Assembly List and with regard to economical lot sizes and minimum inventory, the Finished Stores Section of the planning department may prepare the serially numbered production orders for the parts which will be necessary to build the machines indicated by the Master Assembly List. The Finished Stores Section may also prepare the requisitions for castings, steel, and other materials that will have to be ordered by the purchasing department. In many instances this is done several months before their receipt. Accompanying the production orders into the shop should be the blueprints of the part to be made, the routing sheets (operations and methods schedule), time card for each operation with standard time and other data imprinted thereon and the necessary requisitions for raw materials.

II. How to Design the Cost System

Generally, it is considered that an accounting system should be designed to permit management to control costs of operation from the outlay of the first dollar in the enterprise. Thus, with respect to manufacturing, the cost system should afford adequate control of the cost of materials, direct labor, and overhead. Inasmuch as adequate control cannot be effected retroactively, detailed knowledge as to cost objectives must be available before a job is started and be a governing factor as the job progresses. If a shop man possessing information as to the time a job assigned to him should take finds he cannot do the job within the time limits prescribed he immediately should go to his foreman for instructions as to how to proceed.

The results of this sort of necessary control should be progressively summarized, first according to operations, then according to sections, departments, products, and the enterprise as a whole. This will afford knowledge as to responsibility and the adequacy of administration of the control mechanism and thus permit informed and intelligent development of business policies.

The selling price of a machine tool will have very little effect upon the cost of the products which, during its lifetime, it will produce, for selling prices of the tools are little affected by costs of the tools. However, in determining the selling prices of the component parts and assemblies for repair replacements, it is probable that the relative cost is more of an immediately relevant factor.

Direct labor and manufacturing overhead together oftentimes aggregate 70% or more of the total manufacturing cost of a machine tool. Manufacturing overhead comprises supervisory and other indirect labor charges amounting oftentimes to 50% or more of the total. Such labor charges as well as many of the other overhead costs are variable to a considerable degree with the hours of direct labor required by the work undertaken. Control of direct labor is, therefore, of fundamental importance in the machine tool industry.

Surveys of the machine tool industry indicate a wide variety of costing practices ranging from the purely "historical" type to those with well-developed standards. It appears, however, that very few of the cost systems are devoid of the influence of standards even though there may not be any considerable reflection of the measurement of actual costs by means of standards in the books of account. In the machine tool industry, as previously mentioned, many of the products are the result of the manufacture and assembly of hundreds of parts, which must fit accurately into their designed place. Departures from specified tolerances mean either spoiled parts or lost time in fitting and scraping, which in turn means reduced profits. Bringing to light (1) failures to have in stock the right sizes and kinds of steel, (2) delivery by the foundry of hard castings, (3) errors in the many complex drawings, (4) inadequate tooling, (5) insufficiently trained help—to mention a few nonstandard conditions a properly designed standard cost system will detect—are strong influences in favor of standard costs.

III. Description of the Cost System

The summarized results of operation under the standard cost system should be set forth in a statement of profit and loss (Exhibit 1) in sufficient detail and with sufficient frequency, according to product classifications, to permit the general management of the particular concern to obtain a clear and timely view of the results of operation and of the effectiveness of operation in relation to established standards.

To obtain such a statement of profit and loss, several important steps must first be taken, as follows:

1. Design the standard cost sheet (Exhibit 2) for each part, assembly and machine tool.
2. Design operation reports for foremen and superintendents, summarizing the details of operation in comparison with standards (Exhibit 3).
3. Develop cost standards for materials, labor (Exhibit 4), and manufacturing overhead.
4. Develop the routine procedures and accounts for accumulating standard costs of product and the variances due to nonstandard performance.

The statement of profit and loss and the various preliminary steps in its evolution are commented upon in following paragraphs.

EXHIBIT 1

STATEMENT OF PROFIT AND LOSS

For the Period Ended_____
and
For the Year to that Date

*Black = Current Actual is more than
Red = Current Actual is less than

	Exhibits	THIS PERIOD							YEAR TO DATE			
		Actual		Budget		* Comparison with budget	* Comparison with last period	* Comparison same period last year	Actual	* Comparison with budget	Comparison with last year *	
		Amount	%	Amount	%						Amount	%
Net Sales:												
Domestic												
Foreign												
Total Net Sales	1-2											
Cost of Goods Sold—Standard	1-2											
Gross Profit—Standard	1-2											
Variances:												
Materials — Price	3											
" — Quantity	3											
Direct Labor—Rate	3											
" " —Efficiency	3											
Overhead—Budget	3											
" —Volume	3											
Inventory Adjustments	3											
Total Variances												
Gross Profit — Actual												
Selling Expenses	4											
Administrative Expenses	5											
Experim'l and Devel't Expenses	6											
Total												
Net Operating Profit												
Other Income	7											
Other Charges	7											
Net Profit - before provision for Federal Income Tax												
Provision for Federal Income Tax												
Net Profit												

Exhibit 1.

PART NO. 10017	SYMBOL TM	STD. COST 4.47	
DATE 6-21-46	ROUTING	HOURS	
	SET UP	13.85	
CLASS SF		MACH .807	
STANDARD COST			
LABOR AND OVERHEAD		2.600	
MATERIAL		1.870	
COST FOR ONE		4.470	
	STANDARD LOT	.50	
NAME OF PART 36-Tooth Clutch Gear			

Exhibit 2. Cost Sheet.

Statement of Profit and Loss

There is, of course, no one best form of statement of profit and loss. However, a suggested form which embodies the necessary information for general managements' guidance is presented in Exhibit 1. It matters little, whether the main statement presents total results for the current period and year to date with supporting exhibits setting forth the results according to products, or whether the main statement presents the current period's total results and individual product results and an accompanying exhibit presents similar information for the year to date. It is important, however, that results according to product classifications, each in comparison with standard, be presented.

Variances from Standard Costs and Their Allocation

It is contemplated by the statement of profit and loss (Exhibit 1) that all variances occurring during a period will be charged against the income of that period. While certain accountants object to this practice, with merit in their objections, it appears that those who accept the practice are in the numerical majority.

The classification of variances should be such that management will be able to identify and understand the failures to operate within the limits of established plans. Sufficient supporting details of the general classification of variances should be made available to permit analysis according to materials, operators, departments, causes, and products when significant. Adequate classification for general statement purposes appears to be offered by the following conventional main account headings, according to products:

1. Materials
   (a) Price
   (b) Usage

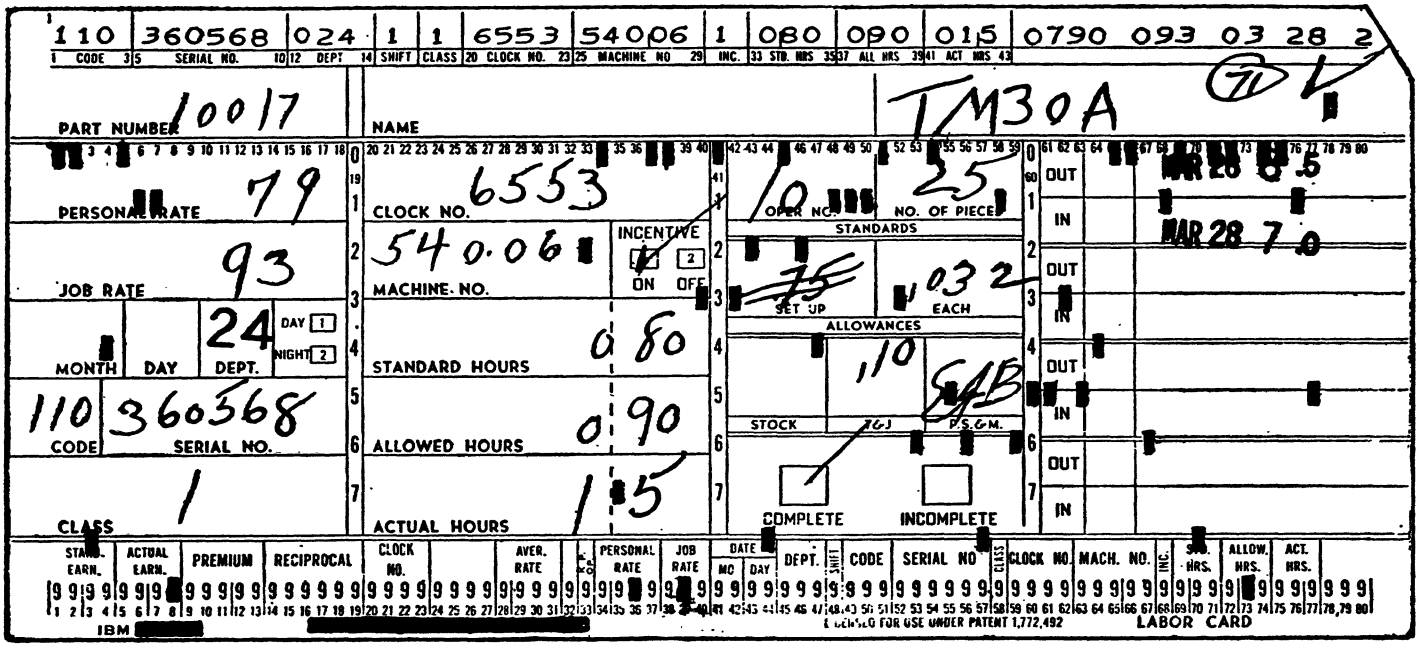

110 360568 024 1 1 6553 54006 1 080 090 015 0790 093 03 28 2
CODE SERIAL NO. DEPT. SHIFT CLASS CLOCK NO. MACHINE NO. INC. STD. HRS. ALL HRS. ACT. HRS.
PART NUMBER 10017
NAME TM30A
PERSONAL RATE 79
CLOCK NO. 6553
OPER. NO. 10
NO. OF PIECES 25
JOB RATE 93
MACHINE NO. 5400.06
INCENTIVE ON OFF
STANDARDS
SET UP 75
EACH 032
MONTH DAY DEPT. 24
DAY NIGHT
STANDARD HOURS 080
ALLOWANCES 110
CODE 110 SERIAL NO. 360568
ALLOWED HOURS 090
STOCK
P.S.&M.
CLASS 1
ACTUAL HOURS 115
COMPLETE INCOMPLETE
OUT IN
MAR 28 8.5
MAR 28 7.0
STAND. EARN. ACTUAL EARN. PREMIUM RECIPROCAL CLOCK NO. AVER. RATE PERSONAL RATE JOB RATE DATE MO DAY DEPT. SHIFT CODE SERIAL NO CLASS CLOCK NO. MACH. NO. INC. STD. HRS. ALLOW. HRS. ACT. HRS.
IBM
LICENSED FOR USE UNDER PATENT 1,772,492
LABOR CARD

Exhibit 3.

2. Direct Labor
   (a) Rate
   (b) Efficiency
3. Manufacturing Overhead
   (a) Budget
   (b) Volume
4. Inventory Adjustments

With respect to allocation of variances to products, it is probable that a large proportion of the variances will be found to arise from general conditions not ascribable directly to product, such as nonstandard materials, inexperienced help and errors in drawings which should be prorated to products upon the basis of relative cost of materials consumed, direct labor cost, or other appropriate bases. Variances attributable to specific products because of conditions peculiar thereto, of course, should not be apportioned.

Standard Cost Sheet

In Exhibit 2 is presented a form setting forth the summarized standard cost of an individual part entering into an assembly and thence into a machine tool. The standard costs of parts entering into an assembly are summarized according to materials and direct labor and manufacturing overhead on an assembly standard cost sheet which has provision for the inclusion of standard costs involved in the assembly operation. The standard costs of component assemblies are in turn summarized on a machine standard cost sheet which is similar in form to an assembly standard cost sheet.

In support of the summarized standard cost of each part entering into a machine tool are (1) the materials specifications and standard cost sheet, (2) the routing sheets (Exhibit 4) showing direct labor standards in detail according to operations and departments, and (3) the standard labor cost and standard overhead cost summaries which are the extensions at standard labor rates and standard overhead rates of the standard time data shown on the routing sheets.

As previously explained herein, it frequently happens in the machine tool industry that an important part of the cost of a machine tool may comprise equipment built to customers' specifications for which no standards of cost are available. In such instances, standard cost sheets should be developed upon the basis of the drawings, for or by the customer. Materials and methods should be scheduled and the estimated standard costs should be, in every important sense, used in the same manner as the regularly developed standards, later described herein.

Revision of Standard Cost Sheets

As a matter of practice, the standard cost factors of material prices, wage rates, and overhead rates should require change infrequently only upon basic changes in economic conditions. Other standard cost factors, such as material quantities and kinds, and direct labor operation time and related overhead, may require more frequent change as manufacturing methods are changed.

Operation Reports—Analyses for Supervisory Executives

As previously indicated herein, the scheme of cost control through standard costs contemplates that no operation shall be undertaken by an operator unless he be-

Routing Sheet For	Material	Part Number	Sheet 1 of 3
36T Clutch Gear Lathe	Forging 10017 SAE 3145	10017	Exhibit 4

Date Typed	Method by	Checked by	Supersedes	Superseded by	Standards Est. by	Checked by
6-21-46	FWD	HPH				

Oper. No.	Dept. No.	Type Mach.	Time-Hrs. Set-Up	Time-Hrs. Each	
		10017			
1	14	412	2.15	.175	
2	14	440	1.45	.057	
3	14	440	1.40	0	
4	14	440	1.00	0	
5	14	440	1.05	.053	
6	16	860	.25	.030	
7	30	800			
8	21	260	.80	.024	
9	21	740	.10	.040	
10	24	540	.75	.032	
11	24	540	.60	.007	
12	22	130	.50	.033	
13	21	740	.10	.042	
14	30	800			
15	17	630			
16	17	660			
17	17	640			
18	21	330	1.25	.112	
19	41	300	.25	.015	
20	26	310	.50	.072	
21	21	220	1.05	.031	
22	21	250	.55	.044	
23	16	820	.10	.040	
24	30	800			
25					
			13.85	.807	

Oper. No.	Dept. No.	Description of Operation	Tools and Instructions	Minutes Each
1	14	No. 5 Universal Chuck Machine. Rough and finish bore, counterbore, back face, face, double chamfer ream.	Note: Hold by outside diameter in hard jaws.	10.5
2	14	12" Fay Automatic (2 Machines). Rough turn 4.145" diameter and face end.	Driver FX-1264-1. Adapter NX-1140-22. Jaws FX-928-8. Arbor 10017-1. 1 tool turn 4.145" diameter. 1 tool face end. 42/019 Carriage travel 1⅜".	3.42
3		12" Fay Automatic (2 Machines). Rough turn large diameter and face end.	1 tool turn outside diameter. 1 tool face end. 42/009 Carriage travel 1".	0
4		12" Fay Automatic Machine (2 Machines). Finish turn large diameter, face and chamfer.	1 tool turn outside diameter. 1 tool face end. 2 tools chamfer outside diameter. 56/014 Carriage travel 1".	0
5	14	12" Fay Automatic (2 Machines). Finish turn 4.145" diameter, face end neck and chamfer.	1 tool turn 4.145" diameter. 1 tool chamfer end. 1 tool face end. 1 tool face and neck. 70/014 Carriage travel 1⅜".	3.15

ROUTING SHEET
(Cont'd.)

Changes			
Op 1 By DCH Date 3-13-46	Op 12 By CF Date 11-13-45	Op 12 By CH Date 11-16-45	

Routing Sheet For	Material	Part Number	Sheet 2 of 3
36T Clutch Gear Lathe	Forging 10017 SAE 3145	10017	Exhibit 4—Cont'd

Date Typed	Method by	Checked by	Supersedes	Superseded by	Standards Est. by	Checked by
6-21-46	FWD	HPH				

Oper. No.	Dept. No.	Description of Operation	Tools and Instructions	Minutes Each
		(Cont'd.)		
6	16	Size hole.		1.80
7	30	Inspect.		
8	21	Gould and Eberhardt No. 24H. Rough hob teeth in pairs. Full set up 1.35. Part set up .80.	Arbor 185AR-1. Spacer 188AR-2. Flange 52282-4-1. Bushing 10017-10-2. Spacer 10017-10-1. Flange 52282-4-2. Spacer 185-AR-5. Spacer 185-AR-7. Hob R2520-8R. Index Gears (60-120) (40-36) with Feed Gears (30-60) (48-75) idler. Speed Gears 33-61. Feed Gears 30-60. 48-75 NWT 12%. Speed Gears 33 x 61.	1.45
9		Burr and brush teeth and stamp.		2.40
10	24	Hand Mill. Mill keyway.	Stud 10017-17. Flat nose drill 10017-18.	1.80

11		Hand Mill. Mill 120° groove.		.40
12	22	Table Drill. Drill 33/64" hole and square bottom.	Jig 10017-1. Flat nose drill 10017-18.	2.00
13	21	Burr milling and drilling.		2.50
14	30	Inspect.		
15	17	Heat treat.		
16		Sand blast.		
17		Hardness test.		
18	21	No. 16 Bryant Grinder. Grind hole and face.	Collet 10618-6. Note: This hole must have a good finish. Do not load on staked platforms.	6.70
19	41	Blanchard Grinder. Grind second face.	Do not load on staked platforms.	.90

(Cont'd.)

Changes	Op	By	Date	Op	By	Date	Op	By	Date

Routing Sheet For	Material	Part Number	Sheet 3 of 3
36T Clutch Gear Lathe	Forging 10017 SAE 3145	10017	Exhibit 4—Cont'd

Date Typed	Method by	Checked by	Supersedes	Superseded by	Standards Est. by	Checked by
6-21-46	FWD	HPH				

Oper. No.	Dept. No.	Description of Operation	Tools and Instructions	Minutes Each
		(Cont'd.)		
20	26	Cylindrical Grinder. Grind 4.1265°.	Washer 10017-8-2. Arbor 10017-8. Nut 10017-8-3. Do not load on staked platforms.	4.30
21	21	No. 6 Gear Shaper. Finish cut teeth.	Bushing 10017-15. Do not load on staked platforms. Strokes 102. Feed 1080 NWT 7%.	1.85
22		Follows Gear Shaper. Shave teeth.	Arbor 10017-14. Do not load on staked platforms.	2.65
23	16	Polish gear end.	Do not load on staked platforms.	2.40
24	30	Inspect.		
25	65T	Store.		

Changes	Op	By	Date	Op	By	Date	Op	By	Date

lieves that he can keep within the limits of cost, of which he is advised by means of his operation ticket (time card—Exhibit 3) and/or materials requisition. If he starts a job and then encounters difficulties not contemplated by the standard procedure or anticipated before starting the job, he must stop immediately, advise his foreman, and await instructions. In spite of these principles of operation which minimize variances from standard cost, the related performances according to operations, departments, significant causes and other details should be prepared daily and summarized weekly and according to periods for use by and for the guidance of executives and to serve as detailed support for variance accounts.

Cost Standards

Materials

From detailed drawings and specifications for each part of each machine tool are determined the dimensions and kind of material to be used, having regard to the size and shape that will require the least amount of processing to produce the particular part. The quantity of material is extended at the standard price furnished by the purchasing department as that at which under normal conditions the particular material can be procured at net cost F.O.B. the company's plant.

Direct Labor

Also from the detailed drawings and specifications for each part of each machine are determined the operations and the sequence thereof that should be performed to produce the finished part.

Ideal conditions presuppose the existence of standard practice instructions (routing sheet—Exhibit 4) as to equipment to be used, the related optimum speeds and feeds for each operation and time studied standards, both for setup of the machine and for operating time. Where such scientifically developed data are not available, the best available estimates of time for each operation may be used along the same lines as the estimates that are required in any event for nonstandard production of special tooling and special equipment of machine tools required by customers to meet their special production problems. Standard rates for wages for each operation should be developed as representative of the rates payable under normal conditions. In actual practice oftentimes, the standard rates for labor may be resolved into one, two or three rates for the plant as a whole, which are fairly representative of the range.

Overhead

As previously described, the control of costs of materials and direct labor is accomplished primarily through the creation of standards therefor with respect to each part or operation, and the rigid insistence by management that if the standards are exceeded, there must be on-the-spot adequate reason for failure to keep within the limits thereof. The control of overhead, however, is not generally accomplished through the creation of standards with respect to each part or machine, but rather by means of budgets developed according to departments, both productive and service, for varying levels of productive activity as indicated by direct labor hours.

For purposes of reflecting, in relation to direct labor hours, a provision for overhead in unit standard costs, the departmental budgeted overhead for the level of

activity representing the normal ability of the company to produce and sell over a period of years considered as a cycle of the industry should be taken and expressed as an overhead cost per direct labor hour. As a practical matter, it may be found in individual cases that four overhead rates are adequate, namely, one each for major parts departments, minor parts departments, special tools department, and assembly and try-out department.

Routine Procedures and the Accounts

Cost of goods sold—standard—(Exhibit 1) represents the aggregate standard cost of all parts entering into the completed machines sold or sold as parts or in assemblies for repair purposes. As previously indicated herein, a standard cost sheet should be available for each part in each standard basic machine summarized according to basic machines, and standard cost estimate sheets should be prepared from the special engineering specifications for those parts of each machine that may be peculiar to the needs of the individual customer. The aggregate of all the applicable standard costs of parts in each individual machine should be debited to cost of goods sold—Standard, and credited to the inventory accounts, finished machines or finished parts.

Materials—price variance—represents the difference between the standard normal price of materials purchased and the net price paid therefor. This variance may be computed during the processing of the invoice and the accounting effect is that the individual materials purchased account is charged with the standard cost of the the material and the materials—price variance—account is debited or credited, as the case may be, with an amount sufficient to balance with the net amount of the invoice.

Materials—usage variance—represents the difference between quantities of materials called for by specifications and the quantities of materials actually used, both priced at the respective standard price of the materials. In the machine tool industry, this difference may arise among other things from the use of steel in shapes and sizes not contemplated by specifications and indicates either the failure of the purchasing department or of the supplier. Moreover, because the material usage variance is actually the difference between the cost of materials charged to work in process, and the standard cost of materials in the finished product, there will be found to be items in that difference arising from accounting and shop irregularities, such as improper reporting and accounting for defective materials, spoilage, and scrap. Differences between book and physical inventories of raw materials and purchased parts are also adjustments that may be properly classified as materials usage variances, although more frequently they are charged to an inventory adjustment account.

Direct labor—rate variance—represents the difference between the standard normal rate for labor determined either for the plant as a whole or according to departments, and the rate actually paid.

Direct labor—efficiency variance—arises either from the inability of the average workman to keep within the established time for an operation, due to lack of skill or failures beyond his control or from the ability of the exceptional workman to exceed the established standards. Both the rate variance and the efficiency variance of direct labor may be determined from individual operation tickets (time card—Exhibit 3), from which all other data in connection with direct labor cost may also

be determined. Summaries of such operation tickets serve as measures of and control media for all direct labor operations.

Overhead Variance is commonly segregated and identified as budget variance and volume variance. The budget variance represents the amount expended in excess of or less than the amount budgeted for the standard number of hours required to complete the operations performed. The volume variance represents the amount by which the amount absorbed at the normal rate exceeds or is less than the amount of overhead contemplated for the standard number of hours required by the production. Overhead variance statements used for departmental control purposes should be divided to set forth separately the expenses which can be controlled by the departmental head and those which are the allocations of service department costs, the control of which comes within the province of the service department head.

Inventory adjustments variance is the account commonly employed to record differences between book and physical inventories and other general accounting adjustments of inventories.

While variances commented upon in the foregoing paragraphs should be, in general, computed currently for each period, with the result that inventories of materials, work in process, and finished product are reflected at standard cost, at least one well-known machine tool builder does not reflect actual variances for accounting purposes until parts are completed. The net result of this procedure is that work in process—parts inventory—is reflected at the actual cost of materials used, the actual direct labor required at standard rate and normal overhead. However, provision for variances is computed each period as percentages (based upon experience) of the value of the materials and of the actual hours of direct labor at standard rates (labor and overhead) charged to work in process during the period. The actual variances incurred with respect to parts and assemblies completed during the period are charged to the accumulated provision for variances. For departmental guidance, material usage variances and labor efficiency variances are analyzed and tabulated more frequently.

COST ACCOUNTING IN MARINE TANK PROCESSING AND CLEANING BUSINESS

By
S. A. TESORIERE *

I. DESCRIPTION OF THE BUSINESS

General

In the course of the past few decades there has evolved a most important change in the handling and use of fuel for marine propulsion. The change has been from coal-fired ship boilers to the present world wide use of oil. With the departure of coal as the principal means of propulsion, certain old hazards and obstacles relative to its use have disappeared. No longer is there concern over expensive space for carrying coal, spontaneous combustion, the shifting of coal in the coal holds, and other problems.

Oil aboard ships has to be carried in tanks or compartments and the maintenance of tanks has become a prime factor in the efficient operation of ships. Tank cleaning and the salvaging of oil therein has brought into being a specialized marine business to handle the task efficiently and with a minimum loss of time to the shipowners whose principal concern is to keep ships moving with their share of cargo and passengers.

Offering Bids for Jobs

While the war was in progress it was customary to work jobs on a cost plus basis. However, with the resumption of normal times the marine business has returned to the system of bidding for its jobs.

Generally, while ships are on the high seas returning to port, the shipowners request bids from marine contractors to clean and make ready the oil tanks on those ships for another voyage. Based upon experience and the size and tonnage of the ship it is possible for the marine contractor to estimate the job and bid accordingly. If the ship is available for inspection, job supervisors are sent down to examine the ship and a more careful bid is therefore submitted. Because it is not always known when the ship will be available for work, it is a difficult task to determine the equipment and men available to handle that assignment. Accordingly, it is not unusual in the tank processing and cleaning business to have periods of slack compensated by periods of heavy overtime shifts. In this business time is of the essence and ships will not lie idle in port waiting the necessary attention.

Equipment Used

The capital equipment in this business is usually its heaviest investment. Floating equipment on large barges for tank servicing are run alongside moored ships.

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Aboard these barges are machinery and equipment of a highly specialized nature. Basically a vacuum system is employed to relieve the tanks of their oils, water, and sediment through suction.

The hose is put aboard and into the tank or oil compartment, and the contents together with dirt and residue are pumped out into "slop tanks" on the servicing barge. By this process, tanks or compartments are relieved of their content and gas freed in one operation. This same vacuum system is also used for tanks containing edible oils, molasses, and similar liquid or semiliquid cargoes.

When the tanks are emptied cleaning men go down through the manhole to remove the sediment or sludge which is not drawn up by the vacuum. The presence of sludge in tanks is a highly undesirable operating impediment. Firstly, sludge can mean dirty oil. Secondly, it takes up tank space which might otherwise be devoted to usable oil or other liquid cargo. Finally, it adds weight, increases tonnage and thereby causes loss of valuable tonnage buoyancy and capacity, all of which can be measured in terms of dollars lost to the ship operators.

Salvaging the Oil

The oil pumped out of the ships into the retainers on the barges is contaminated with water and a certain amount of sludge. In this state it is not suitable as fuel to run ships. Contaminated oil becomes the property of the tank processing company as it is pumped out. This becomes another source of income to the contractor, because this oil is delivered to an oil company which reprocesses it into good oil. The oil company charges the contractors for the cost of reprocessing, credits them with the value of the reclaimed oil, and mails them a check for the difference.

Scaling and Painting

In addition to cleaning tanks, marine contractors may also perform other cleaning operations on ships, the most common of which is scaling and painting the hull. Iron or metal hulls exposed to the elements rust quickly. The corroded old paint is chipped off and a new coat of paint applied. Other ship maintenance work may also be performed by the contractor, such as maintenance of boiler, cleaning cargo holds, etc.

These jobs are also usually performed on a bid basis.

II. How to Design the Cost System

Basic Principles

Because it is the prevailing practice in the marine industry to present bids for the work to be performed, one of the basic principles of any suitable cost system must be to quickly formulate the price for which contractors would be willing to perform their services. The price should be so set that it will have the greatest probability of acceptance by the shipowners and yet be sufficient to cover all costs as well as yield an adequate margin of profit for the contractor.

Having once set the prices of these bids, the second basic principle of the cost system is to point out readily to management any inefficiency or irregularity which will materially alter the estimated costs upon which the bid prices were formulated. Unfavorable conditions must be quickly corrected by management while favorable conditions should be fully exploited to management's advantage.

Information Desired of the System

Because the business is conducted on a job order basis predicated on bid proposals to shipowners, the system should be so devised to give the following information:

1. The cost data necessary to obtain readily the basis for submitting a properly prepared bid.
2. The means of following the actual costs and operating efficiency relative to the individual jobs.
3. The means of immediately allocating any sizable deviation from the expected costs on the job that corrective measures may be taken for the future.

The presentation of the required data to management and supervisors should be summarized in a concise and intelligent fashion that management can be kept up to date on the efficiency of the business.

A Job Order System Supplemented by Standards Preferred

For a well-operated marine tank processing and cleaning business, a job order system is desirable in order to compile costs by jobs. In addition, to facilitate price quoting and to provide a yardstick for measuring business efficiency, it is advisable to supplement job costs with a fair set of predetermined standards.

The books and accounts are maintained at actual costs by jobs. Standards having been used first as the basis for arriving at the quotation price are then employed to provide the means of comparing and analyzing actual costs with standards thereby bringing into focus all worth-while deviations. These standards are not placed on the books. They are instituted for management's guide and control of business. Having performed their function there is little need for reflecting standards on the books with the resultant time and bookkeeping effort involved in so handling them.

Labor costs are the major percentage of costs in this marine business. Carelessly or poorly handled assignments will run up labor costs surprisingly; at times they more than offset the profit earned from the jobs. A system of well set standards will highlight unfavorable conditions quickly. Where historical job costs only are employed these conditions might not be noticed until much later, at which time they may have eaten well into the profits of the period.

How the Standards Are Established

By cost standards it is meant that values be set as norms for the costs entering into each job. These standards are revised, if necessary, periodically to reflect the conditions existing at the time. Briefly, standards are established as follows:

Material.—Standards can be set usually with a great degree of accuracy by the engineers and supervisors as they must specify the type and amount of material required for each assignment.

Labor.—Standards are generally based on past performance for a group of workers engaged upon set functions in the business operations. Group rather than individual labor standards are preferred because the work is done by crews.

Overhead.—While this type of marine organization is subject to a fluctuating volume of business, some year round volume can be determined based on past business experience and future expectations. Care should be employed in arriving at this over-all volume

because bid proposals based on a sub-normal volume will fail to be accepted while bids based on abnormally high volume will be disastrous in the long run, unless the contractor can achieve this high volume of expected business.

III. Description of the Cost System

General

In setting up a cost system for the marine tank processing and cleaning business, the following salient procedures and records must be given ample attention.

1. Preparing the chart of accounts.
2. Establishing a fair set of accounting standards for material, labor, and overhead.
3. Designing the job cost estimate sheet based on standards (Figure 1).
4. Setting up the procedures that will assure the successful operation of the system.
5. Designing the reports that will summarize operations for management—
   (a) Job cost sheets (Figure 2)
   (b) Summary of variations from standards by jobs (Figure 3)
   (c) Profit and loss statement (Figure 4)

Having outlined the basic steps and procedures it would be advantageous at this point to comment briefly on the operation of the system from its inception,

Cost Estimate

Job No. _____ Date _____

Description of Work:	Description of Ship:
1. Clean fuel tanks	Name: Alton II Tonnage x
2.	No. of Tanks: x
3.	Liquid Contents: x
	Surface Measurements: x

Work to be performed at: _____

Equipment to be used: _____

Material Requirements	*Units*	*Standard Unit Value*	*Cost*
List	x	x	x
Labor Requirements			
List	x hrs.	x	x
Other Direct Costs			
List (if any)	x	x	x
Overhead—85% (applied on labor costs)			x
Total			x
General and Administrative Expense 15%			x
Profit 7%			x
Total Quotation Price			x

Prepared by_____ Checked by_____ Approved by_____

Fig. 1. The Cost Estimate.

with the presentation of a bid through performance, through the final step of preparing the profit and loss statement.

Requests for Quotations or Bids

When the shipowners or their local agents require work to be performed on their ships to keep them in working order, they call upon marine contractors for quotations for the work specifications desired. With these requests for bids the machinery of the contractor's business begins to churn.

Submitting the Quotation

Since time is usually of the essence, it is imperative that the business be in a position to submit an acceptable bid in a relatively short time. Through the use of predetermined standards and the knowledge of the size of the ship and the requirements of the assignment, the preparation of the bid is greatly simplified without sacrificing accuracy. A cost estimate as outlined in Figure 1 is prepared containing the following information to arrive at the bid price for the job:

1. Description of the job.
2. Name, size, and measurement of the ship to be worked on.
3. Material requirements.
4. Labor requirements.
5. Overhead rate to be applied based on direct labor hours, the most predominant cost factor.
6. General and administrative rate to be applied on job.
7. Profit percentage.
8. Total proposed quotation price.

Based upon the total quotation price as determined above, the bid is submitted to the shipowners. They will weigh it in relation to bids submitted by other marine contractors and make their choice predicated on price and reputation of the competing contractors.

Acceptance of the Bids

Since bids are requested at the rate of several each day, it is desirable that a written record, such as the cost estimate, be kept of all quotations submitted; also that a good set of standards be available to facilitate their preparation.

When the quotations are accepted the cost estimates are filed in an active file by date of work commencement and they become the guides for the efficient fulfillment of assignments.

Duration of Jobs

The average tank cleaning assignment is completed in one day. Other cleaning operations on ships usually consume substantially the same time. Scaling and painting assignments, however, usually require several days. It is advisable to summarize job costs promptly after the completion of each job on a job cost sheet (Figure 2). In this manner operating efficiency may be measured and variances analyzed that management be placed in a position to rectify unfavorable conditions or exploit favorable conditions on the succeeding assignments.

JOB COST SHEET

Job No. 346 — Supervisor: R. J. Peters

Ship: Alton II — Type of Work: Clean Fuel Tanks

Date	Item	Units	Material	Labor	Overhead 85%	Total	General and Administrative 15%	Profit	Total
July 1	List	x	x						
July 1	List	x	x						
July 1	List	x	x						
July 1	Type of Labor	x hrs.		x					
July 1	Type of Labor	x hrs.		x					
July 1	Type of Labor	x hrs.		x					
July 1	Type of Labor	x hrs.		x					
	Total at Actual		x	x	x	x	x	x	x
	Price Variance		(x)	—	—	(x)	*(x)	*(x)	—
	Quantity Variance		—	x	x	x	* x	* x	—
	Total per Cost Estimate		x	x	x	x	x	x	x

(x) Unfavorable variance.

* The use of two lines for variances under general and administrative and profit columns is merely a balancing medium as the total of both types of variances is considered a quantity variance or more specifically a variance resulting from material, labor and overhead costs different from those called for in the cost estimate.

Fig. 2. Individual Job Cost Sheets.

SUMMARY OF VARIATIONS FROM STANDARDS

Week Ending July 6, 1946

Date	Job No.	Ship	Type of Job	Supervisor	Material Variances		Labor Variances		Explanation
					Price	Quantity	Price	Quantity	
July 1	346	Alton II	Clean fuel tanks	R. J. Peters	(x)	—	—	x	
2	List from Job Cost Sheets								

Fig. 3. Summary of Variations from Standards.

PROFIT AND LOSS STATEMENT

Month of June 1946

	Tank Work	Paint and Scale	Misc.	Total
Sales	x	x	x	x
Cost of Sales (Exclusive of Undistributed Overhead—below)	x	x	x	x
Gross Profit	x	x	x	x
Per Cent	x	x	x	x
General and Administrative Expenses:				
Officers' Salaries				x
Office Salaries				x
Advertising				x
Depreciation—Furniture and Fixtures				x
Insurance—General				x
Stationery Supplies and Postage				x
Entertainment				x
Dues and Subscriptions				x
Legal and Accounting				x
Miscellaneous				x
Total				x
Less: Undistributed Portion (See Below)				x
General and Administrative Expenses Distributed				x
Operating Profit				x
Per Cent				x
Less—Undistributed Costs:				
Overhead				x
General and Administrative Expense				x
Total				x
Adjusted Operating Profit				x
Per Cent				x

Fig. 4. Profit and Loss Statement.

Material

As the foremen and supervisors determine their stock requirements for the jobs, requisitions are prepared for the purchasing agent who places the order with the vendors. It is customary in this business to carry a minimum of stock and to order according to job requirements.

When the goods are received the vendors' invoices are checked to the related requisitions and receipt of delivery forms. The invoice is then processed and the standard cost value of the items thereon is written in as well as the job number for which the items were purchased. The invoice is then filed away in a separate job jacket together with all other vouchers applicable to the job.

From the invoice the entry is prepared at actual cost, charging material to the specific job and crediting the vendor. When the job is completed the material

posted to the job cost sheet (Figure 2) is totaled and compared with the cost estimate (Figure 1), a copy of which is maintained behind each job cost sheet. The comparison aided by the material vouchers in the job jacket will readily reveal the variances, if any, and these variances are analyzed and broken down into:

1. Price variance—representing the difference between actual purchase prices and standard values shown on the cost estimate.
2. Quantity variance—representing the difference between the units of material actually used on the job and the quantity of units required according to the cost estimate.

Labor

As the employee time reports showing time and job worked upon are submitted, they are processed in the accounting department and the standard as well as the actual wage is computed. With this information available the various job cost sheets are charged at actual cost. When the job is completed the labor so posted is totaled and, as was done with material, compared to the cost estimate. The comparison will bring to focus any variances and these variances are further broken down as between:

1. Price or rate variances—arising from paying employees a wage rate different from the standard rate.
2. Quantity or efficiency variances—arising from the consumption of more or less time on the job than the cost estimate calls for. Idle time as well as inexperienced or slow workers will, if present, be brought to the supervisor's attention.

Overhead

The barges with their equipment are treated as separate productive departments and the service department costs are distributed on some equitable basis to the productive departments.

Proceeds from the contaminated oil withdrawn from the ship's tank and salvaged by the oil companies are treated as a credit item in the overhead account.

Because the total cost of the job should be known at least two or three days after its completion, a predetermined overhead rate is applied to direct labor dollars consumed on the job. The cost of the job could not be determined immediately if the overhead expense were not applied until the actual expense was known some time after the end of each month.

The balance in the overhead control account after the distribution at a standard rate to the individual jobs represents the over or under applied overhead expense attributable to business volume. The difference between the overhead charged to the job based on actual direct labor charges and that shown on the cost estimate may be considered as a quantity variance arising from consuming more or less labor dollars than were called for in the cost estimate.

In order to determine the controllable or price variances, the preparation of a schedule at the end of the month showing a comparison between actual overhead costs and budgeted overhead expense will readily disclose these variances for management's attention.

General and Administrative Expenses

Since it is desirable to determine the total cost of the job promptly, general and administrative expenses are treated in a similar manner as the overhead previously described. The balance in the general and administrative control account after dis-

tribution at a standard rate to the individual jobs represents the over or under applied portion.

The difference between the general and administrative expenses charged to the job (on a percentage basis over total costs charged thereto) and that charged on the cost estimate may be considered a quantity variance.

To arrive at controllable or price variances, a report is prepared at the month-end comparing actual with budgeted costs, revealing the differences between the two by expense classification.

The Job Cost Sheet

To summarize, the various purposes served by the individual job cost sheet referred to in Figure 2 are as follows:

1. Timely known costs as material and labor are posted directly to the job at actual costs.
2. Overhead and general and administrative expenses are applied by the use of a predetermined rate rather than using an actual rate which would only be determinable at the end of each month.
3. Through a comparison of the job cost sheet, together with the supporting material and labor vouchers, against the cost estimate it is relatively simple to establish and account for the variations from standard.
4. Analyzing these variances the causes thereof may be directly attributed to a poorly prepared cost estimate, unexpected problems arising on the job, poor personnel or whatever else may be their cause.

Summary Variation Reports

Variances having been established by jobs, management should be informed of them in weekly reports that it may become aware of operating trends as revealed by off-standard conditions.

Accordingly, a summary of variations from standards is prepared for management (Figure 3). The report is extracted from the individual job cost sheets and the causes attributable to such variations explained in the last column of this schedule.

As previously mentioned, summary reports are also prepared at the end of each month to cover overhead, and general and administrative expenditures. These reports show, by expense classification, budgeted and expended costs, the difference between the two representing spending or price variation.

Through these summary reports management is spared from wading through a mass of detail that would offer nothing more than what is shown in concise fashion in these summary reports.

The Profit and Loss Statement

In so far as reports have been submitted periodically to management on off-standard conditions, the profit and loss statement (Figure 4) is prepared on an actual cost basis. If desired, however, the variances for the month may be indicated in memorandum fashion under their respective expense classification.

Overabsorbed or underabsorbed overhead and general and administrative expenses are shown below "Operating Profit." Theoretically over the period of the year these two items will have been distributed in total over-all jobs if the standards were properly set and the expected volume of business attained. At the end of the year any debit or credit balance existing in these accounts will be charged respectively to the cost of sales section and the general and administrative section.

COST ACCOUNTING IN A METAL WORKING PLANT

By

GEORGE N. BENOIT*

I. DESCRIPTION OF THE INDUSTRY

When you pull up to a gasoline pump and say "fill 'er up," the chances are a thousand to one that you have no interest in who made the marvelous instrument that "fills 'er up" in less than two minutes, indicates on its dial face what you owe and for how much gasoline. If perchance you are intrigued by the ingenious synchronization of a power driven stream of a highly volatile fluid through a visible discharge indicator with a device which measures the volume and computes the value of that stream, it is not likely that your curiosity reaches into the interior with its motor-driven blade type rotary pump, air separator, air exhaust chamber, positive displacement meter, automatic calculator, called a computer, power lines, and lighting system, all of which make possible the promptness and exactness with which the transaction of "filling 'er up" is completed.

East of Cleveland the chances are one in three that the pump was made by the company whose cost system is to be described presently. But the gasoline pump is only one of many items that the company manufactures and sells to the service station operator. In addition, he may obtain a tower light, an air compressor, an air meter, an auto lift, a complete line of equipment used in greasing and lubricating your car, and numerous accessory items, such as special pipe fittings and valves used in service station installations.

Besides "everything for the service station" there is manufactured a line of domestic oil burning equipment. This includes several models of power-driven oil burners, boilers and warm-air conditioning units.

The components required to produce the two major lines number as many as twenty thousand. With sales of less than twenty million a year, it is apparent that we have a relatively small company with large company problems so far as cost accounting and production control are concerned. The diversity of product and operations from sheet metal and machine shop to assembly, test, paint and crate, plus an iron foundry, require a rather elaborate departmentalization which is listed below. The "production ratios" appearing at the right of the Productive Group will be explained under subsequent headings.

* Works Accountant, Gilbert & Barker Manufacturing Company, West Springfield, Massachusetts.

Productive Group:		*Product A*	*Production Ratios* B	C	D	*Total*
11-A	Sheet Metal Shop	40%	10%	40%	10%	100%
21-B	Machine Shop—South	80%	10%	0	10%	100%
22-B	Machine Shop—North	50%	40%	10%	0	100%
23-B	Machine Shop—Special Work	50%	30%	10%	10%	100%
24-B	Tool Room	50%	30%	10%	10%	100%
25-B	Heat Treating	50%	35%	5%	10%	100%
31-C	Plating	80%	20%	0	0	100%
32-C	Parkerizing	80%	20%	0	0	100%
33-C	Bonderizing	80%	20%	0	0	100%
41-D	Assembly—South	100%	0	0	0	100%
42-D	Assembly—North	0	100%	0	0	100%
43-D	Assembly—West	0	0	100%	0	100%
44-D	Assembly—East	0	0	0	100%	100%
51-E	Painting—Priming Chain	60%	30%	5%	5%	100%
52-E	Painting—Final Assembly	100%	0	0	0	100%
61-F	Crating	60%	20%	10%	10%	100%

Factory Burden Group:

71-G Gauge and Tool Inspection
72-G Machined Parts, Air Test and Inspection
73-G Pump Test and Calibration
74-G Burner Test
75-G Final Inspection
76-G Inspection of Incoming Material
81-G Production Superintendent's office
91-G Chief Inspector's office

101-G Receiving
102-G Shipping
103-G Storehouse

111-G General Plant Expense
112-G Personnel
113-G Cafeteria and Recreation
114-G Laboratory
115-G Hospital

121-H Power Plant
131-J Maintenance
132-J Janitors
133-J Watchmen
134-J Garage
135-J Steam Locomotive, Cars, and Track

141-J Maintenance Superintendent's office

Engineering and Planning Group:

201-K General Engineering
202-K Return Goods and Salvage
203-K Time Study
204-K Production Planning
205-K Development—Service Station Equipment
206-K Development—Heating and Air Conditioning

207-K Development—Other Products
208-K Research and Development Machine Shop

Foundry Group—Productive:

311-L Coremaking
312-L Moulding—Bench and Floor
313-L Moulding—Light Machine
314-L Moulding—Heavy Machine
315-L Shakeout and Cutting Sand
316-L Grinding and Cleaning

Foundry Group—Nonproductive:

411-M General Foundry Expense
412-M Melting
413-M Inspection
414-M Pattern shop

The raw materials used are very similar to those used in the automobile industry —carbon and alloy steel, brass, and aluminum in bars, strips and sheets plus iron sand castings and nonferrous castings from sand or die molds. About 10% of all direct materials purchased are bolts, nuts, screws, gaskets, name plates, and similar hardware plus paint and crating lumber, which, although not exactly measurable per unit produced, are accounted as direct material.

In the case of materials purchased, the unit of issue as it appears on a stores requisition (this may differ from the unit used on the vendor's invoice) is the standard cost unit. In the case of the material going into a component it is the standard quantity required to produce one component, priced at the standard cost of the constituent material.

A relatively inflexible operation layout from which may be computed the standard time necessary to produce the part, priced at standard departmental rates, provides the unit standard labor cost. The same computed standard time priced at standard departmental burden rates is the unit standard burden cost.

II. Design of the Cost System

The perfect cost system, which only exists in the hopes and aspirations of accountants, first provides accurate and consistent values for transfer between accounts and to cost of goods sold. Secondly, the consistency of those values should make it possible to (1) produce monthly profit-and-loss statements before the accounting department is submerged in gathering the "facts" for the succeeding month, (2) serve as a medium for cost control, and (3) become the most important factor in a formula (often tempered with judgment) used in establishing repair parts prices appearing in a catalogue containing as many as 100,000 items.

Only standard costs have the virtue of consistency. Only standards, whether they be of direct labor operations, of unit costs, of departmental expense or of material consumed, if compared with actual performances or costs, soon enough after the facts to keep those facts clear or prevent their obscurance, can control costs effectively. (While we are discussing systems we are not unmindful, of course, of enlightened and alert management for which there can be no satisfactory substitute.)

To sum up and make two additions, what is needed is a system that will make it possible to *promptly* (1) produce monthly operating statements, (2) reveal when and why cost is incurred without adequate value being received; and to constantly provide the basis for (3) a comparison of cost with selling price, internal or competitive, (4) repair parts prices which are profitable, consistent, and free of customer complaint, and (5) estimate costs of new products and make comparisons with costs of similar products, which are not distorted by variations in prices or rates.

With these objectives in view and with full awareness of the limitations of so-called actual cost systems there seems to be no alternative but a standard cost system, provided (1) adequate and scientific information is available with which to establish standard costs, and (2) the system will be at least as economical to manage as a purely historical cost system.

III. Description of the Cost System

The manufacturing process consists of the fabrication of components sometimes sold as spare parts and the assembly of components and subassemblies into major items, grouped under Products A, B, C, and D. (See list of productive departments.) For this reason the standard unit cost is the heart of the cost control mechanism.

In order to illustrate the manner in which the standard unit cost is established and used either in the accounts or for cost control, the following set of facts is assumed and each fact will be discussed separately.

Standard Cost Facts

1. The standard cost per pound of special stainless steel is $0.30
2. The standard weight in pounds per component is 1.60
3. The standard rates per man hour in effect are:
   - Department 21B
     - a. Labor 0.90
     - b. Burden 1.60
   - Department 22B
     - c. Labor $0.95
     - d. Burden 1.40
4. The standard time to produce one component in man-hours is
   - Department 21B 0.15
   - Department 22B 0.08
5. The unit standard cost is:

a. Material, per Facts Nos. 1 and 2			
1.60 pounds	@ $0.30		$0.480
b. Labor, per Facts Nos. 3a, 3c and 4			
21B	0.15 hours @ $0.90	$0.135	
22B	0.08 hours @ 0.95	0.076	0.211
c. Burden, per Facts Nos. 3b, 3d and 4			
21B	0.15 hours @ $1.60	$0.240	
22B	0.08 hours @ 1.40	0.112	0.352
Total unit standard cost			$1.043

Actual Cost Facts

6. 10,000 pounds of special stainless steel were purchased at ..... $ 0.32
7. Production order for 2000 components was issued.
8. 3300 pounds of special stainless steel were issued by storekeeper to machine shop.
9. Only 1890 good pieces were received into parts stores.
10. The actual direct labor hours were:
    a. Department 21B 4500
    b. Department 22B 2700
11. The actual direct labor payrolls were:
    a. Department 21B $5625
    b. Department 22B $3645
12. The total actual departmental burden was:
    a. Department 21B $9450
    b. Department 22B $4860
13. On the production order for 2000 components the following direct hours were reported:
    a. Department 21B 300
    b. Department 22B 140

Combining these two groups of facts the following comparisons and adjustments arise:

Material Price Variance

Fact No. 6	10,000 pounds @ $0.32	$3200
Fact No. 1	10,000 pounds @ 0.30	3000
	Material price variance (debit)	$ 200

Labor Rate Variance

Fact No. 11a	$5625		
Fact No. 11b	3645		
Total actual labor		$ 9270	
Fact Nos. 10a, 10b, 3a and 3c			
21B—4500 hours @ $0.90	$4050		
22B—2700 hours @ 0.95	2565		
Total standard labor		6615	
Labor rate variance (debit)			$2655

Burden Rate Variance

Fact No. 12a	$9450		
Fact No. 12b	4860		
Total actual burden		$14310	
Facts Nos. 10a, 10b, 3b and 3d			
21B—4500 hours @ $1.60	$7200		
22B—2700 hours @ 1.40	3780		
Total standard burden		$10980	
Burden rate variance (debit)			$3330

Production Order Variance

Combining material consumption variance and time variance.

Actual cost (actual quantities at standard prices)			
Material:			
Facts Nos. 8 and 1.—3300 lbs. @ 0.30		$990.00	
Labor:			
Facts Nos. 13, 3a and 3c			
Department 21B			
300 hours @ $0.90	$270.00		
Department 22B			
140 hours @ $0.95	133.00	403.00	
Burden:			
Facts Nos. 13, 3b and 3d			
Department 21B			
300 hours @ $1.60	480.00		
Department 22B			
140 hours @ $1.40	196.00	676.00	
Total actual cost			$2,069.00
Standard Cost:			
Material:			
Facts Nos. 9 and 5a—1890 @ $0.480		$907.20	
Labor:			
Facts Nos. 9 and 5b—1890 @ $0.211		398.79	
Burden:			
Facts Nos. 9 and 5c—1890 @ $0.352		665.28	
Total standard cost			1,971.27
Production order variance (debit)			$ 97.73

Summary

Material	$ 82.80
Labor	4.21
Burden	10.72
Total	$ 97.73

Fact No. 1

It is felt that there should be little guesswork in the establishment of standard costs for materials and parts used in this particular business. For that reason it is believed that it is possible to set standards for purchases within limits close enough to relieve the pressure of any objections which might arise from the more or less arbitrary method of purging of inventory accounts of variances. The basis of that belief is the procedure used in establishing standard costs for purchased items. For each item or group of items the following tests are applied:

1. How important is the item? Is it used much or little? Is it a direct material or a burden material?

2. Is it a standard or commercial item bought from price lists and discount sheets which are public knowledge?

3. Is it purchased on contract and if so, what are the terms of the contract?

4. Is it a specialty, the requirements for which can be forecast and for which a quasi-contractual quotation may be obtained?

5. Is it a commodity sold on the world market and consequently dependent on the business cycle or other known economic laws for a change in its price?

6. In what phase of the business cycle are we or, in other words, what is the trend of prices?

7. Are there any special considerations which have a bearing on the price of this item or group or class of items for which the standard is being set?

8. Will the standard reflect what would be prudent and efficient planning and purchasing during the next year? What is the economical quantity to buy?

Based on the published price lists containing extras for chemical analysis, size, and quantity, and after deciding the economical quantity to purchase, a price of $0.30 per pound was established, the price being the algebraic sum of the price at the mill, all discounts including cash and transportation.

Fact No. 2

This information may be obtained from a drawing of the component and a book of standards which is available in any modern metal working plant. One formula commonly used for a part machined from bar stock is the following:

$$m = \frac{\frac{w}{b}}{p + c}$$

m = standard unit weight.
w = weight of a commercial or multiple length bar.
b = length of commercial or multiple length bar less 3" for chucking.
p = length of finished piece.
c = width of cut-off tool.

Note: In the case of expensive metals where the residual value of the chip and the bar end is important and computable within reasonable limits, an allowance in the standard and in the accounting should be made for such residual value.

Fact No. 3

A standard labor rate for any cost center whether it be a machine, a group, a line or a department is the predicted rate that will be paid during the period in which the standard will be in effect. In the case of a department composed of several direct workers the rate may be established by modifying the current average rate with expected increases, or decreases if one may be so bold as to believe they will ever occur again.

Arriving at a standard burden rate is not so simple. Yet if past records indicate what expenses were incurred in a given department and how many direct hours absorbed those expenses there is a historical basis for the projection of a rate. (Establishing a burden rate which will be applied as a percentage of direct labor requires a very similar approach, of course.) If it is possible to forecast productive hours and to compare the forecast with a budget of departmental expense, the budget having been agreed to by the factory management, another and more scien-

tific basis of establishing a rate is available. In short, the quotient of a carefully prepared expense budget and a scientific forecast of production expressed in direct hours or direct payroll dollars is the best standard burden rate. Even when the budget-forecast method of establishing a rate is used, it is inevitable that the rate so established be compared with previous rates before their acceptance by operating heads.

Fact No. 4

In a plant which uses a task and bonus wage incentive plan instead of so-called straight piecework, an operation sheet or shop routing listing and describing the operations and the standard time which will be allowed for each is almost indispensable. In the case of the component under review the sum of the standard times or estimates therefor, plus an allowance for setup which should be the quotient of total setup time required and a predetermined economical run, becomes the unit standard time for each department through which the work passes. Specifically the sum of the standard time plus setup allowance in Department 21-B is 0.15 hour. In Department 22-B it is 0.08 hour.

Fact No. 5

Components or major units frequently have a mnemonic or numerical designation that is used throughout the records. The standard unit cost of component Sample 1 is the combination of Facts 1, 2, 3, and 4. The standard cost of $1.043 becomes the value transferred into stock from process and out of stock for assembly into a major unit or when costing its sale as a spare part.

Facts Nos. 6 to 13

These will be discussed under variance headings which follow.

Material Price Variance

The computation arriving at a variance of $200 is made on the invoice for the 10,000 pounds of steel. The accumulation of this and all other variances on purchases are made in the factory ledger, the accounts in which are headed as follows:

Standard Cost			Variance		
Debit	Credit	Balance	Debit	Credit	Balance

the algebraic sum of the standard cost balance and the variance balance being the balance at actual cost.

If the nomenclature of accounts in the Factory Ledger is based on end use rather than kind of material which is the common practice, a method of automatically allocating variances by product is provided. Of course the end use of some materials may be common to two or more products, in which case a method of prorating variance by products would have to be devised.

The basis of clearing variances from factory ledger accounts is to establish a

ratio between deliveries at standard costs to the balance at standard cost and reduce the variance balance accordingly.

Example:

Balance on June 30 at standard cost			$50,000
Receipts during July at standard cost			10,000
Total			$60,000
Deliveries during July at standard cost			$15,000
Balance of variance on June 30		(debit)	$ 1,100
Variance on July purchases		(credit)	100
Balance		(debit)	$ 1,000
Charge cost of sales, product as indicated by nomenclature of the account, 15,000 of $1000			$250
	60,000		

Labor Rate Variance

If possible, departmentalization should be product-wise. In those cases where this is impractical a scientific basis of evaluating man-hours by product should and can be established. Rather than suspending any part of labor rate variances in inventory accounts it is distributed as incurred to the products indicated by the departments in which it occurs. If the $2655, which is composed of $1575 incurred in Department 21-B and $1080 incurred in Department 22-B, is properly allocable to more than one product it should be known in advance how labor (and burden) incurred in Departments 21-B and 22-B will be allocated as to product.

In the tabulation of the Productive Group of departments there appears this information:

	Product A	*B*	*C*	*D*
Department 21-B	80%	10%	0	10%
22-B	50%	40%	10%	0

On this basis the $1575 and $1080 will be distributed as follows:

Department 21-B	$1575	$1260.00	$157.50	None	$157.50
Department 22-B	1080	540.00	432.00	$108.00	None
Total	$2655	$1800.00	$589.50	$108.00	$157.50

It should be apparent that the product ratios can be determined only with a thorough familiarity with operating conditions or schedules and should be subject to review each month. However, no effort, the expense of which would be disproportionate with the value of the information purported to be obtained, should be made to establish ratios in increments of less than 5%.

Burden Rate Variance

What appears in the illustration as $3330 of burden rate variance might be in part unabsorbed burden, and it is commonly recognized that the distinction between the two is of more than academic interest. If in Department 21-B the standard rate of $1.60 was based on 60,000 direct bonus per year or 5000 hours per month

and only 4500 direct hours were worked, then one tenth of nonvariable burden in Department 21-B, plus an obscure fraction that is less than one tenth of certain other expenses which vary only in part as volume changes, is "capacity" variance and should be reported on the profit-and-loss statement as unabsorbed burden rather than included in cost of sales.

Accounts in the factory expense ledger should be so segregated and earmarked that monthly transcripts will automatically show separate totals for nonvariable and variable expense. When capacity contributes markedly to the under- or overabsorption of burden (in the illustration it does not), then a calculation separating volume and rate variance can be made. In order to avoid unnecessary clerical work it should be decided beforehand how much volume should vary from normal before an accounting for such variation should be made. It is suggested that in most cases and for all practical purposes, a variation of less than 20% from normal or standard base is insufficient to make calculations for and a separate accounting between burden rate variance and unabsorbed burden.

Example:

Direct hours on which standard rates were established	10,000
Minimum hours permissible before unabsorbed burden calculation will be made	8,000
Maximum hours permissible before over-absorbed burden calculation will be made	12,000

That portion of burden variance, and it has been attempted to bring out that under normal conditions it will be all of it, which is cleared to cost of sales by products will be allocated on the same basis as labor rate variance.

Production Order Variance—Material

"Actual" so far as cost is concerned is used loosely. But after all, is there such a thing as a truly actual cost in manufacturing? Even the cost which should be the simplest element to ascertain, that is of material, cannot be actual unless the following facts are known—and they probably never are:

1. Exact quantity consumed.
2. Exact price of quantity consumed.
3. Exact transportation costs on the quantity consumed.
4. Exact cost of procuring the material.
5. Exact residuary value of materials salvageable from manufacturing processes.

Be that as it may, in this case it is deemed sufficient to write a requisition for the quantity believed to be required (it will be noted that 3200 pounds should have been adequate whereas 3300 pounds were delivered), price the requisition at standard cost, and charge the production order with $990. The standard unit value of material per Sample 1 being $0.48 and only 1890 being produced instead of 2000 as expected, the standard material cost of the order is $907.20 which, when compared with $990.00, leaves a variance (debit) of $82.80.

Production Order Variance—Labor and Burden

The time records filed under the production order which is being analyzed indicate that 300 direct hours were spent in Department 21-B and 140 direct hours in

Department 22-B to produce 1890 of the component. Extending these hours at the standard rates indicated in Facts Nos. 3a and 3c, an actual cost for labor of $403.00 is applied to the production order. When compared with the standard labor of $398.79, a variance of $4.21 on the order is revealed.

The burden variance of $10.72 is arrived at in much the same manner.

Accounting for Variances

So far, five kinds of variance have been mentioned:

1. Material price variance.
2. Labor rate variance.
3. Burden rate variance.
4. Capacity or volume variance (under or over-absorbed burden).
5. Production order variance.

It will be recalled that material price variance is suspended in factory ledger inventory accounts, the nomenclature of which indicates the end use of the items included in each account. The method of clearing to cost of sales by the use of the ratio deliveries to total debits (old balance plus receipts) was also discussed.

However, labor and burden rate variances are cleared as incurred to cost of sales, the product to be charged being dependent upon a predetermined ratio for each department.

Unabsorbed burden, if determined to exist in a significant amount, is shown as a separate item in the profit-and-loss statement.

The method of suspending and clearing production order variance is identical with that used in the accounting for material price variance. Let us assume the following accounts to appear in the factory ledger:

Manufactured Components—Product A
Manufactured Components—Product B
Manufactured Components—Product C
Manufactured Components—Product D
Major Units—Product A
Major Units—Product B
Major Units—Product C
Major Units—Product D

Let us further assume that Sample 1 is a component of Product A. As production orders are closed which means to prepare the document which is the basis of the entry charging inventory for the standard cost of all production and to compute and accumulate variances thereon, the accounting data is recapitulated on a form organized something as follows:

Description	Quantity Produced	Unit Standard Cost	Total Standard Cost	Actual Cost	Variance	
					Debit	Credit
SAMPLE 1	1890	$1.043	$1971.27	$2069.00	$97.73	

As the recapitulations are segregated by factory ledger accounts, it is a simple matter to journalize the value of monthly production. The entry for our illustration would be—

	Debit	Credit
Manufactured Components—Product A—Standard	$1971.27	
Manufactured Components—Product A—Variance	97.73	
Work in Process		$2069.00

As in the case of material price variance, the balance, of which the $97.73 becomes a part, is cleared to cost of sales (Product A in this case) on the basis of the ratio of deliveries to total debits.

To simplify the illustration, no mention is made of the fact that work in process accounts are divided into material, labor, and burden. In practice they should be so divided.

There is one other source of variance. It is that which originates from changes in unit standard costs. Although some standards, owing to the infrequency of their use, can be kept in effect for as long a period as ten years, as a general rule standards should be reviewed or revised once a year. When changes are made they should be vouchered, posted and cleared in the same accounts and the same manner as material price variance and production order variance.

Reports to Executives

The profit and loss statement with its supporting cost of sales or product analysis schedules, the basis and source of which have just been described, is assumed to be significant only to top operating heads. As a matter of fact, cost data for the works manager or the production superintendent or factory foremen are as a rule syphoned off of the basic data before or during its preparation in voucher form. Although cost reports should be consistent with the history presented by the profit-and-loss statement, rare is the case where they are subsidiary thereto. The reason is simple and twofold. Time is of the essence of effectiveness and factory men are usually not sympathetic toward the confusion generated too often by the formalities of accounting.

Therefore, as the payroll is being made up a weekly report on departmental direct labor efficiency can be prepared. As production orders are closed those showing exceptional variances can be analyzed as to reason and a report made thereof to any one or all of the following people: Works manager, production superintendent, foreman, and time study chief. However, this procedure may follow too long after the variance occurs to be useful or effective. An operation cost analysis, while inherently expensive, sometimes justifies itself because it prevents repetition of losses. If direct labor time tickets are written in duplicate, one copy sent to the payroll department for earnings calculation and distribution and the other copy sent to the cost department for comparison with operations appearing on unit standard costs by *properly trained personnel* (there is more than a simple clerical job involved), exceptions can be culled and reported. The form of the report and the details of its preparation would be dependent on the volume of time cards being analyzed and the nature of the exceptions. Items of unusual price variance can be noted as they occur and taken up with the purchasing agent. Any number of reports can be prepared but only those which are made promptly and presented interestingly will be effective.

COST ACCOUNTING FOR THE MINING, CONCENTRATING AND SMELTING INDUSTRY

By
CRAWFORD C. HALSEY *

I. DESCRIPTION OF THE INDUSTRY

The mining, concentrating, and smelting industry includes companies engaged in the mining and treatment of the ores of iron, copper, silver, gold, zinc, lead, and many other metals. However, as most of the principal problems arising in the industry will occur in such a company, the following discussion is limited to the operations and cost accounting requirements of a company which mines, concentrates, and smelts copper ores containing copper, silver, and gold.

Operations ordinarily start with the acquisition of a mining claim that has been developed to some extent. The further development of the mine must be planned and a decision made as to the building of a metallurgical plant, although this decision may be deferred until after the mine has been further developed and has reached the operating stage. During this period of development and construction all expenditures should be capitalized, the cost of plant and equipment being segregated from the expenditures for development as the former will be depreciated over the life of the equipment or the mine, whichever is shorter, and the latter will be amortized by charges to operations as the ore developed is actually mined.

Methods of mining and metallurgical treatment of copper ores vary greatly, the particular methods used depending largely on the rock formation and on the mineral and metal content of the ore mined. Various kinds of ore might occur in a single mine, it being quite common for a mine to produce both a direct smelting ore and a concentrating ore. Some companies produce only ore which usually contains only a small percentage of copper. Others build a concentrator and produce concentrates which must be further processed in the smelter and contain from 20% to 35% of copper and generally small, but important, quantities of recoverable silver and gold. Still other companies build a smelter (and also a concentrator, if necessary) and produce blister copper which contains roughly 99% of copper, varying quantities of silver and gold which are recoverable, and other mineral and metallic impurities which must be eliminated by refining.

A company may either sell its product (ore, concentrates, or blister) or have it treated by the refinery "on toll," a toll or refining charge being billed the company for the work of removing the impurities, including the recoverable silver and gold. The copper is returnable to the producing company but is usually held by the refinery subject to the order of the producer. The recoverable silver and gold may also be returnable to the company or sold to the refinery and the value thereof

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applied to reduce the amount payable for toll charges. When a quantity of returnable metal is sold by the producer, the refinery delivers the specified quantity to the purchaser as and when instructed by the producer.

The cost accounting described in this chapter is that which would be followed by a company engaged in mining, concentrating, and smelting a nonferrous ore containing copper as the principal metal and silver and gold as the secondary or by-product metals. Under this by-product method the value of silver and gold produced is credited to the cost of the principal metal, copper, no cost being allocated to the silver and gold produced. The ore is mined underground and is of two types—(1) an ore which requires concentrating before being smelted, and (2) an ore which can be charged directly into the smelter without any intermediate processing other than crushing. The blister copper produced by the smelter is shipped to the refinery for refining under toll, the recoverable copper content to be returned to the company and the silver and gold retained by the refinery, the value thereof being applied to the refining charge. In order to simplify the description of the cost system and the forms and statements necessary, many relatively minor operations which are met with continually in the industry have been omitted. Those shown are the principal operations and are intended to serve as examples which, in particular cases, may be extended to any necessary extent. For the smaller companies which do not own and operate a smelter but which sell their ore and concentrates to a custom smelter, the cost accounts as described herein must be limited to those operations performed by the company. The cost accounting as described for the smelting operation applies, of course, only to a smelter operating in conjunction with a mine and not to a custom smelter.

II. How to Design the Cost System

Cost records are maintained principally to facilitate the proper control of operations but are also used for determining a proper basis of valuation of in-process and finished metal inventories. They should result in two basic classifications of cost—by elements such as labor, supplies, etc.; and by operations or departments. Many companies also break down labor, supplies, etc., as between operating labor, repair labor, operating supplies, repair supplies, etc. It is ordinarily necessary to determine two unit costs for each operation or department, one expressing the cost in terms of the amount of material handled, treated, or produced in the particular department, and the other in terms of cost per unit of the primary metal recoverable from such material, in this case a pound of refined copper. The material unit cost for the mining operation would be the cost per ton of ore produced; for the concentrating operation, the cost per ton of ore milled, and also the cost per ton of concentrates produced; for the smelting operation, the cost per ton of new metal bearing material (NMBM) charged into the smelter and also the cost per ton of blister copper produced; for the refining operation, which is performed in this case by an outside company, the cost per ton of blister copper. Cumulative costs including costs of all prior operations may also be determined. In-process inventories are carried at a cost determined by applying the cumulative unit cost to the quantity of the material on hand.

Periodic comparisons of these unit costs provide a measure of the efficiency of the operations which can be of great value to the operating officials. Over-all costs

which include all expenses with the exception of income taxes, interest, and depletion may be properly compared with quoted market prices in order to determine when sales can be profitably made. Some companies include depletion in cost, but because of the inaccuracies inherent therein and the arbitrary nature of many of the basic factors used in the calculations of the charge, such a practice would ordinarily seem to be undesirable.

As cost accounting is primarily for the purpose of showing the costs of operations performed by a company, the first step in the design of a cost system should be the determination of the principal operations involved. The principal operations of a mining, concentrating, and smelting company are shown graphically in the operational flow sheet shown as Exhibit 1.

This chart shows only the major operations or groups of operations applicable in a particular type of nonferrous mining, concentrating, and smelting company, but it can be modified or extended to show the flow of operations and materials for any other company in the same industry. A production cost summary, Exhibit 4, should then be designed outlining the manner in which all the operations of the company should be brought together in summary form and arriving at a method of showing the over-all cost for producing the principal metal. The next step is to design a cost statement for each principal operation or department shown in the production cost summary so that costs of each suboperation thereof may be determined. Cost statements for all operations shown in the operational flow sheet and in the production cost summary are shown as Exhibits 5 to 18 and are described fully in the following section.

After determining the operations or groups of operations to be used and designing the necessary cost statements, adequate means must be provided for reporting the basic information so as to insure that the proper charges will be made to the various operations and departments. Fundamentally, the methods of reporting these original charges are the same as for any other industry, but the design of the forms used must be such as to meet the needs of the particular industry. Payrolls and the daily labor reports showing the operations to which each man's time should be charged must be maintained, and a supply system under which all supplies are issued by the use of a requisition form stating thereon the department or operation to be charged, will provide an accurate method of charging supplies used to the proper operation. For small companies the maintenance of a warehouse and a requisition system would probably be uneconomical, but since the material purchases would be relatively small they could usually be charged directly to the operation or operations using the material. In the case of service and general departments whose work is not concerned directly with the production of the company but whose costs must be absorbed by the productive operations and departments of the company, methods must be devised and proper records maintained to insure that the costs of such redistributable departments are properly allocated to the principal operations.

A type of recording peculiar to the mining, concentrating, and smelting industry is the keeping of adequate and accurate metallurgical records both in terms of tonnages of materials and in quantities of the recoverable metals contained therein. These records must be kept not only for use in determining costs per ton of material handled and costs per pound of returnable copper, but for the more important purpose of establishing as accurately as possible the quantities of metals lost during each of the various operations. Metal losses are a factor which can be most im-

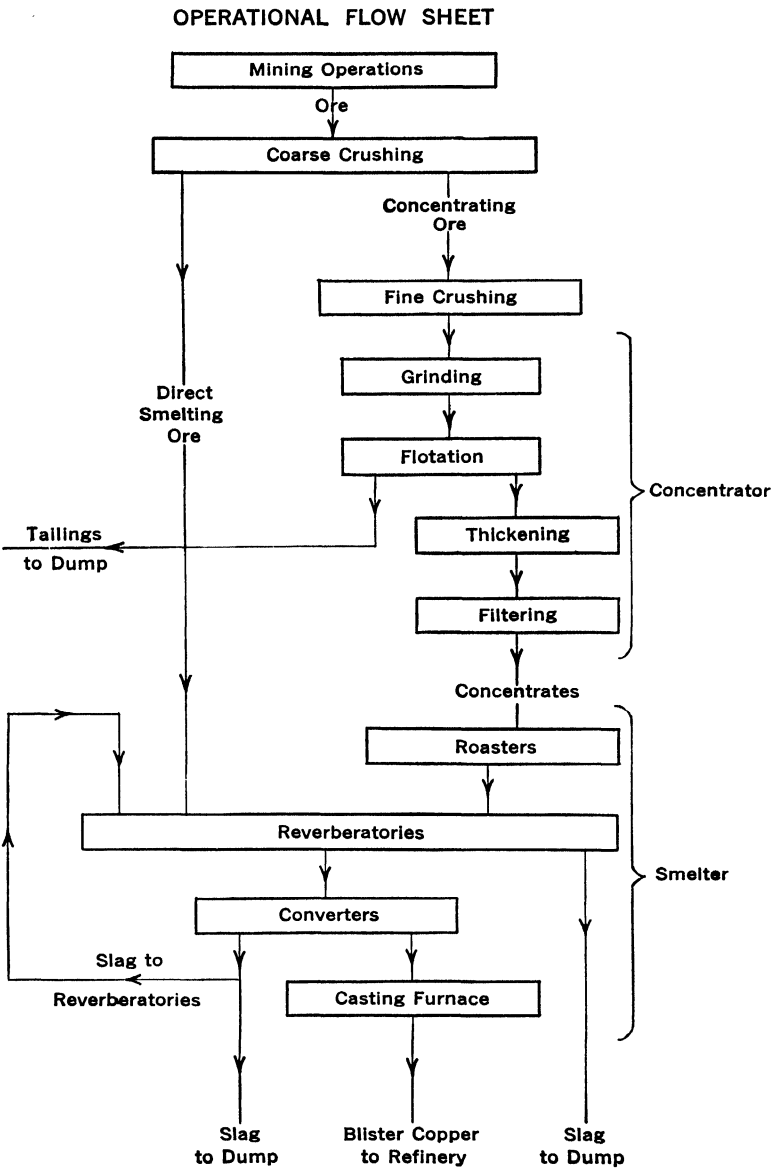

Exhibit 1.

portant to the results of the operations of the company, although such losses are not usually reflected in the money cost accounts prior to the refining operation. Some larger and more complex mining companies use a regular metal ledger and journal, the entries in which are entirely in terms of tons of material, pounds of copper and ounces of silver and of gold. The metal ledgers are usually self-balancing, the offsetting metal controls representing the total quantity of each metal to be accounted

for. Smaller companies accomplish somewhat the same purposes by maintaining cumulative records of production, material handled, charges to furnaces, etc. The accuracy of unit costs depends, of course, on the accuracy of these records, which, in turn, depends on the care with which materials are weighed and assayed. Weighing and assaying are, therefore, auxiliary operating functions which must be carried out with continual care and accuracy in order that the management may be provided with reliable cost data.

III. Description of the Cost System

Costs are charged in the cost ledger to the various operations or departments. If the operation or department to which a charge is made is directly concerned in the production of material, the cost item is called a direct cost. For example, direct costs in the case of underground mining include underground labor, hoisting labor and expense, surface labor directly connected with mining, and such supplies as explosives, timber, and concrete used underground as well as other supplies consumed directly and immediately in the operation.

If the operation or department is not directly concerned in the production of material, the cost is termed a redistributable cost. Redistributable costs include principally the expenses of the service departments, such as blacksmith shop, carpenter shop, electrical shop, machine shop, and warehouse expenses, supervision, geological, engineering, general, and administrative expenses. These redistributable costs are allocated to various direct operations or departments by as logical a method as may be determined. These allocations may be arrived at by careful classification of labor and supplies charged to the redistributable operation or account, or they may be in proportion to labor hours or money in the direct departments, or determined by some logical basis which may be partly specific, partly arbitrary.

Cost Records

The cost ledger accounts are subaccounts of such of the operating accounts shown on the total operating cost summary, Exhibit 5, as require analysis. In our example, these would be mining, ore transportation, concentrating, smelting, and redistributables, the subaccounts being as follows:

Mining:
- Exploration and Development:
  - Drifting
  - Raising
  - Diamond Drilling
- Ore Extraction:
  - Stoping
  - Filling
  - Drills and Tools
- Tramming
- Hoisting
- Drainage:
  - Underground Drainage
  - Surface Drainage
  - Pumping

- Ventilation
- Sampling and Assaying
- Sundry Expense

Ore Transportation

Concentrating:

- Preparation of Ores
- Grinding
- Flotation
- Thickening
- Filtering
- Tailings Disposal
- Sampling and Assaying
- Sundry Expense

Smelting:

- Preparation of Ores:
  - Unloading
  - Coarse Crushing
  - Fine Crushing
  - Bedding
  - Reclaiming
  - Sampling and Assaying
- Roasters
- Reverberatories:
  - Operating Furnaces
  - Slag Handling
  - Sampling and Assaying
- Converters:
  - Operating Cranes
  - Operating Converters
  - Lining Converters
  - Casting
  - Sampling and Assaying
- Sundry Expense

Redistributables:

- Power:
  - Steam
  - Electricity
  - Compressed Air
- Shops Expense:
  - Machine Shop
  - Blacksmith Shop
  - Carpenter Shop
- General Overhead
- Assay Office Expense:
  - Assay Office
  - Bucking Room

The four principal cost ledger accounts are controlled by the operating accounts in the general ledger having the same name, the total of the subaccounts equaling the balance of the account in the general ledger. Redistributables have no balances, as all charges thereto are allocated to current operations. All postings in the cost

ledger are made from the summary of supplies issued, the payroll distribution summary, the summary of expenses, and cost ledger journal entries.

The summary of supplies issued is prepared from the accounting department copies of the requisitions for supplies by applying cost prices to the items requisitioned and then distributing the amounts to the proper operating accounts and subaccounts. The form may be a columnar sheet having as column headings each operating account and subaccount. The amounts are entered in the proper column and after all requisitions have been so entered each column is totaled and a grand total of all columns is then obtained which must compare with a tape total of the requisitions. If the subaccounts are too numerous, the summary may be set up in separate sections for each operating account, and the total of the sections proved as indicated above. This summary should be kept in a neat and careful manner and used as a book of original entry from which postings may be made directly, or it may be used as a work sheet to obtain the figures necessary for the preparation of a journal entry.

The payroll distribution summary is prepared from the daily labor reports by distributing the charges to the various operating accounts and subaccounts. The total of this distribution must, of course, agree with the actual payroll charged to operations for the period. The form used and procedure followed may be similar to the form and procedure described above for the summary of supplies issued.

The summary of expenses is a detailed distribution of all entries to the various operating accounts originating in the voucher register, cash book, and journal with the exception of the payroll and supply entries. Here again the form used and procedure followed may be as described for the summary of supplies issued.

Metal Records

In order to keep accurate metallurgical records it is desirable for companies with relatively complex operations to keep a metal ledger and a metal journal. The accounts in the metal ledger for the simple company under consideration would be as follows:

Concentrating ore—Debits would be concentrating ore mined and crushed—Credits would be crushed ore entering the concentrating operation (mill feed)—Balance would be concentrating ore in bins.

Direct smelting ore—Debits would be direct smelting ore mined, crushed and bedded—Credits would be for ore reclaimed and charged in reverberatories—Balance would be ore on beds.

Concentrates—Debits would be concentrates produced and bedded—Credits would be for concentrates reclaimed and charged in smelter—Balance would be concentrates on beds.

Blister—Debits would be blister produced and shipped—Credits would be for refinery settlements—Balance would be blister in transit to or at refinery.

Salable metals—Debits would be salable metals as per refinery settlements—Credits would be for sales—Copper balance would be quantity unsold. No balances for silver and gold.

The metal ledger would have four columns on both the debit and credit side which would be headed as follows:

Material (tons)	Copper (pounds)	Silver (ounces)	Gold (ounces)

The metal journal also requires the four columns shown above for the metal ledger and the entries are all prepared from the operating reports of quantities handled and produced, etc., kept by the operating departments.

Cost Statements

Statements that can be prepared from the cost accounts and metallurgical records, previously described, are illustrated and described in the following pages. These statements are designed to show pertinent cost information, including unit costs and other statistics, which can be used by the management to determine whether or not the various operations are being performed efficiently. The statements can be enlarged to show comparative figures if desired and to include operating data of a nature other than those expressed by cost accounts.

Statements of Metal Statistics

Exhibit 2 is a statement of metal statistics and presents a summarization of the metal records to show production, changes in in-process inventories, metal losses, the ratio of concentration and the per cent of metals recovered in the concentrator and in the smelter. The quantities shown are those used on the various cost statements which follow.

Exhibit 3 illustrates a production flow sheet showing quantities of materials and copper content thereof as the material passes through one operation after the other. It follows the operations outlined in the operational flow sheet and shows the losses and production resulting from each operation. The quantities shown are the same as those in the statement of metal statistics and used on the various cost statements.

Over-all Cost Statements

A production cost summary outlining the cost of operations shown by the operational flow sheet, Exhibit 1, and the production flow sheet, Exhibit 3, is presented as Exhibit 4. This summary shows the principal operations and costs of producing refined copper and expresses the cost of the particular operation in terms of cents per pound of returnable copper and of cost per unit of material handled or produced in each operation. The items shown thereon should be, in general, a listing of the operating accounts of the company and the amounts shown are the balances in those accounts. The amount of amortization of exploration and development prior to the beginning of the operating period, if any, may be shown in this statement or may be included as a separate item in the statement of mining cost, Exhibit 6.

In support of the production cost summary there should be prepared a total operating cost summary which may be as shown in Exhibit 5. This statement presents an over-all picture of the company's operations showing for each operation the elements of cost, such as labor, supplies, allocable portion of the expenses of redistributable departments, and other charges which form part of the cost of producing refined copper. The totals by operations are the amounts shown on the production cost summary.

Cost statements supporting all of the principal operations that can be advantageously analyzed, in this case, mining, concentrating, smelting and redistributables, should also be designed, the suboperations shown on these statements being the subaccounts which are maintained in the cost ledger as previously described.

EXHIBIT 2

METAL STATISTICS

	Material (tons)	Copper (pounds)	Silver (ounces)	Gold (ounces)
Concentrating Ore Crushed (Mill Feed)	x	x	x	x
Change in In-Process Inventory		x	x	x
		x	x	x
Metals Lost in Tailings		#	#	#
Other Concentrator Losses		#	#	#
Concentrate Production	x	x	x	x
Ratio of Concentration	x			
Per Cent Concentrator Recovery		x	x	x
Concentrates Bedded (Produced)	x	x	x	x
Change in Concentrates Bedded Inventory	x	x	x	x
Concentrates Charged in Reverberatories	x	x	x	x
Smelting Ore Crushed and Bedded	x	x	x	x
Change in Smelting Ore Bedded Inventory	x	x	x	x
Smelting Ore Charged in Reverberatories	x	x	x	x
Concentrates Charged in Reverberatories	x	x	x	x
NMBM Charged in Reverberatories	x	x	x	x
Metals Lost in Reverberatory Slag		#	#	#
Metals Lost in Converter Slag		#	#	#
Other Smelting Losses		#	#	#
Blister Production	x	x	x	x
Calculated Refinery Losses		#	#	#
Recoverable Metals		x	x	x
Per Cent Smelter Recovery		x	x	x

Deduction

NMBM—New Metal Bearing Material

In many cases it will be desirable to have other supporting statements further detailing the cost by suboperations.

Mining Cost Statements

Exhibit 6 is a statement summarizing the mining cost of the company. On this form are shown the tons of ore produced and the cost per ton for each operation, the returnable copper content, and the cost expressed in cents per pound of returnable copper. The silver and gold content expressed in terms of ounces per ton of ore, and the net mining cost, after crediting the value of the silver and gold contents, are also shown.

Each of these operations may be divided into suboperations and a proper statement designed to show information necessary for the control of cost. For example, exploration and development would show as suboperations, drifting, raising, and diamond drilling; ore extraction may be detailed to show the cost of stoping, filling, and drills and tools; and drainage costs could be divided into the cost of

EXHIBIT 3

PRODUCTION FLOW SHEET

	Copper (pounds)						Material (tons)				
		Concentrator		Smelter				Concentrator		Smelter	
	Ore Mined	Mill Feed	Concentrates	NMBM	Blister	Recoverable Copper	Ore Mined	Mill Feed	Concentrates	NMBM	Blister
In-Process Beginning	—	x	x	x	x		—	x	x	x	x
Mined	x						x				
Ore to Smelter	#			x			#			x	
Ore to Concentrator	#	x					#	x			
Ore Concentrated		#						#			
Concentrates Produced			x						x		
Concentrator Losses			#								
Concentrates to Smelter			#	x					#	x	
Smelter Losses				#							
NMBM Smelted				#						#	
Blister Produced					x						x
Blister to Refinery					#	x					#
Calculated Refinery Losses						#					
In-Process End	—	x	x	x	x		—	x	x	x	x
Recoverable Copper						x					

Deduction
NMBM—New Metal Bearing Material

EXHIBIT 4

PRODUCTION COST SUMMARY

	Amount	Cents per Pound of Returnable Copper	Units of Material Handled	Cost per Unit of Material Handled
Mining	$ x	x	x tons ore mined	$ x per ton
Ore Transportation	x	x	x tons ore mined	x per ton
Concentrating	x	x	x tons ore milled	x per ton
			x tons concentrates produced	x per ton
Smelting	x	x	x tons material smelted	x per ton
			x tons blister produced	x per ton
Depreciation	x	x		
Change in Inventories	x	x		
Direct Cost of Blister Produced	x	x	x tons blister produced	x per ton
Deduct Credits for Precious Metals:				
Silver	#	#	x ounces recoverable	# per ounce
Gold	#	#	x ounces recoverable	# per ounce
Net Cost of Blister Produced	x	x	x tons blister produced	x per ton
Freight on Blister	x	x	x tons blister produced	x per ton
Refining Charges	x	x	x tons blister produced	x per ton
Cost of Returnable Copper	$ x	x	x pounds returnable copper	

Deduction

EXHIBIT 5

TOTAL OPERATING COST SUMMARY

	Total	Mining	Ore Transportation	Concentrating	Smelting	Redistributables	Depreciation	Change in Inventories	Silver and Gold Credits	Freight and Refining
Wages	x	x	x	x	x	x				
Supplies	x	x	x	x	x	x				
Timber	x	x								
Explosives	x	x								
Sundry Expenses	x	x	x	x	x	x				
Redistributables:										
Power		x	x	x	x	#				
Shops Expense		x	x	x	x	#				
General Overhead		x	x	x	x	#				
Assay Office Expense		x		x	x	#				
Preparation of Concentrating Ores				x	#					
Depreciation	x						x			
Change in Inventories	x							x		
Silver Recoverable	#								#	
Gold Recoverable	#								#	
Freight on Blister	x									x
Refining Charges	x									x
Total	x	x	x	x	x	—	x	x	#	x

Deduction

EXHIBIT 6

MINING COST

	Total	Exploration and Development	Ore Extraction	Tramming	Hoisting	Drainage	Ventilation	Sampling and Assaying	Sundry Expenses
Wages	x	x	x	x	x	x	x	x	
Supplies	x	x	x	x	x	x	x	x	
Timbers	x	x	x						
Explosives	x	x	x						
Sundry Expenses	x								x
Power	x		x	x	x	x	x		
Shops Expense	x	x	x	x	x	x	x		
General Overhead	x								x
Assay Office Expense	x							x	
Total	x	x	x	x	x	x	x	x	x
Cost per Ton of Ore Mined	x	x	x	x	x	x	x	x	x
Cost per Pound of Returnable Copper	x	x	x	x	x	x	x	x	x

Ore Mined	x	Tons
Content of Ore Mined:		
Returnable Copper—	x	Pounds
Recoverable Silver—	x	Ounces
—	x	Ounces per ton of ore
Recoverable Gold—	x	Ounces
—	x	Ounces per ton of ore

Mining Cost—(as above)		x
Less Credits for Precious Metals:		
Silver	x	
Gold	x	x
Net Mining Cost		x
Net Mining Cost:		
Per Pound of Returnable Copper		x
Per Ton of Ore Mined		x

underground drainage, surface drainage, and pumping. These are shown in Exhibits 7, 8, and 9, respectively.

These subaccounts may be detailed to whatever extent the management deems necessary but it should be borne in mind that the basic records of labor, supplies and expenses would have to be designed so as to include provision for charges to all such additional subaccounts.

EXHIBIT 7

EXPLORATION AND DEVELOPMENT

	Total	Drifting	Raising	Diamond Drilling
Wages	x	x	x	x
Supplies	x	x	x	x
Timbers	x	x	x	
Explosives	x	x	x	
Shop Expense	x			x
Total	x	x	x	x
Feet Advance		x	x	x
Cost per Foot		x	x	x

EXHIBIT 8

ORE EXTRACTION

	Total	Stoping	Filling	Drills and Tools
Wages	x	x	x	x
Supplies	x	x	x	x
Timbers	x	x		
Explosives	x	x	x	
Power	x	x	x	
Shops Expense	x		x	x
Total	x	x	x	x

EXHIBIT 9

DRAINAGE

	Total	Underground Drainage	Surface Drainage	Pumping
Wages	x	x	x	x
Supplies	x	x	x	x
Power	x	x		x
Shops Expense	x	x	x	x
Total	x	x	x	x
Gallons of Water Pumped				x
Cost per Thousand Gallons				x

EXHIBIT 10

CONCENTRATING COST

	Total	Preparation of Ores	Grinding	Flotation	Thickening	Filtering	Tailings Disposal	Sampling and Assaying	Sundry Expenses
Wages	x		x	x	x	x	x	x	
Supplies	x		x	x	x	x	x	x	
Sundry Expenses	x								x
Power	x		x	x	x	x			
Shops Expense	x		x	x	x	x			
General Overhead	x								x
Assay Office Expense	x							x	
Preparation of Ores	x	x							
Total	x	x	x	x	x	x	x	x	x
Cost per Ton Mill Feed	x	x	x	x	x	x	x	x	x
Cost per Pound Returnable Copper	x	x	x	x	x	x	x	x	x
Mill Feed Dry Tons	x								
Pounds Returnable Copper in Concentrates Produced	x								

Concentrating Cost Statements

The cost statement for the concentrating department is shown in Exhibit 10. Concentrating costs are required in terms of both the cost per ton of mill feed and the cost per pound of returnable copper. It has been assumed that all the preparation of both concentrating and direct smelting ores is handled by the smelter department and that a proportion of the costs is allocated to concentrating ore in proportion to the quantities handled (see Exhibit 12). Supplementary statements for suboperations may be prepared if feasible and desirable.

Smelting Cost Statements

In Exhibit 11, the smelting cost statement, the unit cost of smelting is shown as the cost per ton of new metal bearing material (NMBM) charged, as the cost per ton of blister produced, and also as the cost per pound of returnable copper. Supplementary cost statements are desirable in order to show the costs of preparation of ores, of reverberatories, and of converters, and are set forth in Exhibits 12, 13, and 14, respectively.

As preparation of ore applies to both direct smelting ore and concentrating ore, a portion of these costs applies to the handling of concentrating ore and such amounts are shown as credits to this operation and are charged to the concentrating operation, Exhibit 10. The remainder of the cost is charged the smelter for handling and crushing direct smelting ore. These costs are stated as the cost per ton of material handled, the cost per ton NMBM smelted, and the cost per pound of returnable copper. In addition to the unit cost per ton of material charged, the statement for reverberatories also shows operating data, such as cost of slag handling per ton of slag and the copper contents of slag and of matte. These operating data are particularly necessary as a measure of the operating efficiency. The converter cost statement shows the cost per ton of blister produced and per pound of returnable copper, and other operating data necessary for the proper control of operations.

Redistributable Costs

Redistributable costs may include not only service departments and indirect costs, such as general overhead, but also direct operating functions, such as hoist operation, auto truck operation, industrial transportation, pumping plant, etc., which serve two or more operations or departments. For the hypothetical company under consideration, four typical redistributable costs are considered, power, shops expense, general overhead, and assay office expense, the total charges to which are to be allocated to direct operations or departments.

The cost statement for power showing the costs that apply to the subaccounts steam, electricity, and compressed air, is shown on Exhibit 15, and it is indicated that the distribution to operating accounts is on the basis of use. Electricity, for instance, may be metered, steam and compressed air may be measured, but it may be that other methods of allocation must be devised in order to satisfy the particular conditions met.

As is shown on Exhibit 16, three representative shops, the machine shop, the blacksmith shop, and the carpenter shop, comprise the subaccounts for shops ex-

EXHIBIT 11

SMELTING COST

	Total	Preparation of Ores	Roasters	Reverberatories	Converters	Sundry Expenses
Wages	x	x	x	x	x	
Supplies	x	x	x	x	x	
Sundry Expenses	x					x
Power	x	x	x	x	x	
Shops Expense	x	x	x	x	x	
General Overhead	x					x
Assay Office Expense	x	x	x	x	x	
Preparation of Concentrating Ore	#	#				
Converter Revert Treatment				#	x	
Converter Slag Treatment				#	x	
Converter Slag Disposal				#	x	
Total	x	x	x	x	x	x
Cost per Ton NMBM Smelted	x	x	x	x	x	x
Cost per Ton Blister Produced	x	x	x	x	x	x
Cost per Pound Returnable Copper	x	x	x	x	x	x
Tons NMBM Smelted	x					
Tons Blister Produced	x					
Pounds Returnable Copper in Blister Produced	x					

Deduction

NMBM—New Metal Bearing Material

pense. The indicated distribution to operations on the basis of shops labor used by each operation is quite common and generally provides equitable allocations.

General overhead is considered herein as a redistributable cost and is distributed to the principal operations in proportion to the labor cost charged to the principal operations. This type of overhead is sometimes included as a separate cost and not allocated to operations. The expenses included in general overhead are indicated on Exhibit 17.

The expense of assaying samples of materials taken at the various stages of treatment of a nonferrous ore should, of course, be borne by the operations and departments from which the samples are taken. The expense of the assay office and of the bucking room is, therefore, allocated to the various operations on the basis of units of service performed by the assayers in making determinations of content of materials for such operations. The cost statement for the assay office expense is given on Exhibit 18.

EXHIBIT 12

PREPARATION OF ORES

	Total	Unloading	Coarse Crushing	Fine Crushing	Bedding	Reclaiming	Sampling and Assaying
Wages	x	x	x	x	x	x	x
Supplies	x	x	x	x	x	x	x
Power	x		x	x	x	x	
Shops Expense	x	x	x	x	x	x	
Assay Office Expense	x						x
Total Preparation Expense	x	x	x	x	x	x	x
Preparation of Concentrating Ore	#	#	#	#	#	#	
Charged Smelter	x	x	x	x	x	x	x
Cost per Ton Handled		x	x	x	x	x	x
Cost per Ton NMBM Smelted	x	x	x	x	x	x	x
Cost per Pound Returnable Copper	x	x	x	x	x	x	x
Tons Handled							
Direct Smelting Ore		x	x	x	x	x	x
Concentrating Ore		x	x	x	x	x	x
		x	x	x	x	x	x
Tons NMBM Smelted	x						
Pounds Returnable Copper in Blister Produced	x						

Deduction
NMBM—New Metal Bearing Material

EXHIBIT 13

REVERBERATORIES

	Total	Operating Furnaces	Slag Handling	Sampling and Assaying
Wages	x	x	x	x
Supplies	x	x	x	x
Power	x	x	x	
Shops Expense	x	x	x	
Assay Office Expense	x			x
Converter Revert Treatment	##	##		
Converter Slag Treatment	##	##		
Converter Slag Disposal	#		#	
Total	x	x	x	x
Cost per Ton Material Charged	x	x	x	x
Cost per Ton Smelter Slag Produced			x	

	Tons	% Copper
Material Charged	x	
Smelter Slag Produced	x	x
Matte Produced	x	x

Deduction

EXHIBIT 14

CONVERTERS

	Total	Operating Cranes	Operating Converters	Lining Converters	Casting	Sampling and Assaying
Wages	x	x	x	x	x	x
Supplies	x	x	x	x	x	x
Power	x	x	x	x		
Shops Expense	x	x	x		x	
Assay Office Expense	x					x
	x	x	x	x	x	x
Revert Treatment	x					
Slag Treatment	x					
Slag Disposal	x					
Total	x					
Cost per Ton of Matte		x	x	x		
Cost per Ton of Blister Produced	x	x	x	x	x	x
Cost per Pound of Returnable Copper	x	x	x	x	x	x
Cost per Ton Handled		x				
Tons of Matte	x					
Tons Blister Produced	x					
Pounds Returnable Copper	x					
Tons Handled		x				

EXHIBIT 15

POWER

	Total	Steam	Electricity	Compressed Air
Wages	x	x	x	x
Supplies	x	x	x	x
Sundry Expenses	x	x	x	x
Shops Expense	x	x	x	x
Total	x	x	x	x

DISTRIBUTION OF POWER

Mining:			
Ore Extraction:			
Stoping	x		
Filling	x	x	
Tramming		x	
Hoisting		x	
Drainage:			
Underground Drainage	x		
Pumping	x	x	
Ventilation		x	x
Ore Transportation			x
Concentrating:			
Grinding		x	
Flotation		x	
Thickening		x	
Filtering		x	x
Smelting:			
Preparation of Ores:			
Coarse Crushing	x		
Fine Crushing	x		
Bedding	x		
Reclaiming	x	x	
Roasters		x	
Reverberatories:			
Operating Furnaces	x		
Slag Handling	x	x	
Converters:			
Operating Cranes	x		
Operating Converters	x		
Lining Converters	x	x	x
Redistributables:			
Shops Expense:			
Machine Shop	x		
Blacksmith Shop	x		
Carpenter Shop	x	x	
General Overhead		x	
Assay Office Expense:			
Assay Office	x		
Bucking	x	x	x
Total			x

Note: Distributed on basis of use.

EXHIBIT 16

SHOPS EXPENSE

	Total	Machine Shop	Blacksmith Shop	Carpenter Shop
Wages	x	x	x	x
Supplies	x	x	x	x
Sundry Expenses	x	x	x	x
Power	x	x	x	x
Total	x	x	x	x

DISTRIBUTION TO OPERATIONS

Mining:			
Exploration and Development:			
Diamond Drilling		x	
Ore Extraction:			
Filling	x		
Drills and Tools	x	x	
Tramming		x	
Hoisting		x	
Drainage:			
Underground Drainage	x		
Surface Drainage	x		
Pumping	x	x	
Ventilation		x	x
Ore Transportation			x
Concentrating:			
Grinding		x	
Flotation		x	
Thickening		x	
Filtering		x	x
Smelting:			
Preparation of Ores:			
Unloading	x		
Coarse Crushing	x		
Fine Crushing	x		
Bedding	x		
Reclaiming	x	x	
Roasters		x	
Reverberatories:			
Operating Furnaces	x		
Slag Handling	x	x	
Converters:			
Operating Cranes	x		
Operating Converters	x		
Casting	x	x	x
Redistributables:			
Power:			
Steam	x		
Electricity	x		
Compressed Air	x	x	x
Total			x

Note: Distributed on basis of shops labor used.

EXHIBIT 17

GENERAL OVERHEAD

General Administration	x
Accounting Office Expense	x
Time Office Expense	x
Warehouse Expense	x
Legal	x
Engineering and Consulting	x
Taxes—Real and Personal Property	x
—Social Security	x
—Other	x
Power	x
Sundry	x
Total	x

DISTRIBUTION TO OPERATIONS

Mining	x
Ore Transportation	x
Concentrating	x
Smelting	x
Total	x

Note: Distributed on basis of labor cost.

EXHIBIT 18

ASSAY OFFICE EXPENSE

	Total	Assay Office	Bucking Room
Wages	x	x	x
Supplies	x	x	x
Sundry Expenses	x	x	x
Power	x	x	x
Total	x	x	x
Cost per Unit of Service	x	x	x
Cost per Determination	x	x	x

DISTRIBUTION TO OPERATIONS

	Total Cost	Units of Service	Determinations
Mining	x	x	x
Concentrating	x	x	x
Preparation of Ores	x	x	x
Roasters	x	x	x
Reverberatories	x	x	x
Converters	x	x	x
Total	x	x	x

Note: Distributed on basis of units of service.

COST ACCOUNTING FOR MORTGAGE LOAN COMPANIES

By

HOWARD A. MOORE *

I. DESCRIPTION OF THE INDUSTRY

History

Considerable changes have been made in the last fifteen years in the mortgage loan business so that at the present time methods and procedures have been standardized almost universally in the industry.

This movement began with the organization of the Home Owners' Loan Corporation (HOLC) in 1933. Prior to that time interest rates, prepayment plans, financing costs, etc., varied considerably in different communities and often there was a wide range of plans within a community.

The HOLC was formed as an emergency agency during the depression with the express purpose of giving owners assistance when their homes were in distress. Lending institutions had most of their assets frozen and encouraged and recommended to their clients to take advantage of the loan offered by the HOLC. The mortgagee received payment in government bonds which were readily marketable at a premium as payment of the existing mortgage. Occasionally it was necessary for the lending institution to make an allowance to the borrower in order to conform with the low HOLC appraisal. In this way loan companies may have suffered severe losses but were able to stay in business during a hazardous period by securing liquid assets in exchange for poor investments.

In 1934 another forward step was taken by the chartering of the Federal Housing Administration. The purpose of the FHA is to insure approved mortgagees against loss on mortgaged real estate.

After the war the Servicemen's Readjustment Act was passed giving liberal terms and interest rates to veterans. Such loans are commonly called "G. I. loans" and give the lender a guarantee that he cannot suffer serious loss because of making such loans.

This background of the industry clearly shows that government regulations have assisted tremendously in standardizing the methods and procedures used by the industry.

Organization

Generally there are four different types of organizations in the mortgage loan business:

1. Banks and Trust Companies
2. Building and Loan Associations

* Certified Public Accountant, Indiana; Secretary-Treasurer, Whitcomb & Keller, Inc., South Bend, Indiana.

3. Mortgage Brokers
4. Insurance Companies

Although the accounting system of each company may differ, the procedure in handling mortgage loans in any of these institutions is much the same. You may find that some banks and building and loan associations may originate and retain mortgages but do not buy or sell. Other banks may depend entirely upon brokers for loans for their portfolios. Most insurance companies will purchase mortgages from brokers although a small proportion of their business may be done through their own agents.

The office in any one of these lending institutions would have the following distribution of work:

1. Origination of Loan
   - A. Application
   - B. Appraisal and Approval by Loan Committee
   - C. Closing of Loan
2. Servicing of Loan
   - A. Cashier
   - B. Collection
3. Brokerage
   - A. Purchase of Loans
   - B. Sale of Loans

II. How to Design the Cost System

What Information Is Required

The cost system should give the management the following information:

1. Cost of Each Operation
   - A. Origination of Loan
   - B. Servicing of Loan
   - C. Purchase of Loan
   - D. Sale of Loan
2. Net Yield from an Investment
3. Net Yield from Servicing a Loan

Such data should be presented in an intelligible form for determining plans and policies.

Procedures in the mortgage loan department should be analyzed by the cost department in order to insure efficient work with the least amount of cost. Unnecessary and duplicate records should be avoided or discontinued. Accounting work and bookkeeping procedures should be reduced to a minimum by devising accurate and efficient systems in connection with cashier and collection work.

Considerations in Designing the Cost System

In designing a cost system for a mortgage loan company it should be remembered that such an industry is a service organization. Nothing tangible is produced and there cannot be definitely stated the amount of time, work, or effort spent on each unit of product. Accordingly the results are measured after the services have

been performed. At the end of a period the cost of each operation can be ascertained and from this a standard can be established for the next period. The only cost item than may not change materially is "servicing." Volume changes, of course, will cause an increase or decrease in cost.

Variations of costs will occur when a method of procedure is changed. In this business it will be found that changes must be made continually due mainly to changes in government regulations. When changes in the system are required, careful thought should be exercised so as to avoid unnecessary operations.

III. Description of the Cost System

The most important steps in establishing a cost system in the mortgage loan business are as follows:

1. Design the profit-and-loss statement for management (Figure 1).
2. Design monthly report of loan activity for management (Figure 2).
3. Design loan progress sheet (Figure 3).
4. Design expense distribution sheet (Figure 4).
5. Set up the required chart of accounts.

Loan Progress Sheet

It should be the purpose of every cost system, not only to show the cost of an operation, but also to originate methods whereby costs can be reduced. Our first

Profit-and-Loss Statement

Income:			
Commissions			
Collection Fees			
Premium on Sale of Loan			
Interest Earned			
Department Expenses:			
Loan Department			
Service Department			
Brokerage Department			
Other Expenses:			
Interest			
Premium on Purchase of Loans			
Allowances			
Taxes			
Sundry			
Total Expenses			
Other Income:			
Discounts Earned			
Sundry Income			
NET PROFIT			

Fig. 1. Profit-and-Loss Statement for a Mortgage Loan Company.

REPORT FOR MONTH ENDING:		THIS MONTH		LAST MONTH		YEAR TO DATE		LAST YEAR TO DATE	
		NO.	AMOUNT	NO.	AMOUNT	NO.	AMOUNT	NO.	AMOUNT
LOANS CLOSED:	FHA								
	GI								
	UNINSURED								
	COMBINED								
LOANS SOLD:	FHA								
	GI								
	OTHERS								
	COMBINED								
LOANS PURCHASED	FHA								
	GI								
	OTHERS								
	COMBINED								
LOANS PENDING CLOSING									
ALL LOANS IN PROCESS									
TOTAL OUTSTANDING LOANS	FHA								
	GI								
	OTHERS								
	TOTAL								

Fig. 2. Monthly Report of Loan Activities.

step, therefore, is to analyze the work and prepare a form which will show each operation from the consummation to the sale of a loan.

The purpose of a loan progress sheet is to set up these operations that must be performed by the loan department as the loan progresses. By following this progress sheet any unnecessary steps or duplications would be avoided. This sheet should be devised so that all information is shown concerning the work to be done and that each operation as it proceeds through the office is not duplicated.

Figure 3 is an example of such a loan progress sheet. The actual detail will naturally vary with the various requirements of different institutions. On this sheet a time record could also be kept of the different operations so that in analyzing any particular loan the exact cost of the office time can be computed.

Subsidiary information should be maintained on each loan to show net yield. Premium and discount on loans bought and sold should be carried as a current item on the profit-and-loss statement. The subsidiary record would have all detail of such premium or discount showing the net yield of the loan.

LOAN PROGRESS SHEET

Property Address_____

Legal Desc._____

Applicant_____ Tel. No._____

Application Date_____ Cond. Com. Ordered_____ Rec'd._____

Firm Com. Ordered_____ Rec'd._____ Amount $_____ Term_____ Rate_____

Loan Com. Approval _____ FHA No._____ Com. Ex_____ Extend_____

FHA APPRAISAL: Land $_____ Imp. $_____ Total $_____ Rating_____

FHA Inspections:	Ordered	For	Rec'd.	To Architect
1st				
2nd				
3rd				
Repair				

Labor & Mat'l Affidavits_____ Waivers_____ Escrow_____

ABSTRACT: Ordered From_____

1st Cont._____ Rec'd._____ 2nd Cont._____ Rec'd._____

Judgment & Tax Letter Ordered_____ Rec'd._____

CLOSING: O.K._____ Closed_____ Note to FHA_____ Ret'd._____

Mtg. Date_____ Recorded_____ No._____

TITLE INS: Prel. ordered_____ Atty. No._____ Rec'd._____

Final Pol. Ordered_____ Pol. Rec'd._____

ACCOUNTING: Insurance Pol._____

Journal_____ Amort. Schedule_____ Letter to Bor._____

SALE: Offered_____ To_____ Accepted_____

Shipped_____ Rec'd. Pmt._____

Assignment Recorded_____ Mailed_____

CO. APPRAISAL: Land $_____ Imp. $_____ Total $_____

Escrow $_____ Complete By_____

Our Loan No._____

Fig. 3. Loan Progress Sheet.

EXPENSE DISTRIBUTION FOR MONTH OF_____194__

	Total		A Loan Dept.		B Servicing Dept.		C Brokerage Dept.	
	1 mo.	Period	1 mo.	Period	1 mo.	Period	1 mo.	Period
Salaries								
Recording Fees								
Freight, Express, and Drayage								
Electricity								
Office Expense								
Rent								
Stationery and Printing								
Subscriptions and Dues								
Telephone and Telegraph								
Postage								
Abstracts and Title Ins.								
Special State Taxes								
Miscellaneous								
No. Loans								
Amt. of Loans								
Cost per Loan *								

* Computed by dividing total expense by number of loans.

Fig. 4. Expense Distribution Sheet.

Expense Distribution Sheet

Figure 4 shows the division of expenses as set out in Part I above, as shown below:

A. Loan Department (Origination of Loan)
B. Servicing Department (Cashier and Collection)
C. Brokerage Department (Purchase and Sale of Loans)

The distribution of the expenses to these different departments should be according to recognized accounting principles, that is, salaries on time, rent on space, etc.

Because of change in volume of work throughout the year this monthly distribution cannot be considered complete in itself in determining the cost of an operation. A longer period of time—preferably a year—should be used in setting up any standard.

Monthly Report on Loan Activities

Management is vitally interested in the volume of work that is produced by the loan department each month. Through such a report comparisons can be made with other institutions to determine if the proper amount of business is being handled by the institution. Through information secured from county records or agencies able to supply such information, an auxiliary report can be prepared showing the volume of business in the county, the number of loans for each company, and the amount of such loans. For successful business, operation reports should also be made on loans which have been paid in full:

How did the mortgagor secure his fund to pay the Loan?

Did he borrow elsewhere?

Did we lose the loan because of our service? Etc.

Profit-and-Loss Statement

Most institutions that are in the mortgage lending business will also have other activities. The profit-and-loss statement shown in Figure 1 gives emphasis only to the mortgage loan department of an institution. The figures for the expenses of the departments are carried forward from the expense distribution sheet.

This statement is easily understandable and shows only the net results from operations without giving attention to detail costs.

COST ACCOUNTING IN MOTION PICTURE PRODUCTION

By
T. H. BIERCE *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Motion pictures are generally divided between entertainment films and educational or instructive films. Entertainment films may be features, shorts, newsreels, or Westerns. Features may be classified as "A," "B," etc., depending largely upon studio policy and budgeted cost. Shorts, newsreels, and Westerns all provide variety to the entertainment program.

Origin of the Products

Newsreels, of course, depict actual current events and are shot on the spot where the event occurs. Features portray human interest stories of actual or imaginary situations.

Motion picture production is distinctly a special-order type of business. Every picture must be as different as possible from every other picture. Originality, individuality, and human appeal are essentials for successful pictures. Each plot must tell a different story, the scenes must be of different places, the characters must impersonate different individuals, the properties used must not be identical, nor may the actors wear the same clothes. In fact, nothing can be standardized, and the business may be said, therefore, to be distinctly of the special-order type. Product specifications originate as a result of an actual historical event or as a result of the creation of situations originating in the human imagination, portrayed by the artistry of the players and guided by the skill of the director and the producer.

Sources of Raw Materials

The so-called "raw materials" which enter into the finished product include the story rights, pre-production costs, accomplishments of the actors and actresses and the effects contributed by their equipment and properties, together with the necessary background scenes and music. Because the actors and actresses are not inanimate objects but are human beings with feelings and sensitivities, the process of molding the rough material into the finished product requires a delicacy of processing which most other manufacturing activities do not require. Careful, sympathetic attention must be devoted to personal frailties. Likewise, the processing departments are staffed by directors and producers with distinct tastes and prejudices and interpretative abilities, the influence of which, when applied to the so-called raw materials, may bring out the most exquisite of performances from the

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players in their chosen setting. It is the duty of the motion picture producers and directors to see that the talents of the players, and of many other people who contribute delicate skills, are applied in such fashion, and in the proper surroundings, that a picture with a maximum of screen appeal is produced at a minimum of cost.

Organization of Plant

Story Department.—As an aid to the executives in choosing appropriate subjects, a story department is maintained at the studio. Members of this department scan nearly every published story and stage or radio production for the purpose of obtaining subjects suitable for motion pictures. Synopses are made by the readers and after review the best ones are chosen to be submitted to the story department head and to the production executives for final selection. Consideration is given to cost, talent, and equipment available. If a story proves suitable, the picture rights are purchased. Complete records are kept of everything that has been read, for easy reference. Readers make a weekly report listing the publications that they have briefed showing which were recommended and which were not, as a check on the amount of work done.

Writing Department.—From time to time situations arise that may conceivably form the basis for subjects for excellent motion pictures. Exploitation of such subjects is made with the assistance of writers, who transform the idea into a script.

Writers also process long stories by writing a continuity, to which, when approved, dialogue is added. Sometimes these steps are combined into one, and the resultant script of about 100 pages becomes the basis of action for all those working on the picture.

Writers make a weekly report of progress stating the amount of time spent on each part of the work.

Set Designing and Construction.—The producer, the art director, the director, and the production manager each visualize the individual scenes based upon the accepted script, and in conference the general set construction and design are discussed. The art director draws designs for the sets required for the respective scenes and, when the designs have been approved, construction work by the mill, the plaster shop, and the paint shop begins. If existing sets are to be used, they are removed from set location, altered as required, and set up in an appropriate location for the commencement of shooting. Occasionally sets may be rented from other studios. In so far as possible the position of the cameras is determined in advance in order that nothing will be constructed that will not be registered on the film.

After the heavy construction has been completed, electricians arrange for adequate lighting to bring out the best points of the portion of the room being photographed. Set dressers then dress the set and equip it with appropriate properties, furniture, and equipment to simulate the surroundings called for by the period which the picture represents. Artistic consideration is given to every phase of construction, arrangement, and stage dressing; and the producer, director, and art director at all times maintain a continued interest in the proper arrangement of the set and all its movable equipment and decorations.

Casting and Wardrobe.—Of major importance to success in motion picture production is the selection of actors and actresses whose characteristics are peculiarly fitted to the respective roles. Copies of the accepted script are given to the casting department, therefore, as well as to others concerned, and the casting director, after

carefully reading the script, visualizes the requirements of appearance, abilities, personality, and voice for each of the major parts. He may confer with a central casting bureau for supporting requirements. Whenever possible, players already under contract with the company are given parts. If no player under contract seems to meet the requirements for a major role, the studio frequently arranges to borrow a star from another studio, on a "loan-out" basis. Minor roles are filled from available catalogues of players or from the development of young stars recently discovered. The casting director is constantly making voice and screen tests to discover young stars whose talents are great and whose financial requirements are modest. Frequently starlets are discovered and cast in minor roles to gain experience and assurance and suddenly emerge into the brilliance of stardom.

The cast having been selected, the men's and women's wardrobe departments now begin consideration of their portion of the work. Costumes are designed to fit the period and cut to fit the person. It frequently happens that costume designers of exceptional ability will find themselves as much in the limelight, through the productions of their creative talent, as directors do in the development of brilliant stars from unknown individuals.

Rehearsing and Shooting.—The amount of rehearsing necessary before a picture is undertaken depends upon the type of picture and the respective requirements involved. For example, where elaborate dance routines, substantial choral work, difficult dialogue, and timing problems are involved, a substantial amount of rehearsal is absolutely necessary. Shooting is done either at the studio or "on location," which means at some other location of special significance.

The technical development of the art has progressed so far that the various elements comprising the scene can be broken up into parts and each part produced separately and, when in order, these parts can be brought together. For example, a musical number can be done at a recording studio and, when the music is satisfactory, it can be recorded on a play-back. This play-back is then worked into the shooting of the picture so as to be timed appropriately. Meanwhile, in the actual taking of the film, the actors will operate silently in synchronization with the music. Such musical recordings are made in studios especially equipped to receive and record sound. By such arrangements it is possible, for example, for a good actor, who is not a good pianist, to appear to produce wonderful selections on silent keyboard pianos by the use of play-back recordings.

The directors supervising motion picture production are excruciatingly meticulous with respect to every scene. It is customary to shoot scenes over and over again, all day long, until the mannerisms and vocal contributions of each actor are completely acceptable. For the highest grade productions, it is frequently considered a very successful day's work if fully acceptable production amounting to only two or three minutes is obtained. Thus it will be seen that for a 90-minute feature the shooting may take anywhere from one to three months.

If consideration is given to the time cost of high-priced stars and supporting cast, it will readily be appreciated that the cost of such productions can easily become a very high figure. Because of the substantial per hour time costs, it is customary to keep on duty so-called standby painters, grips, carpenters, laborers, greensmen, and allied craftsmen. It is much cheaper to pay these men even though they may not work a single minute all day than to hold up an entire production

company due to a chipped cornice, broken window or any defects in the set that may appear in the photographic effect of the scene.

Pleasing productions are composed of a summation of artistic effects. These are obtained more by careful thought than by much rushing around, and it is apparent therefore that close attention must be given to the settings, tone, and general artistic effect. The casual observer may see many people sitting around apparently doing nothing, but these people are mentally scrutinizing every effect and every artistic feature of the production for possible improvement in the quality of the picture.

Outside independent producers are sometimes permitted to make pictures on the studio lot at times when the studio capacity is not fully occupied. In return for the use of the studio facilities and overhead the outside producer may grant the studio a profit participation in the picture.

Many films are shot silently and sound effects are synchronized in later, as described above. In shooting scenes, shots frequently last from thirty seconds to a minute. Prior to each shot, it is customary for a grip to appear in the picture in a prominent spot with a placard indicating title, scene number, and the take number of the picture. In cutting, these numbers assist in identifying the acceptable parts of the picture to be selected for incorporation in the finished production.

When shooting a picture, one recording channel and two or three cameras are used. Every sequence is ordinarily recorded at least three times, even if the first version seems adequate, in order to protect against an unpredictable mishap to the negative. By liberal use of film, the chances of having a day's work bring no results are greatly reduced. When a production company is "on location" far from the studio, it is particularly important that all sequences be perfect as it would be tremendously expensive to require the entire company to return to the district and thus repeat a costly journey.

After each sequence is finished, the best take is designated by the director. At the end of each day, the best takes are printed in the laboratory and the rest of the film is put on file. Each evening the previous day's work is projected so that the director, head cameraman, first recordist, and others can see how the work is progressing. At this time the director usually suggests to the cutters which of the several angles he prefers to be made a part of the finished picture.

Special Effects.—In every phase of motion picture production, individuality and showmanship play such tremendously important parts that there can be no systematic, machine-made method for turning out pictures. The investment in high-priced talent is so great that substantial expenditures must be made to produce proper vehicles, adequate effects, and acceptable artistry. Each studio, therefore, pays especial attention to selecting departmental experts and to guiding their efforts. For example, the story department will be equipped with men who can alter a printed story in such a way as to exploit fully the capabilities and characteristics of individual stars. Likewise, directors are assigned with particular consideration for their experience along particular types of pictures.

Cameramen develop a special art of their own and must know all of the technical details concerning lighting, angles, shadows, and highlights. Recording experts are schooled in sound tracks, sound effects, tones, and volume. Music experts are required to create or obtain appropriate musical backgrounds or major music and must be familiar with copyright aspects, royalties, the indexing of music and in-

fringement possibilities. Painting is done by men skilled in the art who, in conjunction with set designers, are capable of simulating almost any location or effect. Special effects, photographic effects, mechanical effects, processing, miniature photography, and matte work are all provided by experts who take great professional pride in their work.

Other departments, such as costume design, draperies, make-up, and electric wiring, all require the services of persons who have devoted years of work and study to their arts. Studios provide expert hairdressers and make-up artists to prepare stars for the respective scenes. Private dressing rooms are provided for stars and everything possible is done to promote the welfare and comfort of all concerned. Special technical attention is given to pictures made in color, which usually require special lighting effects, special cameramen, and special processing of the film.

Cutting.—The cutting department performs the function of editing the picture. The various sequences which have been taken are assembled in script order and prints made. Due to the fact that many scenes have been taken out of sequence, there is always the possibility that drags and laughs will occur due to the juxtaposition of situations which alone would be considered perfectly normal. It is customary, therefore, to preview the picture several times during the editing process to get the probable reaction of the audience to the picture.

When the director finally approves the way in which the picture has been pieced together, the negative is then cut and a checkup print is taken to see that no mechanical mistakes have been made. Finally, the sound track and the camera film are combined into what is called the "composite" or "movietone" print, from which positive prints can be made which are then distributed to the 17,000 theaters throughout the country. After previews, copyright, and approval by regulatory bodies, the picture is now ready for domestic release. For foreign release it will usually be necessary to "dub in" foreign languages, or to superimpose foreign titles. After a reasonable period of time (frequently 78 weeks) prints may be made and released in 16 mm. versions for home, club, or school use.

Production Order System

The production of a motion picture begins with the acceptance of the story or sequence upon which it is based. The story is condensed to a script of about 100 pages. When it has been accepted by the production executives, it is transmitted to the production department for preliminary budgeting and shooting breakdown, as described below. Each of the department heads receives a copy of the script and estimates roughly the cost of the picture as far as it concerns his department. The respective departmental estimates are then reviewed by the production office and carefully scrutinized to see if economies can be effected through the use or adaptation of existing sets, cheaper materials, processing possibilities, less expensive talent, or the omission of certain expensive scenes. Eventually, the total budget estimate comes within the limit considered to be appropriate by the production executive.

Ordinarily the studio will have built up an inventory of a substantial number of scripts that can be produced at any time. These scripts are constantly being reviewed with the objective of producing several pictures simultaneously. In this way, maximum output is achieved at a minimum of overhead and idle studio time.

The planned sequence of production is sometimes interrupted to give priority to an "exploitation" picture, relating to a subject of extreme current importance,

the presentation of which can be much more profitable currently than subsequently. Public acceptance of certain types of pictures which suddenly achieve the status of a financial success will frequently suggest the production of pictures of a similar type in order to exploit current desires of the public to see pictures of this general theme.

Major studios seldom produce more than fifty pictures during a year and seldom are there more than three or four productions in process at any one time. Thus it is physically possible to follow the progress of the studio's output and to evaluate the progress of the work in relation to the progress of the cost.

Proper scheduling of pictures is also necessary to permit the availability of sufficient stage space at proper times, as well as the proper location of available equipment. Economies can be effected by scheduling scenes to be taken in such sequence that expensive members of the cast work the minimum number of days. For example, the beginning and the end of a picture may require the presence of expensive actors and these scenes may be produced together. The middle portion of the picture may not require the presence of expensive actors and these scenes may be shot later.

Likewise, elaborate sets and expensive locations may be utilized at different points in the picture by having all scenes thereon shot successively. The events of the plot are then straightened out by cutting and reassembling the film in proper sequence. In studios where stage space is at a premium, such a practice is followed, but in studios where ample space is available at all times for all pictures, it frequently happens that scenes are shot in plot sequence, as little if any money is saved by taking shots out of sequence. The concern in such cases is more for perfection and artistic value of the picture than for economy of production. Shooting schedules are altered at other times because of many unforeseen occurrences, such as incapacity of principals, inclemency of weather, and the like.

Always, in producing pictures, the greatest care is used in the treatment of the subject to avoid offense to any group of individuals, and to avoid the use of colloquialisms which may not be understood by all segments of the population. Also regulatory bodies have rendered great service to the industry in improving the quality and acceptability of pictures prior to release.

II. How to Design the Cost System

What Information Is Required

The accepted script is the basis for the whole cost system. Based upon the accepted script, copies of which have been given to each department concerned, the respective department heads visualize, in conference as well as alone, the requirements of cast, wardrobe, properties, locations, music, color, effects, etc.

Set construction budgets involve individual estimates for each scene. After the designs and blueprints of each set have been prepared, distributed, reviewed, and accepted by all concerned, estimates of the cost of construction or purchase are obtained by the art department. The picture production number and the set number of that production identify all blueprints or construction estimates, and all work done on each set is charged to the proper set number. Each set is identified by a suitable tag or plaque affixed to the set for identification purposes. This number stays with the set permanently until it is finally physically demolished and

withdrawn from inventory. Each set, when completed, is photographed and catalogued for future reference. The units of the set that may be saved are likewise catalogued and the physical portions thereof are transferred to an appropriate location for storage.

Costs are estimated on specially designed work sheets as follows:

Story, continuity, producer, director
Cast
Day players, bits, extras, dancers, musicians, stand-ins
Music and art
Set
Set dressing, action props, vehicles, livestock
Electrical labor and equipment
Miniatures and mechanical effects
Photographic effects, matte shots, opticals, fades, dissolves, montages
Production staff, cameramen, property labor
Wardrobe staff, make-up and hairdressing, editorial and projection
Grip Department and standby
Sound Department and transportation
Wardrobe
Location costs
Re-recording and tests
Negative film and laboratory
Miscellaneous and color process costs
Insurance, taxes, vacation reserve and retroactive wage allowances

The totals on the above individual estimates of direct costs are then assembled on Estimated Final Cost Sheet (Figure 1), and estimated general overhead is added usually on a basis of a percentage of direct cost. This percentage is computed by taking the relationship between all estimated overhead costs on a twelve-months basis and the total estimated program cost less overhead. As the program year approaches completion, the actual overhead percentage is closely watched, so as to insure the proper absorption of all overhead charges.

The Estimated Final Cost Budget is then closely scrutinized by all studio executives, and ways and means of reducing costs and eliminating expensive elements are discussed. Finally, the budget is approved and authorization is given to begin production.

Consideration in Designing the System

The major controls necessary in designing the cost system relate principally to payroll and material controls. Authorizations for payroll additions and separations are required, and an adequate timekeeping system is necessary.

Also, controls of equipment removed from the studio and sent to location are necessary. The usual storekeeping control devices are utilized.

Since daily costs are required, to control the progress of production, a system is necessary that makes possible the accumulation of daily cost totals. Frequently, use will be made of punched card accounting on a "commitment" basis. Production daily costs are reported on a daily cost sheet. It will be noted that all budget summaries, daily cost summaries and final cost report summaries are virtually identical in form and classification.

SHEET No 1

PRODUCTION BUDGET
OR
FINAL COST

Production No. _____

TITLE

Acct No.	CLASSIFICATION	Sheet No	BUDGET ACCUMULATED COST	BUDGET TO COMPLETE	BUDGET TOTAL	ACTUAL COST	OVER OR (UNDER) BUDGET
601	Story Cost	2					
602	Continuity	2					
603	Producer	2					
604	Director	2					
605	Cast	3					
606	Bits and Extras	4					
607	Music Department	5					
	Sub Total						
608	Art Department	5					
609	Sets	6					
610	Set Dressing & Props	7					
611	Electrical Expense	8					
612	Miniatures	9					
613	Mechanical Effects	9					
614	Photographic Effects	10					
	Sub Total						
615	Production Staff	11					
616	Camera Department	11					
617	Prop[illegible]partment	11					
618	El[illegible]						
	[illegible] Dept						
	[illegible]und Department	14					
624	Transportation	14					
	Sub Total						
625	Wardrobe	15					
626	Location	16					
627	Re recording	17					
628	Tests	17					
629	Negative Film	18					
630	Laboratory	18					
631	Miscellaneous	19					
632	Color Process	19					
633	Insurance & Taxes	20					
634	Vacation Reserve	20					
635	Retroactive Wage Allowance	20					
636							
637							
638							
	Sub Total						
	TOTAL DIRECT COSTS						
639	GENERAL OVERHEAD _____ % OF DIRECT COST						
	GRAND TOTAL						

	BUDGET AND STORY CERTIFICATIONS
Est. Starting Date	
Est. Finishing Date	Compiled From
Est. Production Days	
Actual Starting Date	
Actual Finishing Date	Compiled By: _____ Date _____
Production Days	Approved _____ Approved _____
Days Retakes & Added Scenes	Approved _____ Approved _____
TOTAL PRODUCTION DAYS	Approved _____ Approved _____

REMARKS

Fig. 1.

The "standard" cost system is not applicable, since every picture, and every sequence, is completely different from every other picture or sequence. The job-order cost system prevails.

In the case of Westerns and small budget films, however, these pictures are usu-

ally not budgeted in detail, and are not subject to the careful cost control outlined herein for higher cost pictures.

III. Description of the Cost System

Profit-and-Loss Statement

Since the motion pictures produced at the studio are disposed of at production cost to the affiliated distribution organization, there is ordinarily no profit or loss in production, unless the negative is sold to outsiders. Hence there is ordinarily no studio profit-and-loss statement.

Variances Used

Production daily cost sheets, and comparison with cumulative totals and budget totals, by department, are issued daily. These are carefully reviewed for important departmental variances and steps are taken immediately to correct unfavorable cost trends. Being works of art, however, pictures cannot be produced on a strict cost schedule like so many automobiles. The best results are said to be obtained by keeping costs closely in line with budgets, and at the same time accepting realistically the possible need for occasional budget revisions. Moreover, some low budget pictures develop tremendous potentialities and may eventually be completed in the high budget category.

Analysis for Supervisory Executives

Since daily cost reports are available reasonably soon after they have been incurred, production executives are constantly aware of the cost status of each picture. In addition to the actual cost sheets, it is customary for rough prints or "dailies" to be made and projected, to show the production executives the actual accomplishment each day in the way of production of acceptable film. "Dailies" are printed takes, including dialogue and sound effects, recorded during previous shooting. Producers and directors always supplement these reviews by personal follow-up.

Special analyses are available as required. Studio executives, however, are enabled to predetermine major salary costs by control of contracts. For other costs it is usually possible to apply rough estimates, but standard costs in this particular type of operation are not applicable.

If construction work appears to be in danger of exceeding its budget by a substantial amount, the studio executives confer and discuss ways and means of reducing costs or eliminating expensive elements. By a close watch upon daily costs, executives and department heads are able to follow the work under their supervision currently and take immediate steps to keep within budget allowances.

How the Data for the Cost Summary Are Obtained

Labor and material costs are recorded daily from time cards, storeroom issue tickets, purchase orders, and similar data. Charges are made directly to the productions in process. In the camera and sound departments daily reports are made on the amount of film footage used and the footage to be printed..

When construction of a set has been completed, the producer, director, and the

production department examine the work and authorize the issuance of a close slip which prevents any further charges being made to a completed job. This procedure also prevents the shifting of charges from an underestimated set to one which has been overestimated.

Final Variances

So important is the artistic effect that after a picture has been produced, cut, edited, assembled, screened, previewed, and perhaps released, it may be decided that the addition of new scenes, the insertion of new music, or other changes will give the picture additional box office appeal. Producers frequently spend hundreds of thousands of dollars, even millions, after completion of a picture, to improve the quality, artistic effect, and sales appeal of important features. Variations from original cost budgets, therefore, may be relatively unimportant if resulting potential increases of gross income from film rentals are considered to be substantial. If the expected increase in gross income fails to materialize, however, the extra expenditures over budget may become very costly indeed.

Pictures made from carefully written story properties, by producers who keep within budget, are generally found to be the most profitable.

COST ACCOUNTING FOR MUNICIPALITIES

By
MAX TETELBAUM *

I. DESCRIPTION OF FINANCIAL OPERATIONS OF MUNICIPALITIES

The installation of cost systems for municipalities is rather a new venture in the field of cost accounting. The factors governing the installation of a successful system are as follows:

1. Type of government
2. Divisional authority
3. Services rendered
4. Accounting flow of information

The financial operations of municipalities are controlled through the use of a budget. The various department heads submit budgetary control figures that are assembled into a consolidated statement analyzing the difference between anticipated revenues and expenses so that the deficit can be raised by taxation.

The method used by a great number of municipalities in the assembly of the budget is at best a rough estimate based on the previous year's budgetary operations. There is no recourse to cost records as to unit or job cost for various departments. This method of computing the budget at best is haphazard. A controlled budget by the use of cost records is the best method for the taxpayer to receive the most for his tax dollar.

Services Furnished by Municipalities

The varied services offered by a municipality fluctuate according to the mandate of the taxpayer. The most common are:

1. Street Cleaning
2. Scavenger Operations
3. Street Repairing and Paving
4. Planting Shade Trees
5. Public Utilities
6. Construction of Public Buildings
7. Public Work Projects
8. Printing Public Forms
9. Other Capital Improvements
10. Building Hospitals, Clinics, and Other Institutions

The opportunity for cost records from the above classifications shows a coverage unknown in a commercial form of a profit organization. The municipal operations include all forms of cost accounting.

We are concerned with the *cost operations* and shall proceed on that basis.

* Certified Public Accountant, New Jersey; Registered Municipal Accountant, New Jersey; Senior Partner, Tetelbaum, Cobb & Co., Dover, New Jersey.

Organization of Municipal Department for Cost Operations

Most municipal services are provided by the general fund, which is universally segregated into functions known as departments, bearing such titles as public works, public welfare, public health, public safety, finance, law, education, and others. Each department is divided into smaller functional entities known as bureaus or divisions, which are created to administer some definite public service or phase of government.

The flow of accounting information for cost records must have a centralized point for assembly of the various operations of the bureaus and departments. Some municipalities have the comptroller in the finance division summarize the operations; others have a cost accountant under the supervision of the department of public works division assemble the information. Whichever method is used, the duly elected officials must at all times be informed as to the cost of each public service.

The organizational essentials of a successful cost system must also include the following:

(a) Purchasing agent
(b) Centralized storeroom
(c) Various departments for the functional activities of the municipality which coordinate their operations with the controller, purchasing, and centralized storeroom.

It must be understood that municipalities may operate under different types of governmental plans and each have their own peculiar type of arrangements for departmental authority. The organizational essentials in any case will be the smooth flow of accounting information to complete accurate cost records.

II. How to Design the Cost System

What Information Is Required

Governmental cost accounting may be defined as the process of searching out all elements of cost required to attain a purpose, to complete a unit of work, to carry on an operation, or to complete a specific job.

It is usually essential to determine:

1. The appropriations allocated to the various departments.
2. The various methods of costing for certain public services to measure the efficiency of performance as well as to aid in the preparation of current budgets for the general and special revenue funds.
3. The data for preparation of operating reports to measure the efficiency of a work program.

The data presented to the municipal officials will form a basis for establishing the costs standards for the future and serve as a basis for the amount of work planned for a coming year, of changes in wage rates, commodity price levels, the cost of operating equipment, or any change in the service that may affect the actual costs of doing work.

Considerations in Designing the System

The setting of standards of performance is by far the most difficult problem in municipal budgeting. The varied operations of the numerous and complex services rendered have developed:

(a) Standard unit costs system.
(b) Other miscellaneous cost systems.

The "Standard Unit Cost" System

A unit cost standard system may be defined as one where the standard is the "minimum unit cost at which public work officials find they can perform a unit of their work."

Unit costs are established by dividing the total cost of each public service by an appropriate work unit or other measure of service rendered. Unit costs so compiled for current operations then should be compared with unit cost standards, or basic standards set to represent the ideal cost of performing each pubilc service. Comparison of unit costs appearing on the work program with the unit cost or ideal standards may disclose wide variations. Where unit cost analysis is not utilized in the preparation of budgets, the budgets appropriations are not scientifically established, and in a great many instances deficiency appropriations are thereby made necessary to cover expenditures.

Other Miscellaneous Cost Systems

Municipalities may have jurisdiction over hospitals, penal institutions, orphanages, colleges, universities, asphalt plants, water works, and transportation services. Cost systems designed to the particular operation can be incorporated to coordinate a complete over-all cost operating system for the municipality.

III. Description of the Cost System

Steps to Establish the Cost System

The most important steps in establishing a unit cost system are as follows:

1. Design a chart of public works cost accounting system (Figure 1).
2. Design a comparative statement of work, costs, and man-hours for municipal officials (Figure 2).
3. Design a statement of equipment operations for municipal officials (Figure 3).
4. Design records for a cost system such as:
   (a) Work and cost ledger (Figure 4).
   (b) Individual equipment record (Figure 5).
5. Prepare a report of municipal department for a stated period (Figure 6).
6. Establish unit cost standard for comparison against actual operation.
7. Establish the procedure for carrying out the cost system and producing the desired data.
8. Set up the required chart of accounts.

Design of Chart of Public Works Cost Accounting System

Before any city can decide upon the type of field reports needed, it is necessary to determine the activities or operations for cost information. The principles of these reports are the same in all cities. Figure 1 illustrates graphically the flow of

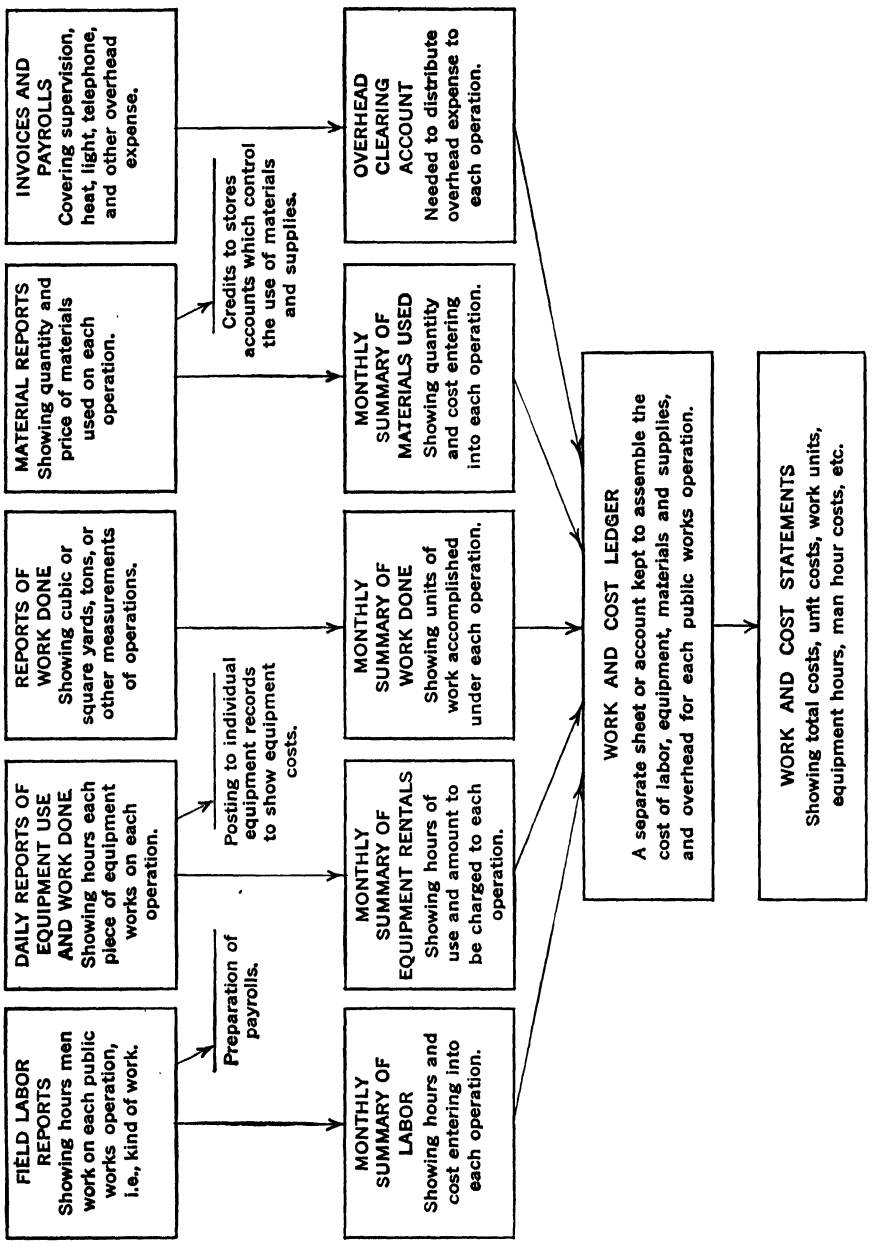
CHART ILLUSTRATING THE STEPS IN A PUBLIC WORKS COST ACCOUNTING SYSTEM
FIELD LABOR REPORTS
Showing hours men work on each public works operation, i.e., kind of work.
DAILY REPORTS OF EQUIPMENT USE AND WORK DONE
Showing hours each piece of equipment works on each operation.
REPORTS OF WORK DONE
Showing cubic or square yards, tons, or other measurements of operations.
MATERIAL REPORTS
Showing quantity and price of materials used on each operation.
INVOICES AND PAYROLLS
Covering supervision, heat, light, telephone, and other overhead expense.
Preparation of payrolls.
Posting to individual equipment records to show equipment costs.
Credits to stores accounts which control the use of materials and supplies.
MONTHLY SUMMARY OF LABOR
Showing hours and cost entering into each operation.
MONTHLY SUMMARY OF EQUIPMENT RENTALS
Showing hours of use and amount to be charged to each operation.
MONTHLY SUMMARY OF WORK DONE
Showing units of work accomplished under each operation.
MONTHLY SUMMARY OF MATERIALS USED
Showing quantity and cost entering into each operation.
OVERHEAD CLEARING ACCOUNT
Needed to distribute overhead expense to each operation.
WORK AND COST LEDGER
A separate sheet or account kept to assemble the cost of labor, equipment, materials and supplies, and overhead for each public works operation.
WORK AND COST STATEMENTS
Showing total costs, unit costs, work units, equipment hours, man hour costs, etc.

Fig. 1.

COMPARATIVE STATEMENT OF WORK, COSTS, AND MAN-HOURS FOR STREET CLEANING, REFUSE REMOVAL AND DISPOSAL

City of _____ For Month Ending _____ 19__

Operation	Work Units	Units of Work Done			Unit Cost			Total Cost		
		Actual Work	Work Program Estimate	Diff.	Actual	Unit Cost Std.	Diff.	Actual	Work Program Estimate	Diff.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Removal Garbage and Burnable Refuse..	Tons									
Garbage for Poor Farm	Tons									
Dump Maintenance	Tons									
Machine Sweeping	Cleaning Miles									
Sweepings Removal	Cubic Yds.									
	Cleaning Miles									
Cubic Yards Removed per Cleaning Mile										

Operation	Work Units	Total Man-Hours			Units per Man-Hour			Units per Equip. Hour		
		Actual	Work Program Estimate	Diff.	Actual	Unit Man-Hr. Std.	Diff.	Actual	Equip. Hour Standard	Diff.
Removal Garbage and Burnable Refuse..	Tons									
Garbage for Poor Farm	Tons									
Dump Maintenance	Cubic Yds.									
Machine Sweeping	Cleaning									
	Miles									
Sweepings Removal	Cubic Yds.									

Fig. 2. The entries for the "actual" columns are obtained from the work and cost ledger. The entries under work program estimate and unit standards are obtained from the work program. These standards represent the minimum unit cost at which the public works official can perform the work. Copies of this statement are submitted to the city manager, the director of public works, the superintendent of wastes, and the director of finance, and a copy is posted on the garage bulletin board.

City of_____ For Month Ending_____ 19____

Equipment No. (1)	Make (2)	Capacity (3)	Performance Measures					Costs						Remarks (14)
			Maximum Regular Hours (Less Time in Shop) (4)	Actual Hours Used (5)	Percent of Efficiency (6)	Miles Run (7)	Miles per Gal. of Gas (8)	Operation (9)	Maintenance (10)	Depreciation and Overhead (11)	Total (12)	Quarterly Unit Costs		
												Per Hour	Per Mile	

Fig. 3. The purpose of this statement is to inform city officials of the amount of use and cost of operation of each piece of motor equipment. The figures in columns 4, 5, and 6 indicate whether the equipment is being used sufficiently. The remaining information is taken directly from the cost record of equipment.

WORK AND COST LEDGER

Page No. _____

Operation _____

Unit Cost Standard _____ per _____

Unit Cost Standard _____ per _____

Control Account _____

For Year Ending _____ 19____

Month (1)	Field Labor (2)		Equipment Expense (3)		Materials and Supplies (4)	(5)	(6)	(7)	Over-head (8)	Total Cost (9)	Work Units (10)		Unit Costs (11)		Per Man-Hour (12)	Per Equip. Hour (13)
	Hours	Amount	Hours	Amount									Per	Per		
Jan.																
Feb.																
Mar.																
Apr.																
May																
June																
July																
Aug.																
Sept.																
Oct.																
Nov.																
Dec.																
Totals																

Fig. 4.

INDIVIDUAL EQUIPMENT RECORD

1. Equipment No._____ 6. Date Purchased_____ For Year Ending _____19____

2. Motor No._____ Serial No._____ 7. Original Cost $_____

3. Make_____ 8. Value Start of this Year $_____ 11. Estimated Depreciation on this Year $_____

4. Type_____ 9. Estimated Salvage Value $_____ 12. Esimated Hours or Miles this Year_____

5. Capacity_____ 10. Remaining Depreciation $_____ 13. Depreciation Rate per Hour Mile $_____

Month (1)	Gasoline (2)		Oil (3)		Tires and Other Supplies (4)	Repair Labor (5)		Repair Parts (6)	Outside Repairs (7)	Depreciation (8)	Overhead (9)	Total Cost (10)	Mileage First of Month (11)	Miles Run (12)	Cost Per Mile (13)	Hours Run (14)	Cost Per Hour (15)	Miles Per Gal. (16)	Rentals Earned (Credits) (17)
	Gals.	Amt.	Qts.	Amt.		Hrs.	Amt.												
Totals																			

Fig. 5.

the field reports for a public works cost system. This chart shows how labor, materials, equipment, and overhead are recorded on the field reports and ultimately find their way into the work and cost ledger, and finally into the work and cost statement.

CITY OF_____

OPERATING COST OF SNOW REMOVAL

Season 1944-1945

Storm No.	Date and Character of Storm	Total Inches	Total Operating Cost	Cost of Removal	Total Cu. Yds. Removed	Cost per Cu. Yd.
1	December 19 (Light, Dry, Cold)	7	$ 82,840.48	$10,290.60	22,868	45¢
2	December 28 (Heavy, Wet)	6.5	58,688.00	8,886.44	15,994	56¢
3	January 8 (Dry, Mealy)	5	72,912.50	14,092.16	30,100	46¢
4	January 19 (Heavy, Slush)	4.8	41,009.22	6,882.50	10,800	63¢
5	February 12 (Light, Dry, Cold)	7.5	85,998.14	11,804.68	24,294	48¢
6	March 2 (Cold, Light)	6.2	38,926.02	5,203.65	11,800	44¢
		37.0	$380,374.36	$57,160.03	115,856	47¢

Average cost of removal per cu. yd.	.47
Total operating cost	$380,374.36
Total miles maintained—423	
Operating cost per mile for season	899.20
Operating cost per mile for storm	149.86
Total inches snowfall—37	
Operating cost per snowfall inch	10,280.38

Fig. 6.

The chart also indicates how field reports for labor are employed for determining costs of each public works operation and as a basis for payrolls. The equipment operators' daily reports are used in obtaining the operating costs of each piece of equipment and to summarize the equipmental rental charges to work done for the work and cost ledger. Materials-used reports furnish the information for charging the operation on the work and cost ledger. The summaries of materials consumed are also used in crediting the stores accounts. Overhead is distributed monthly to the operations on the work and cost ledger.

Basic Records of the System

The basic records required in a public works system include:

1. *Original Documents* (see Figure 1).
2. *Registers or Journals* which are used as an intermediate record for the summation of the original documents (see Figure 2).
3. *Stores Ledger* for Perpetual Inventory (see Figure 2).
4. *Equipment Ledger* in which is maintained a detail record of each piece of equipment owned and used (see Figure 5).
5. *Work and Cost Ledger.* The final basic record for a summary of the varied operations of the department (see Figure 4).

Labor

In the accounting of labor several factors must be considered. The daily report sheet should be definitely analyzed by dividing the labor cost into (1) "effective," which represents the time actually at work and (2) "noneffective," which includes the time spent on vacations and sick leaves. Noneffective labor should be included with the indirect expenses, and supervisory costs applying to the several activities should be prorated.

Materials

Adequate controls of the flow of materials through the establishment of a centralized stores system are essential. All issue of receipts must be supported by vouchers. The pricing policy is either by first in, first out method, or the moving average method.

Indirect Costs

There are three types of indirect costs that must be considered:

(a) Equipment used on a work order.
(b) Expenses of administration and supervision.
(c) Nonadministrative.

The cost of equipment consists of (1) acquisition cost, and (2) maintenance cost —repairs and operations.

The expenses of administration and supervision are allocated to the several activities.

Nonadministrative expenses, such as telephone and travel, are prorated under indirect costs.

The use of a predetermined indirect cost rate, calculated on estimated direct labor cost, is an accepted procedure. The actual expenses and indirect costs are collected in the overhead cost account, and the charges made to the various departments are credited regularly to the overhead clearing account.

Working Capital Funds

Working capital funds, sometimes referred to as revolving funds, are designed to render services at cost on a self-supporting basis for the sole benefit of the department. Upon the establishment of a working capital fund to finance an opera-

tion, an appropriation is customarily made in the general fund covering moneys to be transferred to the operational working capital fund for the purchase of equipment and defraying of operating expenses.

Another source of funds for financing is derived from charges for equipment rented to other bureaus, departments, and construction projects. The rental rates for various equipment are charged either on a mileage or hourly basis. The recourse to the cost accounting records determines the charges by the study of comparative costs over a definite period. Rental billings, summarized daily and entered on a monthly recapitulation record, are charged to the various departments by means of warrants for collection. Such sums received in payment of equipment rentals are applied to replace depreciated equipment. When appropriations are made from the general fund for the acquisition of initial equipment and additional equipment needed thereafter, as distinguished from mere replacements, the rentals paid to the working capital fund are usually ample to replace worn out equipment. It is the application of this principle that warrants the use of the term "working capital" or "revolving fund."

Standard Unit Costs System

Most of the public works department bureaus use the standard unit costs system; and services involving time, materials, and equipment, are most fairly constant and uniform.

The numerous activities of the bureaus within the departments create no common unit. An analysis of the various departments shows:

Activity	*Unit Cost Analysis*
Maintenance of Garages	Per garage
Vehicles	Per vehicle
Maintenance of Sewers	Per mile
Collection of Garbage	Per ton
Maintenance of Incinerator	Per ton of refuse
Repairs of Streets	Per square yard
Garage Service	Per vehicle

Comparative Statement of Work Cost and Man-Hours

The assembly of cost information from the various records is essential for comparison of operation costs for the municipal officials. A danger signal will be reflected for excessive costs. The comparison standards can be determined by:

1. Past experience of the departmental unit.
2. Comparison with other governmental units of similar size and location.
3. Engineering studies.
4. Variances in the cost of living and materials in an unstable economic era.

Other Miscellaneous Cost Systems

Municipal services as previously stated can be varied in scope illustrations, such as:

Department	*Unit Cost Analysis*
Municipal Print Shops	Job cost
Capital Improvements	Job cost
Special Assessments—Project	Job cost
Municipal Institutions	Departmental costs
Municipal Utilities	(a) Construction and Maintenance by Job costs (b) Departmental costs

The cost records to be maintained for the operations described are practically the same as those for private industries illustrated in other chapters in this book.

Miscellaneous Governmental Units

Other departments not described in which a cost system may be designed to measure operating efficiency are as follows:

Activity	*Unit of Measurement*
Police	Per capita
Library	Per capita
Welfare and Relief	Per case
Recreation	Per capita
Construction of Streets	Per mile
Education	Per pupil
Veterans' Bureau	Per case
Parks	Per acre

General Accounting Control

It is recommended that an integrated system of general and cost accounts be used. By the use of controlling accounts on the general ledger, and cost accounts subsidiary records, effective control insures accurate cost data.

The present-day era of modern expansion of industry and science demands that governmental procedure eliminate the horse-and-buggy operation. Scientifically prepared budgets are the only answer to the challenge of *good government.*

COST ACCOUNTING IN OFFICE MACHINERY MANUFACTURING

By
T. R. ELSMAN *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

The typewriter was the forerunner of office machines and some say it introduced women into business. Following the typewriter came a variety of different types of office machines most of which can be classified in one or more of the following categories:

> Accounting, Adding-Listing, Addressing, Autographic Registers, Bookkeeping, Calculating, Checkwriting, Dictating, Duplicating, Mailing, Tabulating, Time Recording, and other mechanical writing machines.

Several other machines used in business and closely related to office machines are Cash Registers, Coin Handling Machines, and Fare Machines.

To grasp the significance of the office machine industry, it is necessary to reflect a moment to realize the huge growth that the American office has taken in the past forty years. In every metropolitan area we see million dollar buildings which house nothing but offices. Without the office and office machines, the modern day business executive would be helpless.

The task of collecting, classifying, computing, listing, and analyzing the huge volumes of facts, figures, and statistics that are necessary for the successful operation of modern business could not possibly be accomplished without office machines. With modern accounting methods and office machines, executives are able to obtain facts and figures, formerly unobtainable except at great expense.

Origin of Products

The progressive office machine companies are constantly studying the needs of modern business offices for machines which will produce more business facts and figures in less time and with less effort. Considerable sums of money are spent on research and the development of new products. Occasionally new companies enter the field with new products or modifications of existing products. Keen competition exists in the industry.

Organization of the Plant

Many companies manufacture a complete line of several different types of office machines while others limit their productive effort to various models of one type of product. Some companies also operate more than one plant in the production of

* Assistant Controller, Monroe Calculating Machine Company, Orange, New Jersey.

their products. Nevertheless, the following represents a typical departmental organization for a manufacturing division of an office machine company.

Service Departments	*Function*
Factory Management	Administration
Engineering No. 1	Research and development
Engineering No. 2	Production engineering including tool design and methods
Production Control	Production planning, ordering, scheduling, and control
Purchasing	Locate suppliers and purchase material
Power	Light, heat, and power
Maintenance No. 1	Plant maintenance
Maintenance No. 2	Machinery maintenance
Personnel	Employment and welfare
House Service	Cleaning and guarding properties

Manufacturing Departments	*Function*
Piece Parts	Machining, heat treating and finishing operations
Subassembly	Assembly of component parts
Final Assembly	Assembly of finished products
Inspection	Inspection of parts and finished products

There may be other service departments in addition to these listed. The manufacturing departments usually include screw machine, punch press, grinding, milling, etc. Very often there are twenty or more manufacturing departments.

Separate stock rooms for raw material, finished parts, and finished products are maintained. In addition there are cribs for storing parts in process between operations in the manufacturing departments.

Factory accounting which covers timekeeping, payroll, and costs while serving the manufacturing division usually reports directly to the controller of the company.

Production Order System

Standard models of office machines are normally produced for stock and as orders are received they are filled from stock. Most special models are basic models with special features and these are usually built to order.

Production schedules are based on two factors: (1) The sales estimates, and (2) the amount of inventory on hand. This applies to both the finished product and work in process inventories. The production cycle from raw material to finished product is from three to four months. The production control department usually receives a regular quarterly production schedule for finished products three months in advance and a tentative quarterly production schedule six months in advance. The production requirements are converted to major assemblies, sub-assemblies, and piece parts. Order quantities for each part and assembly are determined by a reference to the amount in stock, amount required for the next quarterly production, the amount required for the tentative quarterly production six months in advance, and the minimum of parts required in stock at all times. Production orders are numbered with a separate series for each type of product to speed the distribution of direct labor to different product lines.

Final assembly of the product is usually handled in the form of releases, that is,

parts and subassemblies for a lot of finished products are released to the final assembly departments each week or month.

II. How to Design the Cost System

Considerations in Designing the System

Cost accounting in this industry is a very important part of the general accounting procedure; therefore, controls for the factory accounts should be carried in the general ledger. The cost system should be designed to provide adequate subsidiary records in support of the control accounts. The costs of labor, material, and expenses incurred in the production of the products must be classified in a manner which will permit analysis, interpretation, and rearrangement of the cost elements into the different patterns required for various purposes as outlined under objectives.

Cost control requirements should receive equal if not more important consideration than any of the other requirements when designing the system. Budgets may be used as means of cost control; however, the cost system should be designed so that cost figures essential to management in the control of costs can be reported currently in condensed form.

Objectives of the System

A good cost accounting system is a means to an end—not the end in itself. In this industry it should aim at the following objectives:

1. Supply adequate cost figures for profit determination, inventory valuation, cost control, pricing policies, and forecasts and budgets.
2. Be one of the most important instruments of management in the control of costs.
3. Be simple and streamlined so that cost figures for control purposes may be current.
4. Be economical to operate.

The Standard Cost System Favored

Office machine manufacturing is classified as an assembly-type industry, that is, each finished product consists of from a few hundred to several thousand parts which are assembled in various combinations to make the product. Parts are made and placed in stock to be later taken from stock and assembled into various subassemblies and finally into finished products. Many thousands of different parts are actively carried. The different operations required in the manufacture of these parts run into the tens of thousands.

Where many thousands of individual parts are required for a product, the cost accounting objectives outlined above can be accomplished economically only by the use of standard costs. Once this point is agreed upon the problem is one of setting up simple cost records, procedures, and methods that satisfy the accounting requirements and at the same time measure the efficiency of the plant so as to discover, measure, and control favorable and unfavorable variances from standards established for the manufacturing process.

III. Description of the Cost System

Profit-and-Loss and Inventory Requirements

The primary requirements of the cost system in this industry are similar to those in other manufacturing industries; that is to provide costs for the determination of profit or loss and costs for inventory valuation. The chart of accounts for classifying and recording manufacturing costs must also be adequate for the other essential purposes for which cost figures will be required, especially the control requirements.

The cost system should provide the analysis of cost of sales on the profit-and-loss statement and the valuation placed on inventories on the balance sheet. A typical analysis of cost of sales on the profit-and-loss statement would include the following:

Cost of Sales at Standard
Material—Price Variance
Material—Efficiency Variance
Labor—Rate Variance
Labor—Efficiency Variance
Burden—Efficiency Variance
Burden—Volume Variance
Inventory Adjustments

If a separate profit-and-loss analysis is required for each principal product, variance accounts will have to be kept for each product.

Coupled with budgetary control, the profit-and-loss statement is an important report for the control of all business operations. Other reports, however, are also necessary for controlling the day-to-day operations of the business and the development of the company's plans and policies. These will be discussed under reports for cost control.

Standard cost is an acceptable and satisfactory basis for valuing inventories in this industry.

Control Accounts and Subsidiary Ledgers

When installing the system, it is necessary to decide what general ledger control accounts are required and what subsidiary ledgers are necessary. The following general ledger control accounts are suggested as a minimum requirement:

Asset Accounts

Raw Material Inventory
Work in Process Inventory
Finished Products Inventory

Profit-and-Loss Accounts

Factory Burden
Factory Burden Applied
Variances from Standard

A subsidiary ledger should be kept in detail supporting each of the general ledger control accounts. The raw material ledger should have subaccounts for different types of materials, steel, brass, plastics, etc.; the work in process ledger sub-

accounts for material, labor, and burden; and the finished products ledger, the number of different models of product and their standard cost value. The factory burden or manufacturing expense ledger should record all indirect labor and other indirect costs by department. The variance ledger should have subaccounts for each type of variance. The main sources of entries to these ledgers are supplier's invoices, payrolls, and journal entries.

If special products are produced, a control account for job orders in process is desirable. The subsidiary ledger for this account will contain the detailed costs of each job.

Perpetual inventory records of the quantities of raw material, finished parts and subassemblies, and finished products are kept by the production control department.

The Standard Hour Plan

The standard hour plan is recommended in this industry because it has many advantages over other plans not only as an incentive for production employees but for many other purposes it serves. Some of these will be described under control reports.

Under this plan, performance standards for production are expressed as number of units per hours, but for payroll and accounting purposes, the employees' output is converted to standard hours. For example, an operation on a certain part has a standard of 100 per hour. An employee works 8 hours and finishes 1000 units. The output of units (1000) divided by the standard per hour (100) equals 10 standard hours. Since the employee's pay is based on standard hours earned, he will be paid for 10 hours extended by his hourly rate. The work in process inventory is charged for the 10 hours extended at departmental standard hourly rate. If the employee's output falls below standard, he is guaranteed his hours worked extended at his hourly rate. The charge to work in process, however, is still on the basis of standard hours even though they are less than the hours worked. The difference between the amount paid the employee and the value of the production charged to inventory is a direct labor variance.

Standard Costs Based on Normal

The standard costs used for product costing and inventory valuation can be based on normal cost. Normal costs are those which, with historical experience and good judgment as guides, are forecasted for a longer period of time than one year. The standard rates used for costing material, labor, and burden are reviewed each year but not necessarily revised. To revise the rates each year would reflect all of the inflationary and deflationary effects of the business cycle in inventory. To avoid this, favorable and unfavorable variances from standard cost are clearly set forth in the accounts and treated as period costs.

If it becomes necessary for some reason to have product costs and inventory values temporarily reflect current costs and it is not practical to change tens of thousands of operational costs, it can be accomplished conveniently by introducing a fourth element of cost to product and inventory costs as represented by the variance accounts. Standard cost can be increased or decreased by a percentage. For example, if unfavorable labor rate variances represent 20% of standard labor costs and it is decided to reflect this in inventory values, normal standard labor costs are continued in the daily clerical operations, but a 20% factor is added to

the labor element in inventory balances and to all debits and credits to inventories for labor until such time as the values are restored to normal standard costs.

Standard costs should be adjusted once a year for revised material specifications and direct labor time standards to reflect changes in productivity. Current material quantities extended at standard costs and current time standards extended at standard hourly rates at the beginning of each year are considered to be normal costs for the material and labor elements of costs for one year. Changes in material specifications and time standards are evaluated and summarized weekly to products so that current costs are available at all times but these changes do not have to be reflected in the valuation of inventories during the year. The normal burden rate for inventory costing is based on the estimated manufacturing expense and direct labor required to produce normal sales. This will be explained under burden rates.

How Standards Are Established

All standards should be established on the basis of normal efficient manufacturing operations.

Raw Materials—Quantities.—Standard quantities of material in terms of pounds, feet, etc., should be established by the production engineering department. The quantities are usually expressed in terms of 100 parts.

Raw Materials—Prices.—The cost department sets all raw material price standards based on historical experience and a forecast of possible price revisions. Few price standards are required. Twenty-five price standards may be sufficient for a thousand different items if one price standard is established for all sizes of flat, cold rolled steel and another for all sizes of round, cold rolled steel, etc.

Raw material is the smallest element of cost in office machine manufacturing. Direct and indirect labor are the principal items of cost; consequently, the attention of management is focused on the control of labor cost.

Direct Labor—Time.—All operations in the manufacturing activities should be time studied and a standard hourly production rate established that can be attained by every normally efficient worker assigned to the operation.

Direct Labor—Rate.—The cost department, with the approval of management, establishes a standard hourly departmental rate for each producing center. These rates should be the forecasted average of the actual rates for the years in which they are to be used.

Burden Rates.—Normal burden rates should be established by the cost department and approved by management. If all of the products manufactured use all or most of the facilities of the plant, an over-all plant rate applied to direct labor is satisfactory. The few advantages to be gained by apportioning manufacturing expenses in the books of accounting to obtain current departmental burden costs are offset by—first, a true cost cannot be obtained by doing so, and, secondly, satisfactory costing can be obtained with less effort.

Departmental burden rates should be ascertained once a year by a statistical study. These can be used for the development of product costs useful for the company's pricing policies, but it is not necessary to incorporate this type of costing into the accounting records with all of the departmental distributions required.

If there is fear that different products will be charged with too much or too little burden, a weighted average of all burden applicable to a product on a departmental basis can be used as the over-all rate for applying burden on the product.

Different products may carry a different over-all rate on this basis. This requires work in process inventories for the different products to be carried separately on the books.

The basis for the normal burden rate is an estimate of manufacturing expenses and standard direct labor necessary to produce the normal sales. There may be different rates for different products.

Normal sales are determined by plotting previous years' sales after adjustments for extraordinary conditions on a piece of graph paper. A straight line is drawn through all points eliminating the peaks and valleys caused by cyclical fluctuations. This straight line represents normal sales and can be projected several years ahead. In following this technique, normal productive capacity is based on the company's normal sales. If historical sales records are inadequate or not available, the normal capacity has to be arbitrarily estimated until sufficient experience is obtained. Inasmuch as there are violent fluctuations in the demand for office machines during a complete business cycle, considerable productive capacity above normal exists to meet the peak demand. The burden carried into inventory cost should be based on the company's normal expectancy in sales.

Indirect Materials and Indirect Labor.—It is desirable to have standard prices for indirect materials and standard hourly rates for indirect labor for the purpose of speeding the cost accounting work and eliminating the price variance when comparisons are made of different periods. When following this practice, the price variance is also eliminated on the manufacturing expense budget reports. The variances between actual and standard costs on indirect materials and indirect labor are charged to manufacturing expenses. The basis for the standard costs for indirect materials and labor should be expected actual cost, as there is no point in developing wide variances from standard.

Determination of Variances

The following describes the methods used for determining variances from standard. Whenever possible, variances should be charged directly to variance accounts for different products. Variance that cannot be charged directly can be apportioned to the different products on the most equitable basis available.

Material—Price.—Determined at the time of purchase. Material is charged to inventory at standard cost. The difference between actual and standard cost is charged or credited to the appropriate variance account, that is, steel, brass, plastics, etc.

Material—Usage.—The production control department prepares requisitions on the raw material stock room for the standard quantities of materials required for production orders issued. When additional material is required, it is requisitioned on a special requisition which, when extended, is charged to the material usage variance account.

Direct Labor—Rate.—When the standard hour plan is used, the distribution of the hourly payroll can be made in hours inasmuch as all labor, both direct and indirect, is costed at standard rates. The productive output of direct workers is expressed as standard hours of direct labor. The total standard hours for each product class extended by departmental standard rates represents the charges to work in process for direct labor. The difference between actual wages paid (less overtime, night shift premiums and vacation, holiday and other pay allowances

which are accounted for separately) and the total of standard production hours extended by standard rates is a debit or credit to the wage rate variance account. The other payments to direct workers for vacations, holidays, overtime premiums, etc., are charged to the direct labor variance account as separate items.

Direct Labor—Efficiency.—Efficiency variances such as idle time, donations for failure to produce up to standard, extra time allowances for short runs, etc., should be recorded daily by the timekeeping section and charged to the variance account through the payroll distribution.

Burden—Efficiency and Volume.—The difference between budgeted and actual manufacturing expenses represents the efficiency variance. Under or overabsorbed burden plus or minus the efficiency variance, whichever the case may be, represents the volume variance. These two variances need not be segregated in the books of accounting but should be in the analysis of cost of sales.

Inventory Adjustments.—Standard costs are not revised currently to give effect to daily cost changes in time standards and material quantities. Changes in cost resulting from these changes are tabulated and summarized weekly by products. Current standard costs for products are determined from these summaries but no revision is made to costs on the accounting records. The differences between the current standard costs and the standard cost being used for inventory purposes, whether plus or minus, are charged to this variance account monthly.

Product Costs

Standard costs for products, subassemblies and parts are established on the basis of 100 units. Standard direct labor and direct material costs for parts are computed on standard cost cards (Exhibit 1). The standard cost card shows the kind, quantity, and standard cost of the material used and has columns listing the direct labor operations performed on the part, the departments in which the operations are performed, the standard department labor rates, and the performance standards. The standard direct labor cost is determined by dividing the perform-

NAME Selector Gear Cam — PART NO. 57301

MATERIALS: .062x1 Hard CRS; 27/32 Spacing; 16# per M — 5.56 #

MATERIAL COST .09 — DATE OCT 1 1946 — LABOR 1.79 — TOTALS 1.79

NO.	OPERATIONS	DEPT.	RATE	STD.	COST	STD.	COST	STD.	COST	STD.	COST
1	B	2	.85	1380	.06						
2	Roll Finish	4	1.00	5000	.02						
3	Pr	2	.85	850	.10						
4	Grind O.D.	5	.95	760	.13						
5	Ins.	10B									
6	Drill & Spot	5	.85	145	.59						
7	C/Bore & Br	5	.85	117	.73						
8	Ream	5	.85	735	.12						
9	Ins.	10B									
10	Harden	7	1.00	5000	.02						
11	Ins.	10B									
12	Cad. Plate	8	90	5500	.02						
13	Stock	14									

Exhibit 1. Standard Cost Sheet.

ance standards into the department labor rates and multiplying the result by 100. Additional columns are available on the card for cost changes.

Subassembly costs are developed on assembly cost cards (Exhibit 2). This card contains a list of all parts which go to make up the assembly. The standard direct labor and material costs of parts and the standard direct labor necessary to make the assembly are posted to this form from standard cost cards.

DESCRIPTION Hand Crank (per hundred) DATE 8/1/46 NO. 52-671

QUANTITY	PART NUMBER	YEAR OCT 1 1946 MONROE LABOR	LISTER LABOR	MATERIAL	YEAR MONROE LABOR	LISTER LABOR	MATERIAL	YEAR MONROE LABOR	LISTER LABOR	MATERIAL
1	3624	36		44						
1	56503	57		17						
1	3669	20		22						
1	56501	08		03						
1	690	09		73						
1	10	14		02						
1	50906	03		01						
2	50910	06		02						
	TOTAL PARTS LABOR	2 33		1 64						
	ASSEMBLY LABOR	3 98		TOTAL LABOR			TOTAL LABOR			TOTAL LABOR
	TOTALS	6 31		6 31						

884-M REV. 8 42

Exhibit 2. Assembly Cost Sheet.

The manufacture of finished products consists of a series of final assembly operations. The standard direct labor cost of the final assembly operations is computed on a card similar to the standard cost card for parts. The complete standard cost for finished product is summarized on a finished product cost sheet (Exhibit 3) from parts and assembly lists prepared by the production engineering department.

Inspection costs are added to the standard direct labor and standard direct material costs at standard rates before the application of burden. Under or overabsorbed inspection costs are recorded in the direct labor variance account.

The total standard cost of a part, an assembly, or a finished product, is obtained by adding the inspection cost to the standard direct labor and direct material cost and then adding the standard burden cost. For example:

(a)	Standard Direct Material	$0.10	
(b)	Standard Direct Labor	1.00	
(c)	Standard Inspection Labor	0.15	15% of (b)
(d)	Total of (b) and (c)	1.15	
(e)	Standard Burden	2.30	200% of (d)
(f)	Total Standard Cost (a), (d) and (e)	3.55	

EXHIBIT 3

Date 12/31/46

Final Machine Cost Summary Sheet For: XYZ
Per C

Operation		Parts Labor	Final Labor	Material
No.	Desc.			
1	Assem.	77.70	45.00	21.31
2	Assem.	254.97	52.02	51.90
3	Assem.	365.12	72.00	53.89
4	Assem.	173.54	72.00	20.79
5	Assem.	435.73	27.86	44.22
6	Assem.	445.94	97.83	67.24
7	Assem.	197.71	71.43	968.51
8	Assem.	808.87	112.50	247.89
9	Assem.	69.04	84.91	95.00
10	Assem.	—	33.21	—
Totals		2,828.62	668.76	1,570.75

	Labor
Parts Labor	2,828.62
Final Assembly Labor	668.76
Final Inspection Labor	660.54
Parts Inspection Labor	509.15
Total Labor	4,667.07
Burden	8,400.73
Material	1,570.75
Total	14,638.55

Control Reports

Current knowledge of business operations and the effectiveness of the cost control methods are obtained through daily, weekly, and monthly reports. Standard costs based on normal costs have been recommended in this chapter for inventory valuation; however, for cost control purposes, actual costs should be measured against past performance, estimated actual costs, or budgets. Space is not available to list all of the various forms of reports used for control purposes. The importance of the profit-and-loss statement and the analysis of cost of goods sold have been described previously. Comparative figures and relationships represented by ratios and percentages, and trends are, in many cases, more important than the quantities of items or amounts of money.

Cost accountants in this industry must be able to forecast what may be reasonably expected in the future from a study of past and current figures. Familiarity with the effect on costs and profits of the shifting business picture and the ability to interpret the figures make the cost accountant indispensable to the executives who decide current and future policies. The cost figures must be presented in a manner which will impress those who will use them. Different presentations are necessary for different minds. Some people like the figures in the conventional table form and others like graphic analyses. A few of the most important reports are described in the following:

Variances.—Raw material price and usage variance reports should be prepared; also direct labor rate and efficiency variance reports. Direct labor efficiency variances should be classified between idle time, donations for failure to accomplish standard performance, instruction time, etc. All of the variances should be compared with budget allowances so that remedial action can be taken if they exceed these allowances. Manufacturing expense reports should show actual expenses and budgeted expenses. The differences between budgeted and actual expenses represent efficiency variances. By adding or subtracting efficiency variances from over or underabsorbed overhead, as the case may be, the volume variance can be obtained. To illustrate:

Total Overhead—Budget	10,000
Total Overhead—Actual	11,000
Efficiency Variance	(—1,000)
Overhead Absorbed	9,000
Overhead Under-Absorbed	(—2,000)
Less Efficiency Variance	(—1,000)
Volume Variance	(—1,000)

Production Effort.—One of the simplest and most effective reports for controlling direct labor costs is the productive effort report. This report should compare the total number of standard direct labor hours available for the period represented by the number of production employees available at average efficiency with the number of hours expended on production, and the number of hours wasted, classified between idle time, scrap, reworking, defective parts, donations, etc. As an over-all report for the factory manager or as department reports for supervisors, this type of report is very useful because it contains the complete story on the

efficiency of direct labor on one sheet of paper. If possible, the figures should be related to both budget allowances and previous periods.

Inventory Control Charts.—These should be prepared showing the investment in inventories and the rate of turnover. A foresighted business policy is one which does not demand a constant rate of turnover. The highest rate of turnover should be expected when sales are at their peak and poorest rate of turnover when sales are depressed. This policy recognizes a constant float in inventory for all levels of sales volume and tends to stabilize employment.

Profit Contribution.—Several different reports can be prepared showing the profit contribution of different products—(1) a comparison of the sales price, manufacturing cost and gross profit on each product; (2) a comparison of the total standard direct labor hours required to produce each product and its sales price; and (3) the sales value of each hour of standard direct labor by products which is obtained by dividing the standard hours required to produce the product into its sales price less the value of the material used in its production.

The most useful of these reports is the one showing the sales value of each hour of direct labor by products. Manufacturing businesses are in reality selling their costs of converting raw material into a usable product. It is, therefore, important to know how much is being realized on the productive hours devoted to different products. For illustration, suppose that product A requires 60 standard hours to produce and sells for $240, whereas product B requires 100 standard hours in its production and sells for $350. In the case of product A, conversion time sells for $4.00 per hour, and in the case of product B, it is sold for $3.50 per hour. If the hourly cost of producing each product is approximately the same, it is obviously more profitable to make and sell product A. With this kind of information, the company's sales promotion efforts can be intelligently directed.

Other Reports.—Among the other important control reports are found comparisons of the production, sales, and inventory balances of different products. These may be based on standard cost, sales price, units and standard units. Where the number of hours required to produce the different products varies to a considerable extent, a standard unit basis of comparison is preferred.

Other daily and weekly departmental reports will be required for department expenses and for particular items such as tools, supplies, maintenance, scrap, actual labor rates compared with standard rates, etc.

COST ACCOUNTING FOR THE OIL PRODUCER

By
JOHN BURNIS ALLRED *

I. DESCRIPTION OF THE INDUSTRY

It has been said frequently that no set standard for cost accounts could ever be promulgated to cover the oil producing industry.

The reason for this is that there are conditions in the oil producing industry that are present in few, if any, other lines of business.

Oil is brought to the surface of the earth in either of two general methods: By flowing and by pumping. Flowing wells require no pumping equipment. The pressure caused by gas in the subterranean pockets, when released, rushes to the surface and in doing so forces the oil out with it, making the production cost very light. This might soon "blow its head off" and quit flowing, requiring further production from the well to be had also by pumping. But some wells have flowed many years with slight, if any, lessening of gas pressure. Pumping wells are those which do not, of themselves, have sufficient gas pressure to force oil out to the surface, and consequently, must be aided mechanically. The cost of this class of production is heavy —in fact, out of all proportion to that on flowing wells.

The difference between these two methods is also great. The same nature of casing may be used in either, but the pumping well must have well pipe and working barrels inside the casing and sucker rods inside the pipe, together with power machinery to pump the oil out through these facilities.

Once the oil has been brought to the surface by either method, the expense from there on would likely be the same. Storage tanks and connections between the wells and the tanks would be required in either case.

The cost of getting the oil to the surface is called "lifting" cost, and the difference in this cost in the two classes of wells is known as the difference in lifting costs. In fact, since the operation is very similar from there on, it may be said that the difference here is practically the only difference in the two methods.

There are also, however, great differences in the lifting costs based upon percentage of oil produced. If all oil wells produced the same amount of oil daily, the percentages would be of small consequence, but that is not the case. Usually flowing wells produce much more oil daily than do pumpers. Pumpers range from hundreds of barrels of oil per day down to "strippers" producing from two to ten barrels per day.

As stated above the flowing well costs little to operate whereas pumping wells cost heavily. This cost is practically the same amount whether the well produces hundreds of barrels or is a mere stripper.

By using multiple-well power units the cost is reduced, however, and thereby the idea that some have that costly individual power units are required for each

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well is explained away. But many wells, especially "wild cat" wells, are still pumped by individual power units. "Wild cat" wells are those that have been drilled in unproven territory, usually referred to as discovery wells.

Classification of Product

To the oil producer there are only two main products—oil and natural gas. Indeed in many cases the natural gas production is negligible, therefore producing no income, whereas in others the production is entirely natural gas with no worth-while oil production.

Origin of Products

Oil and gas are products of nature. In so far as man is concerned the origin of his product is in getting a likely lease and successfully drilling to where the oil or gas is located. Locating wells where oil or gas may be found is now possible with much less gamble than was once the case. Science has developed methods for locating oil, which will not be discussed here, that make oil production a business rather than a gambling venture.

Sources of Facilities for Production

In drilling a well an owner may use his own machinery or contract with a drilling concern. If the producer drills his own wells he acts in what might be called a dual manner, that is, as a drilling contractor and an oil producer. But few producers do their own drilling.

Organization of Plant

The oil producer's plant organization is now very well developed. He has his field superintendent, his pumpers, his clean-out and repairmen in the field and, of course, the office personnel that attends to such services as keeping records, buying supplies and paying bills and payrolls as well as providing and keeping marked up-to-date maps, promulgating logs of wells on his own and exchanged log-information from other operators, making reports to state and national boards, and receiving and compution of information of oil run to pipe lines.

A general outline of plant processes may be as follows:

Field Department:

Field Superintendent
Exploration—Geologists, etc.
Pumpers, gaugers, etc.
Repairmen, pipe and casing pullers and clean-out men
Tractor and truck operators

Office Personnel:

Office Manager
Bookkeepers and Stenographers
Production Clerks—reading strapping tables, calculating oil and gas run tickets, etc.
Field record men—posting logs of own and other wells
Lease men and legal workers—procuring and perfecting leases, titles, etc.

Production Order System

When the state controls the production of oil or gas, only the amount so allowed may be pumped or run to pipe lines. Consequently wells are not usually pumped continuously.

When approximately the allowed amount of oil has been pumped to storage tanks, the pumper (who is frequently also the gauger) measures the depth of oil in the tank reporting it to the general office where the reading clerk, by use of a strapping table previously prepared for that individual storage tank, calculates the amount of oil in barrels. If oil is run to pipe lines on the same day, the build up by the pumping in, as well as the outlet by the transfer, is shown.

If breakdowns occur or wells get "sanded," the pipe and rod pullers come in for their work.

The exploration and geological services are constant, as every operator knows that new fields must be found. Oil is "wasting asset." When it is gone, nothing can replace it.

The field superintendent's job is to keep operations going. He must be a man who can get results from both men and machines.

II. Designing the Cost System

What Information Is Required

The cost system for this industry is a difficult one to formulate because oil is produced by two distinct methods—pumping and flowing. Needless to state, pumping wells cost much more to operate than do flowing wells. It would seem, therefore, that two separate and distinct standards of costs would be necessary, up to a certain point at least. That point would seem to be when the oil reaches the storage tanks. Since the heaviest cost is in the pumping, it can readily be seen that the difference would be great.

For pumping wells it is essential to know:

1. The cost of each operation.
2. The effective use of labor, machinery, etc.
3. Data for determining the per barrel lifting cost.
4. The cost of all operations, including overhead for comparison to "posted price" of oil in the district.

These data should be in form so that the top management can know at any time what any well is producing and the possibility and probability of its continued production. More detailed data may be provided, such as porosity of sands or other formations, bottom-of-hole gas pressure, etc.

Things to be Considered in Designing the System

In some industries cost systems are designed primarily for pricing of individual products. In the oil production industry there is only one main product to sell, so the design here can be directed to focusing attention upon irregularities and inefficiencies, if they occur, with a view that the most favorable results may be obtained.

Standard Cost System Favorable

Although the variations in the oil producing industry are more prevalent than in almost any other line of business, historical or actual cost systems can be used. The standard cost which is gleaned from the industry as a whole would seem to be favored. This is so because it gives one access to what his costs ought to be, thereby providing a ready means of comparison for corrective purposes.

The standard form for the oil producing industry is also favored because it sets out a workable average of costs developed by experience that the producer can use in budgeting his costs. If he cannot for any reason, such as difference in conditions which increase his costs, match the standard cost he can still know that his cost is reasonable because he knows what made the difference.

Variances from standard costs, as developed by his own operations, should be carefully watched because:

1. There may be a great deal of difference which cannot be laid directly to unavoidable extra cost known to be peculiar to the locality.
2. It is desired to locate and correct tendencies toward higher costs not applicable to local conditions.
3. Rigid control will have a tendency to eliminate carelessness, inefficiency, and waste.

III. Description of the Cost System

The important steps in establishing a standard cost system for the oil producing industry are as follows:

1. Design an operating control statement for the management that is accurate and conclusive.
2. Design a daily progress sheet that will keep management informed as to production, development, etc.
3. Design daily reports for heads of departments or other executives that will give them daily information as to the following: Individual workers—what they did in detail; daily waste time report—waiting for material, repair parts, water, etc.; analysis of operating overhead (this may be monthly).
4. Establish cost standard as to individual operations, labor material, overhead, etc.
5. Set up chart of accounts and require all references thereto to bear account numbers as well as titles.
6. Set up procedures for comparable figures of standard and actual costs so that variations can always be known.

The Operating Profit and Loss

This is a most important statement to the management. This is so especially if the cost data which the producer has established is shown parallel to that developed from the standard for the same class of operations in the field. The resulting comparison will reveal information as follows:

1. Show variances between the actual and the standard costs of operations.
2. Show weaknesses in the system in use and pointing out possibilities for improvement.
3. Enable management to budget expenses with more certainty.

The statement provides truths that can be relied upon regarding past operations, and gives assurance for the future by showing what can be expected under the same conditions. (See Figure 1 and explanation following that statement.)

Variances Between Standard and Actual, How Used

The variances in this industry may be used as follows:

Name of Variance	*To Account for Differences Between*
Labor—Rate	Standard and actual pay rates for productive work, plus bonuses, vacation allowances, overtime premiums, etc.
Labor—Efficiency	Standard and actual labor costs due to inefficiences not applicable to rates of pay.
Materials—Cost	Standard and actual costs due to local conditions.
Locality	Standard and actual for overhead, etc., due to distance from base, bad roads, poor facilities, etc.

All of these conditions are possible in some oil fields, and some of them are prevalent in all oil fields.

The Allocation of Variances

It is usually the case that variances are cleared to proper variance accounts as soon as they are known. Where there is difficulty in determining where the variance should be applied, then apportionment to all operations involved would seem to be the correct method.

Revision of Standard Costs

Revisions should be made from the standard with a very high degree of care. But if they are found to be necessary, because of local conditions, costs of labor and materials, etc., they may be made at any time. It is believed that the blind following of a standard which has been found impossible of attainment should be discontinued and that that basis should be revised, but revisions should always be infrequent. They should not be made at all except when based upon conditions of a permanent nature.

Analysis for Benefit of Supervisors

Daily, weekly, or monthly reports as to effective operation prepared by the cost department should be made available to supervising management. These are particularly important if the operations seem not to improve as expected. In this manner the cause and circumstances of variances may be more clearly analyzed, thereby making it possible to supervise with more reasonable certainty of understanding of results.

How Standards are Created

Standards are always based upon activities of the industry, that is, if efficient operation of the industry is to be reached. They might be developed as follows:

Labor—Rates.—Every operation employing labor should be classified as to a certain type comparable to a standard wage rate which has been established for each operation.

Labor—Efficiency.—The expected labor cost on each operation should be known as established, and all wage payments should be compared with this standard to ascertain if efficiency is reached in the operation. Rates could then be created that would be standard for that locality.

Repair—Costs.—Most repair costs can be standardized. This rate should be compared with actual costs for other like service. Then if adjustment is necessary it should be made.

Material—Prices.—The purchasing department should have a unit cost as an established practice. Actual cost as compared with this should provide a means of establishing a standard.

Overhead—Rates.—Overhead, as budgeted should be the established practice for operations in the normal manner. The operation should be based upon shifts of one, two, or three, per day per shift. If the wage rates are constant for all shifts, and the standard rate, after constant effort to match it, is still less, then adjustments within reasonable limits would seem to be in order.

How Data for the Cost Summary Are Obtained—Cost of Operations

The average cost of operations may be obtained by the barrel or by other means, since all wells do not produce alike. Costs of oil production are usually referred to as lifting costs. If lifting costs are averaged, this would seem good enough to the average reader, but let us take a case such as the following which is very typical of the average oil lease: There are forty wells on the lease. Twenty of these wells produce daily 10 barrels each. The other twenty produce 4 barrels each per day. The cost of operating the lease for a certain period is $6300.00, and the total production is 8400 barrels. The indicated lifting cost is therefore 75 cents a barrel. Now let us suppose that the cost is exactly the same for operation of each 20-well lot. The 10-barrel per day lot would produce 6000 barrels at a cost of $3150.00 or 52½ cents per barrel. The 4-barrel well lot would produce 2400 barrels in the same period at a cost of $3150.00, or $1.3125 per barrel. If the price of crude oil were less than $1.50 per barrel, this last lot would allow very little profit. If the price were as low as $1.00 per barrel the loss would be prohibitive. For that reason, if average-well operations are to be availed of for costs, care should be used in grouping the wells. Unproductive wells should be operated only in times of higher per-barrel prices, if at all.

Lifting cost information, if it is to be of value, must include not only the direct lease cost for the lease where the wells are located, but, in addition thereto, indirect costs, such as depreciation, depletion, and general overhead applicable to that particular operation.

Calculating Material—Price Variance.—Unlike mercantile or other businesses, the oil producer purchases materials usually only for use on his leases. Never the less, he should know by the standard practice what this material is going to cost him. Any variance from the standard price will of course be absorbed in the operation involved.

Material—Usage Variance—How Calculated.—Materials used by the oil producer are generally capitalized, such as casing, pipe, sucker rods, pull rods, pumping equipment, etc. Since these are capital items, the measure of use of most or all of them would be the depreciation sustained. Some will wonder why there should be any variances in depreciation.

E. B. C. Oil Production Company

Profit-and-Loss Cost Analysis

Month of May, 1946

	Flowing Wells			Pumping Wells		
	Actual Cost	Standard Cost	Over or (Under) Variance	Actual Cost	Standard Cost	Over or (Under) Variance
Income:						
Total Production—Oil	$10,840	$10,840		$31,630	$31,630	
Total Production—Natural Gas	1,860	1,860				
Steam Sales				160	160	
Power Servicing Wells				100	100	
Other Income				60	60	
Total Income	$12,700	$12,700		$31,950	$31,950	
Expenses and Deductions:						
Labor	1,200	1,180	20	4,760	4,720	40
Repairs	1,320	1,300	20	3,680	3,700	(20)
Supplies	660	650	10	2,230	2,210	20
Gas, Oil, and Grease	210	190	20	1,460	1,470	(10)
Water	130	125	5	820	790	30
Electric Power				1,280	1,270	10
Auto and Truck Operation	20		20	1,190	1,200	(10)
Fuel	10	20	(10)	1,220	1,210	10
Taxes	140	150	(10)	660	650	10
Insurance	200	210	(10)	1,500	1,480	20
Depreciation	1,220	1,220		4,510	4,510	
Depletion	1,300	1,300		4,050	4,050	
Total Expenses and Deductions	6,410	6,345	65	27,360	27,260	100
Profit for the Month	$ 6,290	$ 6,355	$65	$ 4,590	$ 4,690	$100

Note: The average oil man would likely have included all production in one schedule. But, since the cost of production from pumping wells is so much greater than that by flowing wells, this could hardly have been a fair test. Therefore, where costing is seriously attempted, careful handling, as between these two sources of production, must be used if any reasonable cost accounting is to be expected.

Depletion above refers to cost depletion only. Allowable depletion, other than cost, would likely not be considered on this form of statement.

Fig. 1.

In certain oil fields depreciation on certain materials is three or four times that on others. This is particularly true with reference to pipe under ground. This is caused by what some call a chemical and others an electrical action, which eats holes in steel pipe in a very short time.

Water with a high mineral content is also a cause of variation of life of oil field materials, and salt which is found in most oil fields has a known propensity for producing rust which is a chief enemy of most metals.

Calculating Labor Variances.—Standard rates of pay in oil fields are almost nonexistent. But that is no reason it could not be so. Men of long experience are usually paid more than those less experienced. The standard for long-time employees seems to be more firmly fixed than those for short-time workers. There would seem to be the possibility of comparison at least with regard to the long-time workers.

Calculating the Overhead Variances.—There is no good reason for inability of calculating variances in overhead on oil field operations.

The law of supply and demand applies to a considerable degree to field superintendents, office personnel, etc. Practically all employees know the salaries of the clerks across the hall who are employed by another producer for the same work they are doing. It, therefore, develops into a case of "pay the standard or lose the employee."

However, overhead covers more than labor. Long trips which supervisors must make into the country on poor roads, or any number of other causes, could increase the overhead of one operator above that of another or that set by standard practice.

Further Description of the Profit-and-Loss Statement

The profit-and-loss statement of an oil producer has more variations than that of almost any other occupation. The reason for this is that the income, if any, is more uncertain than that of most businesses because there is no assurance that oil will be found when wells are drilled. If oil is found the production thereof declines at a very fast rate in most wells. This declining rate of production is frequently matched by an increased cost based on time, and tremendously increased based upon barrels produced.

Any accountant or engineer who has prepared depletion reports for income tax purposes can show very graphically the declining curve that is evident in every well or lease. He expects the first year's production to be from two to twenty times that produced in the second year. In later years, however, the curve straightens out somewhat, but any man who makes plans based upon first-year production of any well anywhere is due to be disappointed.

At the same time, any one who expects very much lessening of expense as the years go by is also gambling on an uncertainty. In short, it costs practically the same to pump a 5-barrel-a-day well as it does a 50-barrel one.

The theory of balanced profit and loss, therefore, is not in continued "flush" production of one well, but in bringing in new flush producing wells to keep the total production at some semblance of a level.

It can readily be seen from this that the oil business is unlike any other in respect to constant income. A manufacturer can know how much he can produce and, if he has a market for his product, he can know about what he can expect in profit. The oil man cannot see how much he can produce, although he generally has

COST OF SERVICE SHEET

Standard Cost for
Well or Lease Operation

(Name of Well or Lease)

Description of Service	Labor Cost Hours	Labor Cost Unit	Standard Cost Unit	Standard Cost Total Cost
Machine Operator—Labor				
Miscellaneous Labor				
	Material Cost		**Standard Cost**	
	Quantity	Unit	Unit	Total Cost
Machinery Repairs				
Lease Equipment Repairs				
Lease Supplies				
Misc. Costs				

Summary of Standard Costs	Hours	Total
Labor—Foremen		
Labor—Common		
	Quantity	**Total**
Materials:		
Repair Parts		
Supplies		
Miscellaneous		
Overhead		
Superintendence		
General Overhead: Viz.:		
Allowance, if any, for variance		
Grand Total		

Fig. 2.

Daily Labor Waste Report

Labor Waste Operating_____Lease Month of_____19___

MANAGEMENT RESPONSIBILITIES

Day	Total	Direct	Indirect	% Indirect To Direct	Total	Rates	% of Standard Direct	Machine Breakdown	Waiting Materials	Other Lost Time	Total
1											
2											
3											
4											
30											
31											
Mo.											

LABOR RESPONSIBILITIES

Day	% of Standard Direct	Slow Worker	New Worker	Other
1				
2				
3				
4				
30				
31				
Mo.				

Fig. 3.

a ready market for his product. But he can't sell anything if he is unable to produce it.

The larger companies, by continually prospecting, drilling, and developing new fields, have obtained fairly constant production, and thereby are able to establish standards and dependable costs thereon. The small operator will still be compelled to battle with variations of more or less uncertainty because he cannot afford the continual pepping-up that new wells at fairly average intervals would give his productive volume.

Some items of both income and expense have no bearing on cost accounting as such. These may be: Easements for rights received from a power company, overriding royalties on leases, interest on temporary loans, fire insurance collections, etc., for incomes. For expenses: Interest paid on borrowed money, losses by fire, theft or storm, damages paid, etc. In short, any income or expense that does not recur in all operations would seem to be extraneous incomes and expenses to be included in general profit-and-loss statements but, by their very nature, must be eliminated when cost finding is contemplated.

COST ACCOUNTING FOR OIL WELL DRILLING CONTRACTORS

By

JOHN BURNIS ALLRED *

I. DESCRIPTION OF THE INDUSTRY

Cost accounting for the oil well drilling contractor is a difficult and rather indefinite operation. This is so because of the hazards involved. These hazards are legion, but the most important of them is the likelihood of losing the well before it is completed.

Drilling contractors usually agree to complete the well when they take a contract. A well is not complete until it is ready to deliver, and many contingencies may interfere with its completion.

Instances have been known where the contractor was through with the drilling, and could have delivered the well in a very short time when something happened—something dropped into the "hole," the pipe twisted off or otherwise became disconnected, or one of many other interferences occurred. When this happens the contractor is in serious trouble.

Some wells are drilled to depths of three miles. No man is ever more helpless than is a drilling contractor when something happens at the bottom of that hole to lock or seize a bit to such extent that no power beyond the known tensile strength of the pipe dares be used for fear of twisting the pipe to the breaking point. Once parted, the case is hopeless. If one can do nothing with a direct pipe connection to the bottom of the well there is little hope of success with a loose end at the bottom of it.

Makers of contracts for the drilling of oil wells are usually very certain that the wording of it calls for well completion. No completion, no pay. If the contractor loses the well he finds himself faced with the expense of drilling an entirely new one with the loss of all the footage drilled in the old one. That is why it is stated that the work of the drilling contractor is a hazardous occupation.

Hazardous as it is, however, the industry has made giant strides in the last twenty years toward standards of costs that are fairly accurate and reasonably dependable.

Standards have been worked out which, although varying to some extent in different localities, are found to be sufficiently accurate for pricing contracts and for general use.

But this matter of locality has much to do with drilling contracts. In some oil producing territories rock in varying degrees of hardness is encountered in all wells, in fact, in some almost from top to bottom. In others little rock is found. The difference to a drilling contractor caused by these factors is tremendous.

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Instances are known where hundreds of feet have been drilled in a single day, while in others only a few feet or, indeed, inches.

Much of the success in a present-day hard formation drilling is due to a greater variety of drilling bits than was even dreamed of in the not-too-distant past. The writer is often reminded of a remark made by an old-time driller who, when asked how much he made the previous day, promptly answered: "Six inches; one inch off the rock and five inches off the bit." But that was in the old days of the fishtail bit. These are good now only in soft formations. Many contractors at this time use rock bits all the way from top to the bottom of the hole and, consequently, are ready for any contingency.

Since formations have much to do with the cost of drilling wells, standards have been attempted on at least two bases—the rig-day and by the foot. If no standard has been established in a territory, such as when drilling is done in completely "wild cat" areas, the contractor is subject to a gamble as rank as that of a novice in Reno. By "wild cat" we mean a venture undertaken in an area never before tested by drilling. The stakes are generally high if success is met in this operation. They should be, for the contractor is "going it blind." However, after a well is drilled, the log of that well can always be used as an example of what to expect in the way of formation in other wells in the same general area.

The cost of drilling oil wells depends materially upon the capabilities of the rigs used. That is, a new Diesel-powered rotary rig can be expected to produce more favorable results than an old and worn rig of the same originally rated power or capacity. Naturally a heavy rig would be expected to make better headway than one of lighter construction which was probably intended to be used on shallower wells.

The cost of operating the larger rig is naturally greater if both types were new, but the final result might prove that it is more economical to use. All these contingencies must be taken into consideration when any semblance of a standard of drilling cost is attempted.

Classification of Service

The services rendered by the drilling contractor are limited almost wholly to the drilling of oil wells. The successful contractor must know his formations. That is, he must know with a reasonable degree of certainty what subterranean structures he is going to encounter in drilling the well before he undertakes to price the job. Moreover, he must know the general depth of these formations. He can afford to give a much cheaper estimate on a 2500 foot well, per foot, than he can on a 5000 foot well for a number of very good reasons. The lesser depths are less likely to have hard formations and certainly will require less power to drill. The greater depths require more time in making in-and-out runs of tools, there is much more strain on the derrick and drill pipe, and there are many other reasons for higher costs on the greater depths.

Origin of Contracts

This is purely necessity by the one wishing the job done. He may own the land in fee-simple, or he may own rights in the nature of leases.

Leases usually have clauses that require drilling for oil on the happening of an

event, such as being off-set by drilling on an adjacent lease, or by the limitation of time.

Under such conditions a ready employer and an also ready contractor find a means of serving each other.

Sources of Service to be rendered can be said to be in the drilling machinery owned by the contractor and by labor provided by the contractor. Unlike other industries, there are no raw materials to be processed, but mainly services of machinery and labor.

The organization of the plant of the drilling contractor is of great importance. His machinery or rig, as it is generally called, is not housed in a building but is more or less transitory. It must be capable of being dismantled, moved to a new location, and reassembled in short order, because the contractor is not usually paid for this time.

His organization should consist of a good rig and a trained crew. Good rigs are those not so badly worn as to require long repair jobs, and trained crews should need no special instruction in operating the rig.

The rigs should be equipped with adequate lighting facilities for night drilling. Needless to say, these lights must be electric, as any flash lighting, such as flares, where gas pockets are likely to be encountered without warning would probably cause an explosion.

A general foreman, usually a competent driller, must be in charge of each shift. From three to five or six helpers, as needed, can be used on each well, but they can be less experienced. Shifts are usually eight hours, or three shifts a day. Fuel, water, drilling mud and other necessities should be available at all times, because delays are costly. Provision in the nature of light trucks for hauling supplies should be made. This frequently saves time because of shutdowns while waiting for needed supplies.

The order of production of service is continuous. If a contractor's rig functions properly his rig is running twenty-four hours each day. Every operation must be coordinated or the continued successful progress is hampered.

II. How to Design the Cost System

What Information Is Desired

The American Association of Oil Well Drilling Contractors with headquarters in Dallas, Texas, in its manual of uniform practices of the industry denotes considerable attention to cost accounting. It lists the following divisions of cost and goes into considerable detail in explaining their application.

1. Labor and Supervision
2. Supplies
3. Maintenance
4. Ordinary Operating Expense
5. Other Operating Expense
6. Depreciation
7. Overhead

Every one of these factors can reasonably be expected in every well drilled. It logically follows that information about these costs would be desired in any good cost system.

Consideration in Designing of the System

In this industry the cost system is designed to know the cost of producing the service. The actual cost is continually reduced, if possible, by comparison with the standard costs applicable to the industry. Attention must be directed to irregularities or inefficiencies from any cause that can be corrected so that the very best results can be obtained.

The Standard Cost System Should Be Followed

Although such a system is still in an inadequate stage, such as has been developed should be availed of because it gives a target at which to shoot. Comparisons are thereby more easily made.

The standard costs are especially favored for the oil well drilling industry because, at best, cost systems for the industry must be varied due to the differences of locations, hardness of subterranean formation, etc. But a certain degree of allowance can be made for these differences and still use made of the comparisons.

Unlike most industries which have large costs in raw materials, the operating cost of this is almost entirely in labor, upkeep, and depreciation, but since this applies to all drilling contractors, the standard should not be difficult in this respect.

If variances between the operations cost and the standard cost occur to any great extent the cause should be located and corrected. Such variations could be caused by the following:

1. Difference in depth of wells.
2. Difference in underground formations (hardness, quicksand, water infiltrations, cave-ins, etc.).
3. Difference in locations, distance from supplies, inaccessibility due to bad roads, mountains, swamps, etc.
4. Condition of rig (new, old, or out of date).
5. Undercapitalization. Plenty of funds must be available to pay labor, repairs, etc.

III. Description of the Cost System

Profit-and-Loss Statement—See Figure 1

Profits are the aim of the drilling contractor as they are of any businessman. To keep him informed as he goes along, an adequate profit-and-loss system should be available to him at frequent intervals. This should:

1. Give information as to what a standard profit and loss for the operation should be.
2. Give information as to what his actual costs are, with variations from the standard for the industry for like operations.
3. Provide charts of accounts with the standard costs shown for pricing, comparing, etc.

If proper care is used there will be considerably less uncertainty at the end of the year as to the final results because the operator will know fairly well what he has been doing all the year and will have had ample chance to correct any errors.

PROFIT-AND-LOSS STATEMENT
E. B. C. DRILLING COMPANY
May 31, 1946

	Actual Cost	Standard Cost for Area	Over (Under)
Income:			
Drilling Contracts			
Day Work			
Other			
Gross Income			
Expenses and Deductions from Income:			
Labor Costs:			
Supervision			
Drillers			
Helpers			
Compensation Insurance			
Withholding Taxes			
Social Security Taxes			
Crew Transportation			
Auto Expense—Direct			
Supplies Costs:			
Rig Supplies			
Hand Tools			
Pipe, Fittings, etc.			
Oils, Greases, etc.			
Other Supplies			
Maintenance and Repairs:			
Draw Works and Parts			
Pump Repairs and Parts			
Power and Transmission Repairs and Parts			
Blocks, Swivels, Wire and Hose Lines, Repairs and Parts			
Rotary Repairs and Parts			
Electrical Repairs			
Blacksmith and Welding Repairs			
Fishing Tools Rentals, etc.			
Drill Pipe Repairs and Parts			
Kelley Joints, Collars, etc. Repairs and Parts			
Other Expenses			
Ordinary Operating Expense:			
Bits and Reamers			
Trucking In and Out			
Pits and Dirt Work			
Derrick Erection, Rentals, etc.			
Fuel			
Water			
Drilling Mud and Chemicals			
Other Ordinary Expenses			

Fig. 1.

	Actual Cost	Standard Cost for Area	Over (Under)
Depreciation:			
Rigs			
Drilling Pipe			
Other Depreciation			
Overhead:			
General Overhead			
Administrative Expense			
Total Expense			
Net Profit for the Period			

Fig. 1. (*Continued*)

Variances and How Used

There is no doubt that variances from standard practice will occur. When they do, the cost system readily points them out and makes possible the necessary adjustments. These differences will occur in the following:

Name of Variance	*Cause of Variance*
Labor Rate	Standard plus overtime, premiums, bonuses, other excesses.
Labor—Inefficiency	Standard plus costs due to inefficiency not caused by pay rates.
Material—Costs	Standard plus extra costs due to price increases, distance from supply, etc.
Depreciation	Standard plus wear and tear excess due to conditions not prevalent in other localities.
Other	Standard plus any other cost caused by difference in conditions to which the operator is subjected.

Variances Allocated

Variances are allocated to various costs as they are known. This keeps the operator informed as to what he can expect from an operation. By so doing he will be able to price his services and estimate his final result with a fair degree of accuracy, even though it is somewhat above the standard for the industry in his locality. Failure to reach the standard should not be taken as the continuing cost for all future operations. The operator has two marks to guide him, a standard to try to reach and his record to try to beat.

Costing of individual wells is a proper end. Some operations make no pretense of separating costs of individual wells; consequently, they do not know on which operations profits or losses occur.

Each well should bear its cost. This cost should cover moving on location, setting up, all operating costs while drilling, dismantling of rig, depreciation, and reasonable overhead.

These costs should be further analyzed to show the per-foot cost of the well, and this information should be kept available for handy reference for use and comparison with reference to other wells.

WELL COST

Well Name and Number_____

County_____ State_____

Survey Location_____

	Standard Cost	Actual Cost	Variance Over or (Under)
Labor Cost:			
Supervision			
Drillers			
Helpers			
Labor Insurance			
Compensation Insurance			
Withholding Taxes			
Social Security Taxes			
Crew Transportation			
Auto Expense—Direct			
Supplies:			
Rig Supplies			
Hand Tools			
Pipe, Fittings, etc.			
Oils, Greases, etc.			
Other			
Maintenance and Repairs:			
Draw Works Repairs and Parts			
Pump Repairs and Parts			
Power Transmission Repairs and Parts			
Blocks, Swivels, Wire and Hose Line, Repairs, and Parts			
Rotary Repairs and Parts			
Electrical Repairs			
Blacksmith and Welding Repairs			
Fishing Tools Rentals, etc.			
Drill Pipe Repairs and Parts			
Kelley Joints, Collars, etc.			
Ordinary Repairs and Parts			
Ordinary Operating Expense:			
Bits and Reamers			
Trucking In and Out			
Pits and Dirt Work			
Derrick Erection, Rental, etc.			
Fuel			
Water			
Drilling Mud and Chemicals			
Other			
Depreciation:			
Rigs			
Drilling Pipe			
Other			
Overhead:			
General Overhead			
Administrative Expense			

Fig. 2.

Standard Cost Revision

The standard cost would ordinarily seem to be fixed. However, as stated previously, certain variations of conditions, when fully established in a locality, may make revision necessary. Such revisions should be constantly reviewed and further revisions, up or down, should be made where demanded by consistency.

Supervising Executives Furnished With Information

Analytical data should be constantly available to executives. These could be in the nature of daily, weekly, or monthly reports showing the results of productive operations. Particularly should this be so if inefficient results are recurring with much regularity.

It would be well to furnish the executive with the variances in order that he might have information to change prices of services to be rendered in future or to discontinue certain losing operations.

How Standards Are Created

These are based upon results obtained by like operations in the same industry. If inadequate information is available in any locality, they can be created by experience. The following costs information would likely be necessary to such attainment.

Labor—Rates.—Classification of types of labor required and standard rates for each type.

Labor—Efficiency.—The operator should know what results to expect from labor. Inefficient workers should be eliminated.

Repair Costs.—Since it is impossible to know when a machine is going to break down, this is the most difficult cost to estimate. But past costs can be known, and the law of averages is fairly constant.

Overhead.—Overhead expense should be established with a fair degree of accuracy. When changes occur the standard should bear its portion of the adjustment.

How the Data for the Cost Summary Are Obtained

Finding the Cost of the Services Rendered—See Figure 2

The cost of the services rendered in the case of the drilling contractor is what he has used generally in the nature of labor, repairs and replacements, fuel, lights, water, moving, slush pits, depreciation, and overhead. These costs are frequently more than the standard costs outlined for the industry. They are nevertheless the operations cost and the measure by which profits are gauged, and they are also the measure by which comparison with standard is made possible for efficient operations and to show how far the contractor is missing the mark of perfection.

From experience gathered by the American Assocation of Oil Well Drilling Contractors, previously mentioned, a per-day cost of $550.00 is set as standard for the larger type machine as a basic cost. It adds thereto maintenance of drilling string at $20.00 per day, bits and reamers at $1200.00 per well, and trucking and transportation at $1000.00 per well. Counting the time for completing the well at forty over-all rig-days, the cost is calculated as follows:

Rig Operation (40 Days at $550.00)		$22,500.00
Drilling String Maintenance (40 Days at $20.00)		800.00
Bits and Reamers (Each Well)		1,200.00
Trucking and Transportation (Each Well)		1,000.00
Extras:		
Pits and Cellars	$ 450.00	
Fuel	1,250.00	
Water	800.00	2,500.00
Total Direct Expense (Standard for 40 Days)		$27,500.00
Rig Depreciation (40 Days at $60.00)	$2,400.00	
Drill Pipe Depreciation 4 Inch, Any Depth Day (Estimate 3500 Feet at 1½ Cents per 25 Days)	1,125.00	
Overhead (40 Days at $50.00)	2,000.00	
Total Indirect Cost		$ 5,525.00
Total Cost		$33,025.00

On this basis, the total cost divided by 40 days equals $825.62 per day, or on, say, a 5000-foot well, $6.60 per foot.

The above are standards developed by reliable authority. They are used by many contractors for pricing jobs, which is frequently required in advance of contracts.

If the time, for a number of reasons, might require fifty rig-days with corresponding increase every factor, running the cost up to $40,150.00, the per-day cost would be $803 or a footage cost of $8.03.

The form in Figure 2 is designed to record the actual costs with spaces for standard costs and the under-and-over variances. This presumes that the standard operation and the actual cost are similar in nature. By this means and by careful study of the results in a few wells in a designated area, the difference can be corrected so that the variance will be small.

It must be kept in mind, however, that any standard for a designated area will have to be worked out from actual similar operations in that specific area. It is doubtful if standards for any two areas will be alike.

Extraneous Costs

In calculating costs of drilling wells there are certain costs which may, and often do, appear in the total costs of wells. These are in the nature of loss of time on fishing jobs (trying to recover tools lost in the hole), waiting on water, fuel, pipe connections to storage, and other shutdowns which do not appear in all wells. These losses are not specifically chargeable to the cost finding feature. If they are included in the general records (and they should be included in the general records of profit and loss), they should always be eliminated for cost-finding purposes.

In this connection, the question comes then: What should be done with costs for whole repairs or general overhauls of machinery? The answer is not simple, but this much can be said: They are not entirely chargeable to the operation in progress. Suppose, for instance, a well is finished and the rig has been transferred to another location. During the first day on the new well a major breakdown occurs. Which well broke it? Some writers say: Charge it to the depreciation

reserve; others say the repair should be capitalized; still others would charge the well on which the machinery was occupied at the instant of the break. None of these are completely correct. The rig may be practically new. Therefore, these would have no reserve for depreciation of any consequence. It should not be capitalized, usually, because that would probably increase the book value beyond the cost. It would be unfair to burden a new well with a cost for a break which was almost ready to happen on a previous one. Therefore, it should be handled with a great deal of care from any standpoint, but particularly with respect to cost accounting. The following methods would seem to be satisfactory:

If the rig were old and a large depreciation reserve is already accumulated, the cost should be properly charged to it.

LABOR WASTE FOR MONTH OF_____, 19____

Payroll

Day	Total	Direct	Indirect	% of Indirect to Direct	Rates	Total
1.						
2.						
3.						
4.						
30.						
31.						
Mo.						

MANAGEMENT RESPONSIBILITIES

Day	% of Standard Direct	Machine Breakdown	Waiting Materials	Waiting Orders	Other	Total
1.						
2.						
3.						
4.						
30.						
31.						
Mo.						

LABOR RESPONSIBILITIES

Day	% of Standard Direct	Slow Worker	New Worker	Poor Worker	Other	Total
1.						
2.						
3.						
4.						
30.						
31.						
Mo.						

If the rig were practically new, it is an extraneous expense, not chargeable to cost accounts, but nevertheless, an economic loss to be charged off in the general operating statement.

In neither case is the cost chargeable to cost accounting, and certainly not where costs are averaged for cost standard usage.

Part of the reason for this is that, especially in the older rigs, depreciation cost has already been charged regularly for just such contingencies. In the newer rigs, it is comparable to a fire which costs heavily, but which is not expected to recur with any degree of regularity. Therefore, we repeat, such costs should not be included where comparative costs are to be considered.

OIL REFINERY COST ACCOUNTING METHODS

By

LYLE R. SPROLES *

I. DESCRIPTION OF THE INDUSTRY

Classification and Origin of the Products

Contrary to most manufacturing industries, oil refineries have only *one* raw product with which they manufacture their various finished salable products—namely, crude oil as produced from wells drilled into the earth.

Crude petroleum in its raw state is generally classified as paraffin base oil, asphalt base oil, and mixed base oil.

Dependent upon the geological formation and geographical location, there is a wide variance in the yield of finished products resulting from refining crude petroleum because of the difference in the chemical content of various crude oils. Some crude oil contains a high percentage of gasoline and naphthas, whereas other crude oil is rich in lubricant value, and still another is so viscous that it requires very little treatment to be used for various type road oils.

Composition

Crude petroleum consists of about 84% by weight of carbon and 12% of hydrogen together with varying proportions of sulphur, nitrogen, oxygen, and minerals. Such elements as sulphur and minerals are impurities inasmuch as they interfere with the commercial utilization of the finished product and are eliminated by acid treatment in a process known as "scrubbing." Hydrocarbons possess boiling points, ranging from less than zero; whence they are gaseous at ordinary atmospheric pressure and temperature, to several hundred degrees Fahrenheit.

Crude oil and its refined products are graded according to gravity in degrees A.P.I. standard.

Viscosity is the term which denotes the body or cohesiveness of a liquid.

Flash point is the temperature at which there is enough gas given off by the volatile liquid to cause a small flash to shoot across surface, by passing a flame over the liquid as the temperature increases.

Fire point is the temperature at which oil will burn without extinguishing.

Refining

Regardless of the chemical analysis of petroleum, from the accountant's viewpoint, the single raw product of crude petroleum is split up into a number of finished products, each of which has a value and commands a market of its own. The following is a fair sample of recoveries in a typical mid-continent field:

* Certified Public Accountant, Oklahoma and Texas; Partner, Sproles & Woodard, Certified Public Accountants, Fort Worth, Texas.

	Degrees Baume Gravity	*Recovery Percentage*
Gasoline	85.7	28.00
Naphtha	48.2	18.00
Kerosene	40.1	15.00
Gas Oil	34.6	15.00
Viscous Natural Oil	28	10.00
Steam Refined Cylinder Stock	24	6.00
Refined Paraffin Wax		.50
Asphalt		3.50
Loss in Refining		4.00

Refining of crude petroleum is a series of processes whereby the component elements of the oil are separated, principally, by the application of heat and pressure, and by utilizing the physical characteristic that these elements possess.

In the first operation, the crude oil is fractionally distilled so as to separate it at normal boiling points into wet gas, gasoline, kerosene, gas oil, fuel oil, etc.

In the "cracking process," the residuum is re-run after the topping distillation has taken off certain products. This residuum is then charged to the stills where heat is developed to 650° F. and further finished products, principally gasoline, are obtained. Higher temperatures cause the re-run sludge to disintegrate and be decomposed. The process of "cracking" is comparatively new. A decade ago these so-called "end point" products were sold as fuel oil.

Source of Raw Materials

The "independent refiner" usually purchases his supply of crude oil from the "independent producer," and processes it into principal and by-products. These finished products are then sold to wholesale "bulk dealers," or independent retail stations, who in turn retail it to the consumer. However, the last several years have witnessed the consolidation or amalgamation of the several activities of the oil industry as a whole into large integrated units, whereby certain holding companies, through subsidiaries, own producing properties, and control transportation by pipe line companies, refineries, and marketing organizations.

The law of supply and demand in so far as the independent "producer" is concerned regulates the price of crude oil only theoretically. In truth and in fact, the price of crude oil is controlled by the "postings" of large major oil companies which operate with a complete cycle of the industry—namely, production, transportation, refining, and marketing. It is also a matter of common knowledge, and undisputed by those having intimate knowledge of the industry, that in many instances these "postings" of price paid the independent operator for his crude oil are indeed most arbitrary. Such posted prices are made without considering the cost of development and production in difficult areas. It is also a matter of record that prices are set without consideration of whether the price of refined products have fluctuated to justify the changes in crude oil "posted prices."

Crude oil is purchased from the producer at his lease. When it is produced, it is flowed or pumped into the lease storage tanks. When purchased by refiners or pipe line purchasing companies, it is run from the lease storage tanks into the pipe

lines by means of gauges of the tanks before and after the run is made. From tank tables compiled by "strapping" computations, the exact number of barrels are obtained by which record the purchaser pays the producer. The oil is then transported, usually by pipe line (sometimes by trucks), to the refinery storage or tank farm. From there it is charged to the stills and is processed into the finished salable products. The mechanics of accounting in connection with getting the oil from the lease to the refiner's storage is considered to be in part a different subject from "oil refinery cost accounting" and also one of only academic interest. Therefore, for this reason it is omitted here.

The measure of both crude oil and refined products is first gauged for actual volume and then corrected according to both gravity and temperature at the time tested therefor, so that the net result will represent correct volume as though the gauge was taken at 60° F. on which basis it is bought and sold. Various publications, such as those of the U. S. Bureau of Standards and the American Society of Testing Materials, and the American Petroleum Institute, as well as books that are issued by the Manufacturers of Hydrometers, give more detail for those interested in the subject. The necessity of this "yardstick" process as outlined is occasioned by the fact that oils expand with heat and contract with cold. For crude petroleum the general practice is to add or subtract 1% of the volume for every 20° above or below 60° F. The following is a table of approximate allowances for various temperature derivatives of petroleum.

Light Gasoline—Subtract or add 1% for every 15° above or below 60° F.
Other Naphthas, Gasolines, and Illuminating Oils—Subtract or add 1% for every 20° above or below 60° F.
Gas Oil and Lubricating Oils—Subtract or add 1% for every 25° above or below 60° F.

The "posted" price of crude oil contains schedules of prices according to the quality of the oil with a sliding scale of differentials up or down for various degrees of gravity. Crude oils of high gasoline or lubricant content are posted at a higher price than oils containing a smaller percentage of these products.

For a more detailed discussion of features pertaining to gravity and temperature, reference is hereby made to pages 80 and 81 of "Accounts of an Oil Company," by H. G. Humphries, C.P.A., and also pages 299 and 300 "Handbook of Petroleum Accounting," by R. W. McKee, C.P.A.

Organization of Plant

The accountant should visualize graphically the physical operation of a refinery before he designs his cost system. For this reason a chart or organization of the plant should be outlined and, therefore, the following is submitted:

(a) A general description of the processes that crude petroleum is put through to obtain the various finished salable products and the products that are produced by each process. This outline is for a refinery in operation that has both the "skimming" or "topping" units as well as the "cracking units," with a capacity of about 4000 barrels per day.

(b) A flow chart of the refinery herein designated as Exhibit 1 shows the various process from the raw to finished products as well as the treatment of each product.

Note: The author is indebted to Mr. Allen M. Peairs, consulting refinery engineer and manager of Ampco Inc., Dallas, Texas, for this chart and description of processes as follows:

No. *Description of Processes and Products Obtained*

1. Crude from storage to topping still.
   Fractionate out natural constituents in crude.
   Quantity and quality varies with the gravity of the crude. Usually the following products result:
   1. Straight run gasoline
   2. Naphtha
   3. Kerosene
   4. Gas oil (sometimes lubricating oil)
   5. Topped crude or fuel oil
2. The above products are then treated as follows:
   Straight run gasoline in a modern plant is de-sulphurized either by thermal or catalytic processes which increases the lead susceptibility.
   Naphtha is sweetened and is used as a conventional cleaners' naphtha, or used as solvents, paints, etc.
   Kerosene is sweetened with conventional doctors solution (Lithard and Caustic).
3. Topped crude is then charged to a cracking unit and heated to cracking temperatures with allowance for pressure and time element, which then produces—
   1. Cracked Gasoline
   2. Cracked Fuel Oil

   Note: The larger plants charge their gas oil to a catalytic cracking unit which produced further cracked gasoline of higher octane.
4. Cracked gasoline from either thermal or catalytic cracking unit is then sweetened and stabilized, usually by running through a continuous doctor sweetening plant.

Class of Refineries

The following are the general classes of refineries together with brief descriptions:

1. "Skimming" plant that merely takes the lighter products of gasoline or naphtha; kerosene and the balance or residue are sold for fuel oil.

2. The "lubricating" plant, which covers the first processes described in (1) and then produces various lubricating oils before disposing of the residue as fuel oil.

3. The complete refinery, whose operations embrace both (1) and (2) above, and in addition thereto employs one of the patent processes known as catalytic "cracking," whereby residuum from the first process is re-run and then heated to higher temperatures whereby additional lighter products are recovered.

4. Casinghead gasoline plants—these plants are the type of refineries that manufacture gasoline from natural gas which is produced from an oil well that also produces gas, or from a gas well that produces no oil. There are certain areas that produce gas which is rich in gasoline content, whereas certain gas wells in some areas are dry and have little or no gasoline content. The methods of extracting the gasoline from the gas produced by these wells are (1) the compression method whereby the gas is compressed at a low temperature, and (2) the mineral absorption method in which the gas is caused to bubble through an absorption medium, from which it is afterward purified, "scrubbed," and refined.

II. How to Design the Cost System

Accounts and Records

What Information Is Required

By custom and practice, most of the smaller refineries described in group (1) (Supra) do not have sufficient daily records of stock movements into the plant that will be useful in any current cost analysis. However, from a long-range operation, with the opening and closing inventories available, a profit-and-loss statement can be compiled showing gross sales and costs by products giving quantities and value. The cost by processes, refining loss, and variance statistics will necessarily be absent.

In the class described in group 2 the accountant would usually find complete daily stock records prepared at 7 A.M. giving inventories, receipts of crude oil, and deliveries to stock tanks by each process. The following summary would be typical:

Inventory	*7 A.M. Previous Day*	*Barrels*
Receipts at Plant		
Crude Oil		xx
Purchased Products		xx
Total to Be Accounted for		xx
Less: Deliveries per Loading Report		xx
Plant Consumption		xx
Total Deductions		xx
Total to Be Accounted for 7 A.M. today		xx

Through mediums of pumping reports and miscellaneous data, such as daily run and yield statements, and pipe lines or loading rack reports, the quantities of crude oil or cracking stock that are put into each process or operation are accurately obtained. From this compilation the "processing loss" may be computed. The variance or loss is caused by evaporation and distillation at high temperatures. Any large loss should be investigated to ascertain that no leaking lines or defective equipment is in operation.

The "refinery summary sheet" should show daily the movement of all stocks and production of each product.

Considerations in Designing the Cost System

If a plant is to have in operation a complete process cost system it is necessary to have an auxiliary cost process ledger. The ledger will show the receipts by quantities, and the deliveries and/or production of finished products, together with the cost of all raw products consumed for any given period. If adequate records are maintained to establish costs by processes (usually monthly), this statistical analysis will develop losses by quantities after being corrected to 60° F. The receipts and deliveries are likewise corrected to 60° F. Following is a typical summary of information that would be developed.

Process Unit No._____
For Month of_____, 19_____

Cycle No._____
Hours on stream
Consumed
Column for each commodity _____ bbls., per cent of total, gravity _____
Total bbls. _____

Produced:
Column for each product _____ bbls. Per cent of total gravity _____
Processing Loss _____ bbls.
Total bbls. (as above) _____
Gasoline content of product _____ %

Statistical
Totals _____ Consumed and produced _____ bbls. Per cent of total and average gravity _____
Time _____ Charge started _____ Stream started _____
Stream ended _____ Cycle ended _____
Time on charge hours and minutes
Time on stream hours and minutes
Time idle hours and minutes
Remarks.

For this cycle, charges from the controls of the "plant expense" through the medium of clearing accounts would be transferred and accumulated to the process cost ledger, together with the cost of the product consumed, similar to the following:

(a) Cost of crude oil put into process, or
(b) Cost of products transferred from previous process
(the latter is dependent upon accumulated costs per unit developed in previous process)

(c) *Expenses*

Fuel	$_____
Operating Labor	_____
Chemicals and Supplies	_____
Repairs and Maintenance	_____
Overhead and Variance	_____
Insurance	_____
Taxes	_____
Direct Departmental Expense	_____
Depreciation	_____

Most of the features of expense can be applied direct to specific process units, with exactitude. In order to do this, however, the accounting department must have complete records in order that the charges can be broken down and distributed to the respective process units (see Flow Chart in Exhibit 1 and process description and products produced by each). Payrolls would necessarily show the description of work performed daily by each plant worker. All requisitions from warehouse

would show the purpose and unit on which all supplies are used. Fuel, such as gas or fuel oil, used in the stills would have to be metered and measured, etc. Naturally, such expenses as superintendence, taxes and insurance, etc., would have to be spread equitably over the various processes. The method of application of these burden or overhead items would depend upon the particular circumstances prevalent, the method of cost system in vogue, etc.

Printed and ruled auxiliary forms must be maintained, and be subject to analysis tied into the plant expense controls, or the stock and inventory controls. Some of the most important forms may be enumerated as follows:

(1) DAILY GAUGE REPORT

24 hours ending 7 A.M. _____, 19_____

(Horizontal classification)

Kind of Oil
Product
To
From
Feet
Inches
Temperature
Net Gallonage

(2) STILL REPORT Still (or Unit) No._____

Crude Oil Charged.

From Tank No.	Before		After		Barrels	Meter Reading	Temperature	Barrels
	Ft.	In.	Ft.	In.				

(3) PUMPING REPORT No.

_____A.M._____P.M._____ 19_____

Kind of Oil Pumped	Supt. Order	Tank or Car	From				Time		To					
			Before		After				Tank or	Before		After		
	No.	No.	Ft.	In.	Ft.	In.	Begun	Pumper	Car No.	Ft.	In.	Ft.	In.	Pumper

(4) DAILY PRODUCTION REPORT No. _____ Day _____ Month _____

For Period Ended 7 A.M._____19_____

Process 1—Direct Refining		Process 2—Re-running (Cracking)		Process 4—Kerosene and Distillate Treating	
Consumed:	Barrels	Consumed:	Barrels	Consumed:	Barrels
Crude used @ 60° M. and B.S. Net Crude Used Tops Used		Tops		Kerosene Stock Furnace Oil Painters Dist.	
Total to Acct. for		Total to Acct. for		Total to Acct. for	
Produced:		Produced:		Produced:	
Straight run gasoline Tops Naphtha Fuel Oil Kerosene Stock Klengine Stock Furnace Oil Etc.		Cracked Gasoline Cracked Fuel Oil Loss %		Kerosene No. 1 Kerosene No. 2 Stove Oil Spec. Painters Distillate	
		Totals			
		Proc. 3—Gasoline Treating			
		Consumed: Raw Gasoline		Loss %	
				Totals	
		Produced:		Etc.	
Loss %		Treated Gasoline Loss %			
Totals					

Note: The sub-processes of sweetening, desulphurizing, and desalting are omitted, but where crude has these ingredients such processes are necessary (see below chart).

(5) PROCESS COST LEDGER—AND QUANTITIES

Received and Delivered — Process No.

Month ended _____ 19_____ — Process _____

(Horizontal ruled Columnar Ledger with following classifications).

Left Page

1. Date
2. Posting Reference
3. Description or Item
4. Total $

Right Page

Quantities—(receipts)

1. Day of Month
2. Crude Oil
   (a) Tank No. } _____
   Gallons

5. Labor	$	(b) Tank No.	
6. Fuel Used	$	Gallons	
7. Chemicals	$	Total Gallons Received	
8. Repairs	$	Quantities Produced	
9. Service Department	$	3. (a) Name of Product Gallons	
10. Overhead	$	(b) Name of Product Gallons	
11. Superintendence, Etc.		(c) Name of Product	
Total Expense	$	4. Total Gallons Produced	
Statistical Gallons Produced		5. Loss—Gallons	
		Loss— %	

In this condensed treatise it is not possible or practicable to reproduce all of the various forms that may be used in even a medium-sized refinery—especially where a process cost system is in operation. Some other forms that have not been reproduced in the foregoing exhibits are:

6. Company Transfers—giving record of finished products moved from one part to another.
7. Refinery, Daily Detail of Production and Transfers.
8. Pump Order, representing loadings and shipping by tank cars.
9. Product Stocks—at branches and stations.
10. Refinery Inventory Record.
11. Refinery Reconciliation of Inventories (Daily).

"The Weighted-Selling Ratio Method" and Other Methods of Cost Finding

The principal mysteries of cost finding on any manufactured product are, generally speaking, the following factors:

(a) Direct Materials and Labor Used
(b) Overhead or Burden
(c) Variations and Losses

Because the processes of refining and catalytic "cracking" are continuous and so closely related, it is most difficult to distinguish certain costs and make the proper segregation as between each process. Especially so is it with (a)—unless inventory and movement of stocks through the flow lines are minutely correct it is almost impossible to account for the refinery loss by processes. Where a process cost system is not in operation, there is no great problem in finding both the over-all cost for a given period (say, a year) and the refining loss. The elementary equation of inventories (quantities and cost) at the beginning of the period plus purchases, and less the inventory at the end of the period gives this amount.

The following is a brief description of the various methods of cost finding for refineries.

The one considered most ideal and by concensus the most usually employed is as follows:

1. "The Weighted-Selling Ratio Method." The theory of this method is that the same rate of gross profit is earned on each product. By the same token, the allocation of processing cost (not blending and bad costs which are direct gasoline costs) is distributed to the products on the basis of their respective sales values. This factor is obtained by multiplying the quantity produced by the sale value of each of the products. The ratio of each amount thus obtained to the total of all amounts is applied to the total processing cost to be spread. Naturally it will be observed that this method does not assume the same rate of gross profit on each product. The sales value of unleaded gasoline should be used in determining the sales value of the gasoline yield for the purpose of this allocation of cost. Blending costs of gasoline, such as natural gasoline, Ethyl lead, etc., should be allocated to the particular grade of gasoline realized upon the basis of actual quantities used in each blending operation.

Other Methods

2. Another method is that of dividing the total cost of raw material and expenses by the total quantity of all products produced, and arriving at the same cost for each. It is most obvious that this method is deceptive for the reason that certain products command a better market price than others, and certain products require more processing than others. This method would produce a gain or loss on certain products that would be most incorrect.

3. Still another method is that of concentrating all costs on the main products and deducting therefrom the sales value of the by-products. Under this method the cost of the by-products would be unknown and therefore certain products might be produced at an actual loss. In such an event it would be better to discontinue such by-product and sell the residuum as fuel oil.

There are still other methods not discussed due to space limitations and considered to have only theoretical and academic importance.

III. Description of the Cost System

Profit and Loss Statement

The following skeleton profit-and-loss statement is taken from a refining company's actual operation. In fact it is the same company whose "flow chart" and process description is described under the heading of "Organization of the Plant."

	Gallons	Price per Gallon (Cents)	Value (Dollars)
Sales:			
80 Octane Gasoline	xxx	xxx	xxx
Ethyl Gasoline	xxx	xxx	xxx
3rd Grade Gasoline	xxx	xxx	xxx
Que Gasoline	xxx	xxx	xxx
Distillate	xxx	xxx	xxx
Fuel Oil	xxx	xxx	xxx
Kerosene	xxx	xxx	xxx
Gas Oil	xxx	xxx	xxx
Total Sales			xxx

	Gallons	Price per Gallon (Cents)	Value (Dollars)
Cost of Sales:			
Inventory of Crude Oil and Refined Products (Beginning of Year)		$ xxx	
Purchases	$ xxx		
Crude Oil	xxx		
Natural Gasoline	xxx		
Refined Products	xxx	xxx	
Total		xxx	
Less: Inventory (End of Year)		xxx	
Total Prime Cost		xxx	
Plant Expense:			
Superintendence		xxx	
Laboratory Expense		xxx	
Treating Plant Labor		xxx	
Telephone and Telegraph		xxx	
Operating Unit Labor		xxx	
Repairs and Maintenance Labor		xxx	
Loading Rack Labor		xxx	
Operating Supplies		xxx	
Repairs and Maintenance		xxx	
Loading Rack Expense		xxx	
Treating Plant Expense		xxx	
Chemical Expense		xxx	
Ethyl Treating Lead		xxx	
Auto and Truck Expense		xxx	
Miscellaneous Plant Expense		xxx	
Compensation Insurance Expense		xxx	
Payroll Taxes		xxx	
Electricity and Water		xxx	
Fuel—Gas		xxx	
Kero Treating Expense		xxx	
Depreciation		xxx	
Total Plant Expense			xxx
Total Cost of Sales			xxx
Gross Income			xxx
Sales Expense:			
Sales Manager		xxx	
Salesmen's Salaries		xxx	
Other Sales Office Salaries		xxx	
Agents Commissions		xxx	
Miscellaneous Sales Expense		xxx	
Printing and Stationery		xxx	
Traveling Expense		xxx	
Advertising		xxx	
Licenses		xxx	
Bad Debts		xxx	
Payroll Taxes and Insurance		xxx	xxx
Total			xxx

	Gallons	Price per Gallon (Cents)	Value (Dollars)
General and Administrative Expenses:			
Executives Salaries		xxx	
Other Office Salaries		xxx	
Postage		xxx	
Telephone and Telegraph		xxx	
Printing and Stationery		xxx	
Traveling Expense		xxx	
Automobile Expense		xxx	
Legal and Professional		xxx	
Miscellaneous		xxx	
Interest Expense		xxx	
Insurance Expense		xxx	
Property Tax Expense		xxx	
Contributions		xxx	
Bad Debts		xxx	
Depreciation		xxx	xxx
Total Operating Income			xxx
Other Income:			
Gain on Sale of Assets		xxx	
Use and Occupancy Insurance Benefits		xxx	
Sale of Junk		xxx	xxx
Total			xxx
Other Deductions:			
Sales Discounts		xxx	
Lease Rentals		xxx	
Rent Paid		xxx	
Expired and Surrendered Leases			xxx
Net Income for Year			xxxxx

The foregoing profit-and-loss statement would be supplemented with the cost of sales by individual products. The process ledgers according to the cost finding methods discussed under "The 'Weighted-Selling Ratio' Method and Other Methods" in operation would be tied into the controlling accounts that are represented in this profit-and-loss statement.

Variances Used

The following accounting variances exist in the oil refining industry.

Name of Variances

1. Raw Material—(Crude Oil). Fluctuation of posted price from time to time will affect process costs.

2. Reprocessed Products. Predetermined costs used currently and the variations between such costs and actual cost adjusted periodically.

3. Labor and changing construction for newer methods of refining, or for breakdowns of machinery.

4. Overhead or Burden. Where amount is indeterminable caused by bonuses to management or key employees—also where there are other activities of the company besides the refining operations.

These variances will be now discussed in the same order and sequence as outlined above.

Raw Material (Crude Oil).—When the "posted price" of crude oil is changed (as discussed heretofore) and substantial inventories are being processed currently, the true cost by processes is distorted. It is necessary to charge average prices into the various processes currently, and then periodically to clear these variances through some appropriate suspense or variance control account and thereby equalize the cost accounts to conform to actual costs. Where the posted price of the *one raw product*—namely, *crude oil*—remains constant over a given period, then no adjustment or variance for this feature would exist.

Re-Processed Products

As heretofore explained, while oil refining starts with one raw product in the first process, the products obtained are subject to treatment and reprocessing sometimes two or three times before being converted into marketable finished products. (See Flow Chart in Exhibit 1 and description of products.)

For this reason the accumulation of cost, if a process cost system is in operation, must necessarily be maintained from one process and such established cost carried over to the next process. For example, since crude oil in various areas does not contain exactly the same ingredients, and some crude with sulphur or salt content must be treated by special processes, it is sometimes necessary to blend raw gasoline with it for better efficiency. It would be impracticable to calculate the cost of raw gasoline before the first main product—namely, *raw gasoline*—is completed. Therefore, it is necessary to use predetermined costs, say, for the prior period, in order to get out a cost statement currently covering the transfers of this product. It would follow that this variance would be accounted for by suitable controls or suspense accounts and cleared from time to time—usually for a year of operations. The revised process cost should be adjusted to disclose both the costs with the predetermined items contained therein, and the amount of these variances to the final actual cost figures.

Labor and Cost Changing Construction for More Modern Methods—Also for Breakdowns of Machinery and Equipment

A refining plant considered the "last word" in efficiency and production today may be a "back number" in another five years because of newer inventions of both machinery and process formulas. Also it must be remembered that both the machinery and the products handled are most hazardous from the standpoint of explosions, fires, and breakdowns. When a refinery organization decides to install certain modern machinery to replace the obsolete units, it is sometimes necessary to shut down the entire plant. A breakdown, caused by fires, explosions, or otherwise, even in one department or one unit, usually causes the entire plant to be shut down.

In any of these events it also follows that there is certain labor paid while the workers are idle, and/or there are various costs not compensated for by insurance, etc. In the final analysis, these labor and construction costs or repair costs must be apportioned over the processes in some equitable manner. The method employed would depend upon the facts and circumstances. In some cases only certain processes would be affected, whereas in others all processes should bear ratably such

extraordinary expenses. The usual method of apportionment in the latter case would be to distribute these (usually non-recurring or extraordinary costs) on the basis of the direct cost of each to the entire cost of all processes. Another method would be distribution, on the basis of the separate quantities produced by each process to the total quantities produced by the plant. The accounting controls for these variances would be handled and finally adjusted as explained in other variances discussed (supra).

Overhead or Burden

(a) The following expense accounts are typical of overhead items, not directly attributable to any one process, that must be spread in a scientific and equitable basis over all of the products produced:

Electric and Steam Plants
Crude Oil Storage Expense
Insurance
Laboratory Expense
General Repairs and Miscellaneous Refinery Expense
Finished Products Storage Expense
Cost of Fuel Used
Fire Fighting Equipment Expense
Delivery Expense
Machine Shop Expense
Etc.

Most of these expense accounts enumerated would be spread on a gallonage or quantity basis to the products so affected. Some part of the items, for example "Fuel Used" could be accurately measured and charged as a direct expense of the process, provided proper mechanical devices were installed. If natural gas is used as a fuel a separate meter for each process would be required. Delivery facilities would be apportioned only on the major finished products delivered to customers or to company branches. The application of the overhead items and theories of distribution could well fill a chapter in itself. For any accountant installing a cost system for complete refining processing, it would be necessary for him to discuss every function with the refining engineer who designed the plant or the superintendent and management who operates such plant, before he could "get his feet on the ground" and compile a chart of accounts and write a manual for the cost accounting mechanics and procedure.

(b) Where the company has integrated operations, that is, various other activities such as producing oil, operating a trunk pipe line, or marketing facilities, the matter of apportioning overhead is more difficult, and extra precaution must be taken to ascertain that each department or branch of the business is apportioned its correct amount of this overhead expense.

(c) Bonuses to key employees or management officials not determined currently but usually subject to action of the board of directors at regular annual meetings are subject to special study and treatment as to apportionment.

All of these factors outlined above render it impossible to find actual costs currently, except by predetermined estimates. Naturally these estimates used in monthly process cost statements are subject to the same accounting control, and the attendant adjustment periodically in order to show actual cost.

Costing of Individual Products

As explained under the caption of "Accounts and Records," the smaller plants with insufficient records to develop process costs can, in the over-all picture, obtain the cost of products produced with application of certain reasonable arbitrary assumptions.

In an article by William B. Finlay, C.P.A. of Great Falls, Montana, published in the "Pathfinder Bulletin" by Charles R. Hadley Company, Los Angeles, California, Mr. Finlay has made some computations of refining costs that are reproduced in Exhibit 2.

Exhibit 2 can be compiled for that class of smaller refineries mentioned above that do not have complete records of expense analysis and daily movement of stocks from one process to another.

The example in Exhibit 3 is based upon the "Barrels gravity" method. Such method is based upon the principle that the raw product content (crude oil) is the basis of cost and therefore should not be ignored in its application of the cost of the finished products. It is a compromise of the Weighted-Selling Ratio method. In the latter method the average market price is the factor by which individual products are multiplied to reach a basis of allocation, and in the "Barrels Gravity" method *gravity* is substituted for *Market Price.*

Reference is now made to Exhibit 4. This exhibit referred to will show the *same quantity* of crude oil processed as is shown in Exhibit 3, but with some different products. This summary in Exhibit 4 develops cost by *processes* as well as *products,* while Exhibit 3 disclosed *only* cost by *products* under this same method of costing—namely, "Weighted-Selling Ratio."

The comparison in Exhibit 5 with that of Exhibit 2 discloses the variation of cost as between the separate products; Exhibit 2 under the same method but *not individual processes,* whereas Exhibit 5 shows the cost developed by products under the *process* system. Naturally the over-all cost of all products is the same under both systems.

Analysis for Supervisory Executives

If the plant is of sufficient magnitude to warrant the extra expense, a process cost system should be operated. If some by-products are being produced that cost more than their current selling price, production of the particular product should be discontinued unless, of course, it is merely a medium in which to obtain a more valuable product.

For example, certain additional products can be produced with comparatively small changes in plant "hook-up" and not too great an additional investment that might yield a great deal more profit. The executives would be "at sea" unless they were supplied by factual cost data to base their decisions as to change in products, etc.

It goes without saying that the management executives should have, in addition to cost data, other information to insure good, well-balanced management. Such other data should include:

1. Sources of Crude Supply.

In this connection the independent refiner who does not own production of his own is in a bad state of affairs if he loses some of his substantial connections and cannot

EXHIBIT 2

(Name of Company)

STATEMENT OF RECOVERIES AND DISTRIBUTION OF COST FOR THE YEAR ENDED_____19__

EXAMPLE 2. Cost Finding by the "Weighted-Selling Ratio" Method, Giving Costs for Products but Not by Processes

Description of Transactions	Gallons							
	Gasoline	Benzine	Kerosene	Kero Distillate	Gas Oil	Fuel Oil	Road Oil	Totals
Sales	1,950,000	1,000,000	7,300	1,460,000	827,500	862,500	4,267,500	10,374,800
Transfers to Bulk Stations (1)	200,000		2,000	170,000	50,000	500,000		922,000
Fuel Oil Used in Processes								
Total	2,150,000	1,000,000	9,300	1,630,00	877,500	2,362,500	4,267,500	12,296,800
Deduct: Casinghead and Other Blending Gasoline Used	500,000							500,000
Remainder	1,650,000	1,000,000	9,300	1,630,00	877,500	2,362,500	4,267,500	11,796,800
Add: Inventory at End of Period	250,000	150,000	700	500,000	700,000	1,000,000	500,000	3,100,700
Total	1,900,000	1,150,000	10,000	2,130,000	1,577,500	3,362,500	4,767,500	14,897,500
Deduct: Purchases	300,000		4,500			50,000	500,000	854,500
Remainder	1,600,000	1,150,000	5,500	2,130,000	1,577,500	3,312,500	4,267,500	14,043,000
Deduct: Inventory at the Beginning of Period	200,000	500,000	500	700,000	450,000	750,000	1,500,000	4,100,500
Remainder Being Recovery of Product	1,400,000	650,000	5,000	1,430,000	1,127,500	2,562,500	2,767,500	9,942,500

SUMMARIES OF RECOVERIES AND DISTRIBUTION OF REFINING COSTS

Product Recovered	Gallons (See Statement of Transactions Above)	Per Cent of Recovery Allocated to Each Product	Per Cent of Recovery of Products to Total Recovery of all Products (a)	Average Price Received During Previous Period ("Net Back")	Product of Gallons Times Average "Net Back"	Per Cent of Each Product to Total of All Products (b)	Refining Cost Allocated to Each Product
Gasoline and Benzine	2,050,000	0.2000	0.2062	10.5¢	$215,250.00	0.367	$184,968.00
Kerosene and Distillate	1,435,000	0.1400	0.1444	8.	114,800.00	0.196	98,784.00
Gas Oil	1,127,500	0.1100	0.1134	5.	56,375.00	0.096	48,384.00
Fuel Oil	2,562,500	0.2500	0.2577	3.5	89,687.50	0.153	77,112.00
Road Oil	2,767,500	0.2700	0.2783	4.	110,700.00	0.188	94,752.00
Total Recovery (Gallons)	9,942,500	0.9700	1.0000				
Loss in Refining Process	307,500	0.0300					
Total Crude Oil Run to Stills (Barrels times 42) in Gallons	10,250,000	1.0000					
Total (Basis of Distribution)					$586,812.50	1.000	
Cost of Refining (in Actual Operation, Detail Would Be Submitted in Separate Schedule).							$504,000.00

EXHIBIT 3

EXAMPLE 1. Process No. 2—Steam Stills
Run to Steam Stills 40,000 Barrels at $1.80 = $72,000.00
To Be distributed to Product Recovered upon a "Barrel Gravity" basis (Barrels times gravity)

Products Recovered	Gravity		Barrels	=	Barrels Gravity	×		Barrels Gravity %	
Gasoline	62	×	28,000	=	1,736,000	×	1/2,168,000	80.07	$72,000.00 × 80.07 = $57,650.40
Kero Stock	42	×	8,000	=	336,000	×	1/2,168,000	15.50	72,000.00 × 15.50 = $11,160.00
Diesel	32	×	3,000	=	96,000	×	1/2,168,000	4.43	72,000.00 × 4.43 = $ 3,189.60
			39,000		2,168,000			100.00	$72,000.00

$13,000.00 overhead allocated to steam distillation was distributed upon a barrel-yield basis.

Barrels Produced	Barrels Obtained			=	Yield Barrels	×	$13,000.00	=	
28,000	Gasoline	×	1/39,000	=	71.79	×	$13,000.00	=	$ 9,332.70
8,000	Kero Stock	×	1/39,000	=	20.52	×	13,000.00	=	$ 2,667.60
3,000	Diesel	×	1/39,000	=	7.69	×	13,000.00	=	$ 999.70
39,000					100.00				$13,000.00

			Summary		
Products Produced	Barrels Produced	Tops Cost	Overhead Cost	Total Cost	Per Barrel	Per Gallon
Gasoline	28,000	$57,650.40	$ 9,332.70	$66,983.10	$2.39225	5.69¢
Kero Stock	8,000	11,160.00	2,667.60	13,827.60	1.72845	4.12
Diesel	3,000	3,189.60	999.70	4,189.30	1.39643	3.32
	39,000	$72,000.00	$13,000.00	$85,000.00		

Example (1): Process No. 3—Treatment
25,000 Barrels Gasoline Treated at Product Cost from Process No. 2 at $2.39225 per Barrel.

Cost of Material	$59,806.25
Add: Distributed Refinery Overhead	5,000.00
24,000 Barrels Produced, Cost	$64,806.25

Average Cost $2.70026 per Barrel, or 6.43¢ per Gallon.

8,000 Barrels Kero Distillate Treated Stock Cost,

8,000 Barrels at $1.72845 from Process No. 2	$13,827.60
Add: Overhead Distribution	2,500.00
7,500 Barrels Produced, Cost	$16,327.60

Average Cost $2.177013 per Barrel, or 5.18¢ per Gallon.

EXHIBIT 4

EXAMPLE 3. The Process Cost Method Using the "Weighted-Selling Ratio" Method, Adapted to a Modern Plant, Selected for illustration because of its simplicity

Description	Gallonage		Cost Factors				
	Quantity	% to Total	Avg. "Net Back" Prev. 12 Mos.	Quantity X "Net Back"	% to Total	Amount	Cost Cents Per Gallon
Process No. 1 (Straight Run Stills)							
Charge:							
Crude Oil	10,250,000					$250,000.00	2.44
Process Costs						50,000.00	.49
Total Refining Cost Through Process No. 1 (Avg. Cost per Gal.)						$300,000.00	2.93
Produced:							
Tops	2,500,000	24.39	9¢	$225,000	0.4237	$127,110.00	5.08
Tailings	7,650,000	74.63	4¢	306,000	0.5763	172,890.00	2.25
Loss	100,000	00.98					
	10,250,000	100.00		$531,000	1.0000	$300,000.00	
Process No. 1 (a) (Asphalt Unit)							
Charge:							
Tailings	500,000					$ 11,300.00	2.26
Process Costs						250.00	.05
Total Ref. Cost Through Process No. 1 (a) (Avg. Cost per Gal.)						$ 11,550.00	2.31
Produced:							
Kerosene Distillate	100,000	20.00	7.5¢	$ 7,500	0.3228	$ 3,728.34	3.78
Gas Oil	90,000	18.00	5.0¢	4,500	0.1937	2,237.24	2.48
Fuel Oil	225,000	45.00	3.5¢	7,875	0.3389	3,914.30	1.74
Asphalt	84,000	16.80	4.0¢	3,360	0.1446	1,670.12	1.98
Loss	1,000	.20					
	500,000	100.00		$ 23,235	1.0000	$ 11,550.00	
Process No. 2 (Cracking Unit)							
Charge:							
Tops	2,000,000					$101,600.00	5.08
Fuel Oil	200,000					3,480.00	1.74
Tailings	2,000,000					45,200.00	2.26
	4,200,000						
Process Costs						120,000.00	2.86
Total Refining Cost Through Process No. 2 (Avg. Cost per Gal.)						$270,280.00	6.44
Produced:							
Gasoline (Raw)	2,500,000	59.52	9.5¢	$237,500	0.7504	$202,818.11	8.11
Kerosene (Raw)	500,000	11.90	7.75¢	38,750	0.1224	33,082.27	6.62
Fuel Oil	1,150,000	27.38	3.5¢	40,250	0.1272	34,379.62	2.99
Loss	50,000	1.20					
	4,200,000	100.00		$316,500	1.0000	$270,280.00	
Process No. 2 (a) (Treating)							
Charge:							
Gasoline (Raw)	2,000,000		9.5¢			$162,200.00	8.11
Process Costs						15,000.00	.75
Total Ref. Cost Through Process No. 2 (a) (Avg. Cost per Gal.)						$177,200.00	8.86
Produced:							
Gasoline (finished)	1,995,000	99.75	10.5¢	$209,475	1.0000	$177,200.00	8.89
Loss	5,000	0.25					
	2,000,000	100.00		$209,475		$177,200.00	

EXHIBIT 5

EXAMPLE 2a. Variation of Cost Finding by the "Weighted-Selling Ratio" Method Shown in Example 2

Cost of Refining:	
Crude Cost (including Freight and Handling into Plant Storage)	$250,000.00
Process Cost including Prorated Service and Clearing Accounts	254,000.00
Total Cost of Refining	$504,000.00

See percentages shown on preceding pro forma statements (Example 2) in columns designated by letters—

	Costs Distributed		Total Cost of Refining
	Crude (a)	Expense (b)	
Gasoline and Benzine	$ 51,550.00	$ 93,218.00	$144,768.00
Kerosene and Kero-distillate	36,100.00	49,784.00	85,884.00
Gas Oil	28,350.00	24,384.00	52,734.00
Fuel Oil	64,425.00	38,862.00	103,287.00
Road Oil	69,575.00	47,752.00	117,327.00
Cost of Crude	$250,000.00		
Refining Expense		$254,000.00	
Cost of Refining			$504,000.00

get others to replace them. Therefore, the management should have statistics before them at all times and look ahead to insure themselves of adequate supply of crude petroleum.

2. Markets for Finished Products.

The sales analysis should be before the executives currently. Almost any kind of an independent refinery should have a good sales manager who is "on his toes" to get good customers and to obtain the kind of regular customers who will pass the credit department. Sometimes smaller refiners have come to grief by not watching their market outlets. Putting too much confidence in two or three large customers to the exclusion of several smaller ones is bad policy and especially so if you lose one or two of the larger ones.

3. About the most important information that the executives should have before them currently—almost as vital as the cost analysis itself—is the Balance Sheet. If it becomes necessary to expand the plant facilities, or replace certain units with more modern equipment, funds must necessarily be provided for such purpose. With high income tax rates, it is sometimes most difficult to do such financing with "short term paper" to be paid out of current earnings. Therefore, if the organization does not have on hand sufficient cash for such expansion, it is well to consider bond issues or preferred stock issues.

Inasmuch as this discussion is confined to "Refinery Cost Accounting Methods," no detail discussion of the balance sheet is considered appropriate. However, a few comments on the highlights of the accounts that go to develop such a statement would be appropriate.

(a) The current assets and liabilities of a refinery organization are common to any industrial organization; for example, accounts receivable and payable, notes receivable and payable with discount analysis, securities owned, inventories, cash on hand, etc.

(b) The fixed assets deserve special study and treatment. The plant investment ledger should be broken down into units with sufficient detail whereby the depreciation sustained and reserve analysis are readily accessible in order to apply such charges as are applicable to the process costs.

When a balance sheet is prepared, an analysis should be compiled to show on each unit or class of investment the following:

(1) Original Cost of Asset	$_____
Less: Reserve for Depreciation (or Amortization)	_____
Net Balance (Book Value)	$_____

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COST ACCOUNTING FOR THE PACKAGING INDUSTRY

By

NATHAN E. JORDAN *

I. DESCRIPTION OF THE INDUSTRY

The packaging industry has been a decisive factor in stimulating the growth of small business, wherein the substantial capital required for investment in fixed assets (for example, mixing and filling machinery, labeling and sealing machinery, etc.) has been unavailable or prohibitive. In lieu of such capital investment it became necessary for these small businesses to "farm-out" their packaging problems to organizations equipped to handle the job. Although the gross packaging cost per unit was thereby increased, it was not increased sufficiently to warrant the substantial capital investment referred to.

The functions of the packaging industry may be briefly described as follows:

Receiving and warehousing of bulk materials (liquids in tank cars, powders in barrels, viscous materials in drums, etc.), containers (such as bottles, cans, jars, etc.), labels, etc., shipped from the customer; filling, sealing, and labeling the containers; further packaging of the filled containers, in varying quantities, in cartons, crates, etc., and the return of such packaged merchandise to the customer, or to such destinations as may be designated.

A short while after the inception of the industry, and the invention or design of various types of machinery to meet specific problems, the industry divided into two classes:

1. *Consistent or straight-line packaging,* wherein the equipment available is permanently set up and can be used for one and only one type of operation; for example, the packaging of tea balls. The tea is shipped to the packaging plant, fed into hoppers, weighed, bagged, tagged, boxed in varying quantities and diversified containers, and emerges at the other end of the line ready for delivery. The setup can be used only for tea.

2. *Job packaging,* wherein a new line setup is needed for each new job; the equipment must be relocated and adjusted to meet the new requirements, and new time studies and controls must be established over the various phases of the operation.

The first class may be likened to a continuous process type of operation and presents no particular problem in cost accounting. Costs are collected by department and reduced to average cost per unit of product and eventually the distinction between direct and indirect costs vanishes. Once the cost per unit of product has been determined and the percentage of profit decided upon, a sales price per unit can be established subject to no further variation, other than normal labor

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and material variances which can readily be determined and sales price easily adjusted therefor.

The second class, with which we will be concerned mainly, is by far the larger part of the industry. In its turn it may be likened to a specific order type of operation and presents the usual problems of job-order cost accounting plus certain characteristics peculiar to the industry.

The job packaging plant organization is generally divided into four departments:

I. Engineering department—which handles plant layout, line setup and discontinuance, time studies, and process charts.

II. Operations department—which handles production after the line has been set up.

III. Material control department—which accounts for materials received, packaged, and shipped; and their physical handling.

IV. Administrative department—which sets price policies, handles the financial control, budgeting, etc.

The engineering department works closely with the administrative department inasmuch as price-setting is based almost entirely on the engineering department's line setup cost and production cost estimates.

II. How to Design the Cost System

The major point of difference in cost system design between ordinary manufacturing organizations and the packaging industry lies in the inability of the latter to predetermine standard costs that can be revised currently to conform with operational variances.

A well-designed packaging plant is extremely fluid and mobile. It lends itself to quick rearrangement of machinery and setting-up of lines and conveyers for a change in packaging of materials or containers. Consequently, the cost of line setups and time studies of normal production on previously packaged items, while serving as a guide, will in no way set a "standard" for *new* items. It is only after many years of extensive experience and accumulation of data on the costs of packaging many diversified items that a scale of relative values, as a basis for scientific pricing and costing, will emerge. It is with this secondary requirement in mind that our cost system must be designed; the primary consideration being that of current costing.

In designing the cost system it is necessary to bear in mind that it is primarily designed to formulate price policies. The engineering estimate as well as the final actual cost summaries, with explanation of the variances, must be arranged in some form of permanent record readily available for future pricing purposes and comparisons. The detailed data on direct and indirect costs must be accumulated in such fashion as to be readily allocable to specific jobs. The question of allocation of manufacturing expenses has been a bugaboo in the industry but is now being generally resolved via the "passage of time" theory; inasmuch as manufacturing expense is incurred mostly due to the passage of time (namely, rent, insurance, etc.), the allocation thereof should be based on the time required for each run, and distributed proportionally when two or more items are being packaged or "run" simultaneously.

III. Description of the Cost System

The profit-and-loss statement (Figure 1) for the packaging industry presents a format not generally encountered by the reader of financial statements. The primary deviation is the absence from the statement of the cost to manufacture section including inventory accounts.

The distribution columns, although presenting the appearance of a departmentalized statement, only reflect the results of operations of the various jobs completed or partially completed during the month, for which invoices have been

Packall Manufacturing Company

Profit-and-Loss Statement for the Month of June, 1946

	Total	Job No. 1	Job No. 2	Job No. 3
Sales	xxx	xxx	xxx	xxx
Cost of Sales:				
Direct Costs:				
Engineering Department	ttt	xxx	xxx	xxx
Production Department	ttt	xxx	xxx	xxx
Materials Control Department	ttt	xxx	xxx	xxx
Materials	ttt	xxx	xxx	xxx
Total Direct Costs	ttt	ttt	ttt	ttt
Less: Variation in Cost of Incompleted Jobs	ttt	xxx	xxx	xxx
NET DIRECT COSTS	ttt	ttt	ttt	ttt
Indirect Costs:				
Engineering Supervision	xxx			
Production Supervision	xxx			
Material Control Supervision	xxx			
Unallocated Departmental Salaries	xxx			
Rent	xxx			
Light and Power	xxx			
Factory Supplies—Unallocated	xxx			
Cartage Out	xxx			
Insurance	xxx			
Taxes—Payroll, etc.	xxx			
Machinery Repairs	xxx			
Depreciation—Machinery	xxx			
TOTAL INDIRECT COSTS	ttt	ddd	ddd	ddd
COST OF SALES	TTT	ttt	ttt	ttt
Gross Profit on Sales	ttt	ttt	ttt	ttt
Less: Administrative Expenses (in detail)	xxx			
NET PROFIT FOR THE MONTH	ttt			

Note: xxx = original figures
ttt = sum or difference
ddd = distribution

Fig. 1. Profit-and-Loss Statement.

rendered. In the event that there has been no invoicing on any specific job, the direct and allocated costs will appear on the monthly profit-and-loss statement as a matter of course, but will be automatically eliminated by the inventory of cost of incompleted jobs.

To digress for a moment from costs, it should be pointed out that ordinarily for purposes of management, the sales reflected in the profit-and-loss statement represent invoices of completed units which have been shipped to the customer. However, a controversial point arises with regard to year-end accruals of sales of

JOB ORDER CARD

Job No. 357 No. of Units 100 M

Type 1 gallon can—liquid—export seal—labelled—packed 10 to a crate

Costs	*Estimate*	*Actual*
Line Set-up Cost:		
Men 3 hrs. 8 @ .95		
Production Costs:		
Men 15 hrs. 20 @ .65		from job order jacket
Materials Required:		
Solder		
Paste		
Container Spoilage 2 %		
Receiving and Shipping: (incl. line distribution)		
Men 2 hrs. 20 @ .65		
Materials Required:		
Banding Wire		
Nails		
Cartage Out		
Total		
Apportionment of Indirect Costs		
Total Cost		
Total Cost Per unit		
Sales Price per unit		

Fig. 2. Job Order Card.

completed units that await delivery and billing to the customer. Conservatively it has been held that one should not anticipate profits; and consequently any accruals of sales (of the above referred to completed units) would not be considered conservative accounting. Nevertheless, from a practical standpoint, should there be a considerable quantity of completed units on hand awaiting shipment, the nonaccrual of such sales would tend to distort the profit-and-loss picture and relegate to a succeeding period profits properly includable in the current period. To avoid such distortion it has become a practice in the industry to accrue such "sales" if they

JOB ORDER JACKET

Job No._____ Date Started_____

Specifications No. of Units_____

_____

_____

ENGINEERING DEPT.

Date	Name	Hrs.	@	Ext.

Total_____

MATERIALS DEPT.

Date	Name	Hrs.	@	Ext.
	Total_____			

PRODUCTION DEPT.

Date	Name	Hrs.	@	Ext.
	Total_____			

MATERIALS DRAWN

FACTORY SUPPLIES:

Date	Description	Units	@	Ext.
	Total_____			

CUSTOMERS:

Date	Description	Units
	Totals (by Type)_____	

SPOILAGE:

Date	Description	Units	Explanation

Fig. 3.

are of sizable amount, and to merely carry forward as a cost of incompleted jobs, those of minor import.

The direct costs appearing on the profit-and-loss statement, under their respective job number columns, are collated from the job order cards (Figure 2) which contain the summaries for permanent record, taken from the detail on the job order card jackets (Figure 3). The individual direct costs are then totaled and extended into the total column on the statement. The journal entry on the books reflecting such transfer is:

Dr. Direct Cost of Jobs
  Cr. Engineering Department Salaries
  Production Department Salaries
  Material Control Department Salaries
  Factory Supplies
  Spoilage Account.

The credits to the various salary accounts are self-explanatory. The balances remaining in the salary accounts are subsequently picked-up under the indirect costs section as unallocated salaries. The increase or decrease in the efficiency of the organization can then be readily ascertained by an inspection of the unallocated salaries. As higher efficiency is attained there will be naturally a decrease in the amount of unallocated salaries, and conversely.

The credit to factory supplies is the sum total of all direct materials issued to the "line" by the materials control department (which also handles stores) that can be allocated to specific jobs. The balance of the account after adjustment for inventory on hand is then listed under indirect costs.

The credit to the spoilage account merits some slight discussion. The account arises from the crediting to the customer of the value of spoiled containers by the journal entry:

Dr. Spoilage Account
  Cr. Accounts Receivable.

This spoilage usually results from incorrect engineering of line setups, employee carelessness, excessive machine pressures, etc. Although, in the main, it is a relatively small figure, custom has established the practice of crediting the customer for such spoilage inasmuch as it promotes considerable good will.

The indirect costs appearing on the profit-and-loss statement are the usual indirect costs appearing on most manufacturing company statements, plus the unallocated departmental salaries. These costs are taken from the respective ledger accounts and listed in the total column. The sum of these accounts, the total indirect costs, is then distributed to the various Jobs on the basis discussed in Section II, thus differing from the method used for direct costs. It should be noted that "cartage out," which ordinarily is treated as a selling expense, is herein treated as an indirect cost, since the packaging contract provides that the customer deliver materials and containers to the plant and the plant return the packaged merchandise to the customer. In the event of shipment of packaged merchandise to other than the customer's premises, the freight incurred is, of course, recharged to the customer.

The direct and indirect costs are then totaled for the cost of sales and by sub-

traction a gross profit *by job* is arrived at. From the *total* gross profits thus determined, the selling, administrative, and financial expenses, in detail, are deducted, and the net profit for the month determined.

The job order card (Figure 2) originally contains the detailed estimated direct costs, the estimated total indirect costs, and a computation of the estimated cost per unit. From this estimated cost per unit the sales price per unit is determined by the administrative department in consultation with the engineering department that has prepared the foregoing estimates.

Subsequent to the completion of the job, the actual direct costs summarized from the job order card jacket are then entered on the card; the apportionment of actual indirect costs, from the monthly profit-and-loss statements, are also recorded thereon, and the true cost per unit is then determined. Any variation in excess of a predetermined percentage (usually from 5% to 10% based upon experience) of the actual figures from the estimates is then analyzed and explained on the reverse side of the job order card. This card is then stored in a permanent file, arranged by the type of packaging operation, for future reference; thus meeting the secondary requirement of our cost system design.

The job order jacket is designed to record currently all the required detail. The three sections, respectively headed by the names of the three operating departments, contain the details, taken from the time cards, of the hours spent by the respective employees of each department on the specific job. The "customer's materials drawn" (from stores) serves as a check upon the units packaged and shipped and as a basis for determining and controlling the "spoilage" which is also listed on the jacket. Finally, the "factory supplies drawn" serves as a means of arriving at the amount to be transferred to direct cost of jobs from the factory supplies account (journal entry supra).

COST ACCOUNTING FOR THE PAINT, VARNISH AND LACQUER INDUSTRY

By

W. R. SIEPLEIN *

I. DESCRIPTION OF THE INDUSTRY

The paint, varnish and lacquer industry comprises 680 establishments doing a business in the United States during 1947 of $1,038,575,456.00. Approximately 50% of this volume was consumed by householders to protect and beautify their homes and furniture. The remaining 50% was supplied to manufacturers of a wide variety of machinery and household equipment, automobile manufacturers, railways, steamship companies, aircraft manufacturers, builders, state highway departments, Federal, state and municipal governments and the War and Navy Departments.

Product

Products supplied to dealers for household use include a variety of paints, varnishes, stains, and lacquers, each designed for a special purpose, such as the painting of buildings, interior decoration, floors, furniture, and many other purposes about the house. Such products are produced by individual manufacturers under trade names and manufactured in large quantities for stock that can be supplied on dealer orders.

Marketing Costs

Much advertising is published to interest the user in the merits of the individual finish.

The cost of such distribution and marketing is very great and represents as much as from 25% to 35% of the selling price. Many manufacturers sell direct to the public through their own retail stores which, of course, eliminates the manufacturer's cost to sell to the dealer.

The cost of selling and distributing for retail trade and the cost to service the manufacturers and consumers has been the subject of much study on the part of manufacturers but the accepted practice at present is to consider such expense as a percentage against the total volume of sales.

These features, of course, are not involved in the cost accounting for the manufacture of the product and are therefore not included in detail in the following treatise on the cost to manufacture.

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The Manufacturing Process

Manufacturing operations to produce paint, varnish, and lacquer, are quite simple compared with many industries and, because of this, the controllable operating expense is quite small.

The process entails the mixing of dry paint pigments with oil or varnish liquid; next, grinding the paste through a mill into a tank in which further reducing liquid is added. The batch is then tinted and, after testing against a standard, is filled into containers.

The smaller one-quarter pint to one gallon packages for dealer trade are usually filled on automatic machines, passed through a labeling machine into fiber packing cartons, and conveyed to a stock room awaiting shipment to the dealer.

Larger five gallon and drum packages for consumer trade are filled by hand and are usually shipped to the consumers at once. Some products are ground in revolving cylindrical ball mills into which the pigment and all the liquid ingredients are put immediately and after thorough mixture are tested and filled.

II. How to Design the Cost System

Considerations in Design

Because the controllable manufacturing cost represents so small a part of the finished product, the cost accounting system should be extremely simple. It need merely tie together the necessary payroll and expense accounts with the records of raw materials purchased and output of individual manufactured products necessitated to keep an accurate record of stock.

Simplicity of cost accounting is imperative so that figures showing the cost may be available to the factory operating superintendent promptly after the manufacturing run is finished. Proper study of these afford prompt and complete study of the cost of individual items revealing cases in which costs may be out of line and thus providing an opportunity to investigate, consider, and install corrective measures.

A comprehensive cost system serves as a rudder for a business. It enables the management to direct a course true to the fundamental policy governing the enterprise. Without such control the course is uncertain and may drift toward dangerous shoals that might cause disaster. The history of successful manufacturing concerns indicates that a true knowledge of costs is one of the foundation stones upon which the success was built.

The expenditure incurred in figuring costs has been found by many companies to be less than ¼ of 1% of sales. In other words, it costs only 25¢ to obtain true knowledge of the cost of products for a sale amounting to $100. This nominal expense is more than justified by the security it brings about.

Every manufacturer should sell his product with exact knowledge as to whether his price is above or below cost and what profit or loss will be realized on the sale. Products sold at a loss represent capital and labor thrown away. Such sales inevitably result in a curtailment of industrial activity and greater unemployment.

The study of cost details will reveal inefficiencies in production methods or use of materials and make available to individuals responsible for various divisions of the factory operations complete reports of the details of the work under their imme-

diate direction. It provides constant reports showing what is happening in the plant rather than what has happened, and suggests immediate corrections of inefficiencies.

As business primarily must make money in order to exist, it is obvious that the product must be disposed of for more than it costs. It is said that 95% of those who enter business fail. Probably no one feature influences a manufacturing enterprise more favorably than a dependable cost accounting system that will provide a correct measure of profits. Every manufacturer, therefore, is vitally concerned in knowing the actual cost of his product.

The problem presented in the use of materials and in operating costs make it necessary for the manufacturer to determine and constantly know the cost of his product in order that his business may continue to be a profitable one, earning the margin of profits desired.

Thorough cost accounting methods will determine the cost of making a complete salable product and delivering it to the carrier for transportation and will record the various elements that go to make up such cost in a comprehensive manner. They reveal individual products that may have been marketed on an unprofitable basis, as well as those most profitable. They prescribe what must be done to make a business profitable.

The system must present such cost data very promptly and concisely. Delayed costs are almost useless.

III. Description of the Cost System

A proper cost system for both manufacturing and selling should tie in with the general books so that the final statement will reflect all conditions of the business accurately.

Identification of Products

The first requirement is to establish a comprehensive system of code numbers to identify the individual manufactured products.

A very practical system is to assign a number to each line of products, such as "house paints," "flat wall paints," etc., and then a second number to identify individual members of the line. In each case, number 1 shall be assigned to the most important member as:

House Paint—Line number	1.
White	1–1
Cream	1–2
Gray	1–3
Flat Wall Paint—Line number	2.
White	2–1
Ivory	2–2
Peach	2–3

This system provides an elastic method of numbering without confusion for an unlimited variety of individual products.

Predetermination of Finished Stock Needed

Through a careful study of former sales and potential markets the manufacturer can predetermine the quantity of each individual product and size of package to be provided for expected dealer business. A series of stock limits can thus be set up and from such records the stockkeeper can order from the production department the required amount to provide for anticipated business, thus to the greatest extent possible, avoiding shortage or surplus. A weekly check of stock will indicate the quantity to be ordered from the factory for replacement.

Products for consumers are usually manufactured on special orders and shipped direct as produced. Little, if any attempt is made to maintain a stock of consumer products.

Scheduling Production and Cost Accumulation—the "Formula Slip"

When the factory receives the order, the department foreman will schedule the production and procure from the factory technical office a formula slip indicating the quantity and code number of raw material to be used (see Figure 1). He then procures the necessary raw material from the raw material stores department and proceeds to mix, grind, reduce, shade, and fill the product into packages. He keeps a careful record of all raw material used, the number of batches mixed, and the amount filled into packages and sent to the stock department. He also records the hours of labor employed and the number of hours the product has occupied the mill, reporting these details to the factory office for cost figuring.

The cost of raw material used is determined by calculating the total quantity consumed at the average monthly cost of the individual raw material code number. Manufacturing, labor, expense, and factory overhead are assessed against the individual run or the manufacturer may have determined a standard complete cost to manufacture all items within a certain group.

The total material and manufacturing cost is then divided by the total quantity of material filled into salable packages to determine the bulk cost per gallon. To this is then added the standard package addition, thus determining the complete cost of the individual manufactured product filled into packages.

A wide variety in the proportion of expense to material cost is due to the wide difference in material value and the process of manufacture. However, a general average of total product of the industry is approximately:

60–70%	Material
12–15%	Package
5–15%	Labor
2– 5%	Manufacturing expense
8–15%	Factory overhead

Overhead Distribution

The problem in cost accounting lies chiefly in exactly how to distribute the operating and overhead expenditure fairly to individual products. Some manufacturers determine only the average cost per gallon for all products and assess a uniform standard manufacturing cost to each individual product. This method is very unsafe because, among the many thousand of different products manufactured, there is a wide variety in the production cost and by the use of an

FORMULA MANUFACTURING SLIP

Date _____ 19____ Code No._____

Name _____

PIGMENT	Pounds	Code No.	Cost Per 100 Pounds	Total Value
VEHICLE				

Standard Yield _____

Standard Wt. per Gal. _____

Actual Wt. per Gal. _____

Labor _____ Hours @ Rate

Mill Hours _____

Mill No. _____ Rate _____

No. of Batches Made _____

Actual Output Filled _____

COST

Total Raw Mat. _____

Total Labor _____

Total Grinding _____

Overhead _____

Total Cost _____

Bulk Cost per 100 Gals. _____

Fig. 1.

average the manufacturer would figure the cost too low for the expensive operation and too high for the more simple one. Thus, he will very likely find himself receiving orders for the expensive product at a small profit margin, while other manufacturers will be favored with orders for products that cost less to manufacture, thus affording a larger profit.

Cost Figuring Chart

To properly account for the cost of each individual product or group of products, it is necessary to determine accurately the expenditure for material, package, labor, expense, and factory overhead on each. These elements are graphically illustrated in the following chart and outline showing the successive steps through which the production, selling cost, and selling price are built up. This outline covers a complete logical set of fundamental principles upon which the detailed accounting should be based.

How the Costs are Figured Systematically

The cost of paint, varnish, and lacquer products comprises the following elements: Material, package, labor, expense, and overhead.

To standardize the terms used to designate intermediate steps in cost figuring, the cost may be divided into the following: (1) Material cost, (2) bulk cost, (3) factory filled cost, and (4) full selling cost.

Material cost includes all raw materials used in manufacturing the product.

Bulk cost represents the product in bulk ready for filling into packages, and shall include: Raw material, labor, power, factory expense, and factory overhead.

Factory filled cost includes the above cost of the product in bulk, also the container, packing case (if any), and other expenditure needed to prepare the product for shipment to the customer.

Full selling cost includes all of the foregoing items and, in addition, the expenditure for selling and distributing the product to the trade.

Selling price should cover all preceding elements and include the desired margin of profit.

Chart of Cost Figuring Accounts

The raw material cost is the complete cost of raw material delivered to producing department ready for use. It embraces the following:

Purchase Price of Material

Market replacement cost at which material can be purchased should be used for estimating costs to serve as a basis for selling prices.

Price at which raw material has been acquired shall be used as the basis for determining actual cost of production.

Handling:

Freight or other charges for delivery to plant Purchasing—Salaries and Expense Receiving—Labor and Expense Storage Handling	To be added to raw material purchase price at a definite cost per 100 pounds or gallons

Shrinkage and handling loses to be added as a standard percentage for each individual item.

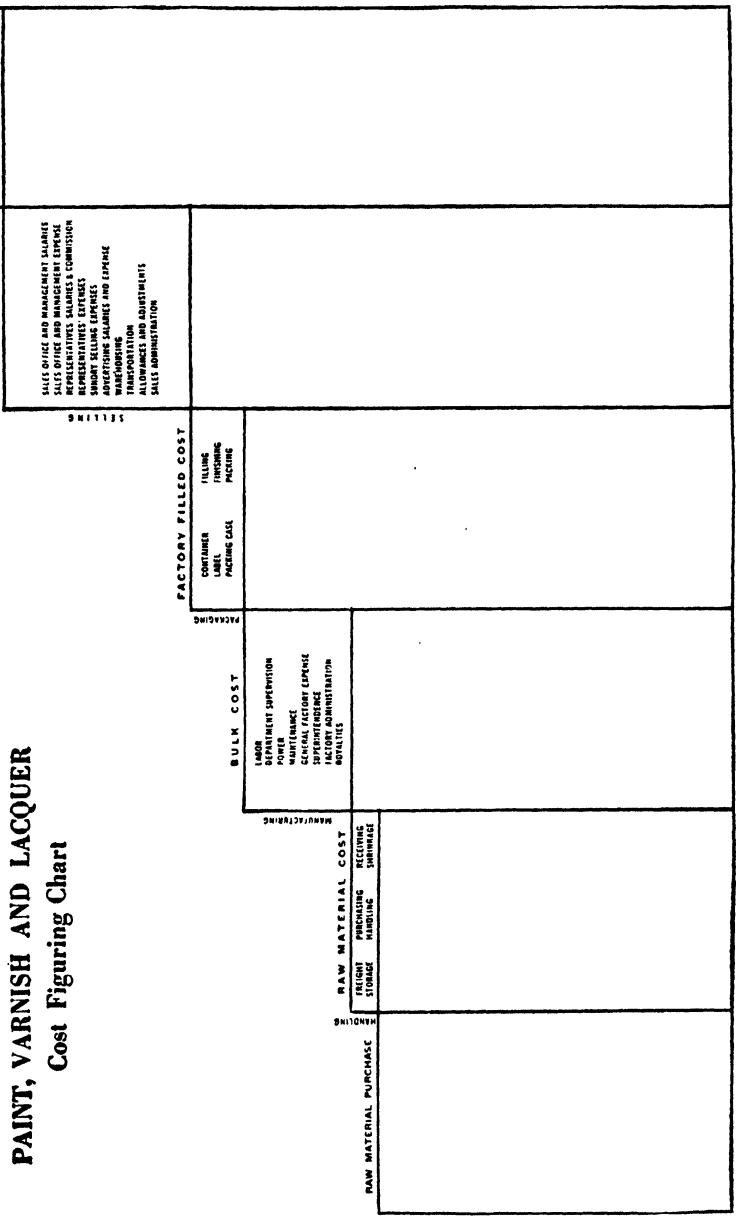
PAINT, VARNISH AND LACQUER
Cost Figuring Chart
SELLING PRICE
PROFIT
FULL SELLING COST
SELLING
SALES OFFICE AND MANAGEMENT SALARIES
SALES OFFICE AND MANAGEMENT EXPENSE
REPRESENTATIVES SALARIES & COMMISSION
REPRESENTATIVES' EXPENSES
SUNDRY SELLING EXPENSES
ADVERTISING SALARIES AND EXPENSE
TRADE DISCOUNTS
TRANSPORTATION
ALLOWANCES AND ADJUSTMENTS
SALES ADMINISTRATION
FACTORY FILLED COST
PACKAGING
CONTAINER
LABEL
PACKING CASE
FILLING
FINISHING
PACKING
BULK COST
MANUFACTURING
LABOR
DEPARTMENT SUPERVISION
POWER
MAINTENANCE
GENERAL FACTORY EXPENSE
SUPERINTENDENCE
FACTORY ADMINISTRATION
ROYALTIES
RAW MATERIAL COST
HANDLING
FREIGHT
STORAGE
PURCHASING
HANDLING
RECEIVING
SHRINKAGE
RAW MATERIAL PURCHASE

Fig. 2.

The manufacturing cost is the complete cost of processing resulting in product ready for sales. It embraces:

Direct Manufacturing Cost
All labor and expense employed in actual production of the product

Labor:

Productive: Mixing, Grinding, Thinning, Shading | of Paints and Lacquers
Cooking, Thinning, Filtering, Storage, Blending | of Varnishes
— Assessed to individual product to cover time employed

Nonproductive: Janitors, Mill dressers, Elevator Operator, Nonproductive workmen
— To be treated as department burden and added to productive labor on a percentage basis

Department Supervision
Salaries: Foremen
Department clerks
Light, heat, telephone, etc.
Sundry Dept. Expense

Power—for mixers, mills, etc.

Fuel —for operating varnish kettle fires
— Assessed against individual product at a standard cost per hour for time mill or kettle is occupied by individual product

Through careful accounting of labor and expense incurred in the manufacture of each individual product, standards can be set up to cover the proper direct manufacturing expense to be figured.

Factory Overhead:

General Factory Expense
Supplies and general expense not chargeable to individual departments

Superintendence
Salaries:
Superintendent
Laboratory and technical men employed in control
Factory office clerks
Watchmen

Expense:
Factory Office
Laboratory

— To be treated as general burden and added to direct manufacturing cost on a percentage basis or at a fixed rate per unit of product. To be based on normal capacity operation of plant

Factory Administration
- Maintenance of Buildings
- Factory Administration Expenses
- Laboratory Research for Development of New Products
- Taxes on Factory Land, Buildings, Equipment, Raw Materials, and Manufactured Products
- Insurance Expenses
- Insurance on Buildings, Equipment, Raw Materials, and Manufactured Products
- Employees Liability Insurance
- Social Security Tax
- Employees Welfare
- Depreciation on Buildings, Machinery and Equipment; To Be Figured on Basis Allowed by the U. S. Treasury, Income Tax Division
- Rent on Factory Buildings and Land Rented

Included in above bracket

A standard for each product or group of products can be determined by a thorough study of the overhead operating expense incurred on each and overhead may therefore be added as a cost per unit of production.

Royalties

Royalty paid for formula or process to be included in cost of individual item.

Bulk Cost comprises all preceding elements

Package and Packaging Cost—
- Containers, labels, packing cases, filling; closing and labeling; labor and expense; packing and stockkeeping labor and expense

To be added to bulk cost for each size package

Factory Filled Cost comprises all preceding elements to manufacture a product ready for sale.

Full Selling Cost embraces:

Factory Filled Cost
Selling, Distributing, and Administrative Expense
- Sales Office and Management Salaries and Expense
- Representatives' Salaries, Commission, and Expense
- Stationery, Office Supplies, Stamps, etc.
- Allowance and Adjustments
- Warehouse Salaries and Expense
- Branch Warehouse Rent, Taxes, and Insurance
- Advertising Salaries and Expense
- Transportation on Shipment to Warehouses
- Cartage
- Cash Discounts on Accounts Receivable
- Bad Debts Charged Off
- Sales Administration Expense
- Technical Service for Consumers

To be included in cost on basis of a per cent added to complete factory cost

Selling price is the price per gallon or pound of product offered to the trade at a list price, subject to discount to dealers and jobbers or at a net price to consumers. All prices are to be based on full selling cost. No profit is realized until all selling expense has been provided for.

Explanations of the Cost Figuring Accounts

The following paragraphs define in considerable detail the captions mentioned in the foregoing outline and illustrate the method of handling the cost figuring involved.

Raw Material Cost

The cost of raw material should be figured into the cost at the monthly average cost of raw material stock provided. The cost of available material on any given day is usually that purchased 30 to 60 days previous.

Raw Material Identification Code.—To facilitate handling of raw material, it is most practical to establish a code indicating individual raw materials, preferably by number. A simple code numbering system can be devised by assembling raw materials of similar character into groups, as, for example: White pigments, iron oxides, varnish gums, nonvolatile oils, volatile thinners, etc. Next, assign to each group a number and another series of numbers for individual members of the group, allowing sufficient blank numbers for additional raw materials within each group.

Group 1—White Pigments	*Group 2—Inert Pigments*
1– 1—White Lead Carbonate	2–1—Asbestine-Magnesium Silicate
1– 2—Basic Lead Sulphate	2–2—Barytes
1– 3—Leaded Zinc 35%	2–3—Whiting
1–10—Titanium Dioxide	2–4—China Clay
1–15—Barium Titanox	
1–16—Calcium Titanox	

Incoming packages of material should immediately be clearly marked with the code number, and storage room space should be reserved for each individual material number. This code should be used in all handling of raw material, stock records, requisitions for further supplies, etc. Cost records should be kept by code numbers. Formulas should be written up in code. It has been found that code numbers greatly facilitate and simplify, and also that they reduce the amount of clerical work in recording and accounting for the movement of raw materials. Their use aids in avoiding errors in handling materials.

Raw Material Purchase Record.—A most practical and simple way to record raw material purchase and cost is to provide a card for each raw material. This card should show name and code number, and other data to facilitate cost and stock control—defined in later paragraphs. On this should be entered all invoices for purchases, freight, etc. On the reverse side of the card disbursements, or supplies issued to consuming departments should be recorded (see Figure 3).

At the beginning of the fiscal year each card should record the amount, value, and cost per 100 pounds or gallons of the material in inventory. At the close of each month an accounting should be made of the movement of stock and the average cost per unit calculated for all material available for consumption during the succeeding

RAW MATERIAL COST RECORD CARD

Code No. _____ Date Jan. 1st 194___

Name _____ To Dec. 31st 194___

Order Number	Purchased From	Date		Quantity	Cost Per 100			Total Invoice	Total Freight
		Invoice	Rec'd		Price	Freight	Del'd Cost		

Fig. 3.

month. This cost, plus the handling and loss factors, should be set up as the cost of raw material to be used in figuring product costs during the month.

It is assumed that the average workable stock of raw material is probably about a thirty day supply, and the average cost of the stock at the close of a month may well be used as the cost of material consumed during the succeeding month.

Stock limits should be provided to control the amount of material in stock, and the quantity to be ordered at one time. New supplies should be ordered in minimum quantity procurable at the most favorable price. Orders are to be placed in time so that new supplies may arrive before existing stock is exhausted. It usually is found most practical for the raw material storekeeper to take an inventory of all raw material weekly, and place requisitions for necessary purchases to replenish the supply.

Special attention should be given to slow moving or dormant stock items, and every effort made to use them up promptly. A large amount of more or less useless material can accumulate in a short time unless this feature has intelligent attention and close supervision. Raw material stores should be under the care of a storekeeper who will deliver to the consuming departments on their requisition. Obviously, to reduce handling expense, supplies should be stored adjacent to but not in the consuming department. It has been found that control of raw material stock is not so dependable if handled by the same man who uses it.

Handling.—The freight or other delivery charges for incoming raw material should be added to the invoice price to determine the delivered cost per unit of material.

The cost to purchase, store, and handle raw material from the time it is ordered and received until it is put into the manufacturing process amounts to 1½% to 3% of the cost of material. This may be included at a definite rate per 100 pounds or gallons or, for simplicity, may be added to delivered purchase price as a percentage.

This applies not only to dry raw materials, but to liquids as well which may be received in drums or in tank cars and pumped immediately into storage tanks.

For manufacturers of medium size it has been found this expense averages 10¢ to 15¢ per 100 pounds for dry raw materials, ½¢ to ¾¢ per gallon for liquid raw materials in tank cars, 1¢ to 1½¢ per gallon for liquid raw materials purchased in drums.

Some manufacturers may not care to include this handling expense as a part of the cost of raw materials, preferring rather to merge it with mixing, grinding, etc., expense. However, it is generally more satisfactory for close supervision to treat raw material handling, labor, and expense as a separate caption in factory operating expenditure and include it in the cost of individual raw material. Shrinkage and handling losses, due to drying out, sifting, leakage, and evaporation, depend upon the character of the material and quantity handled. This loss averages:

Dry Pigment	½ to 2%
Resins, Nitro-Cellulose	2 to 4%
Non-volatile Oils and Plasticisers	1 to 2% Tank Cars
	2 to 3% Drums
Volatile Liquids	2 to 3% Tank Cars
	3 to 5% Drums

Formula Yield and Material Cost.—The bulk yield of a formula can best be determined by actual weight or measurement of raw material put into the process and by a count of filled packages or an actual measurement of bulk material produced.

To calculate the theoretical yield of a formula, the manufacturer is referred to data included in circulars issued by the Scientific Section of the National Paint, Varnish, and Lacquer Association, Inc., covering the bulking value, specific gravity, oil absorption, etc., of many ingredients commonly used.

These data will enable the formulator to estimate the number of gallons of paint, varnish, or lacquer resulting from the ingredients used. When making due allowance for manufacturing losses a very accurate determination of the yield of any given formula may be reached.

A considerable amount of raw material is lost in the process of manufacture. When putting material into the mix, some may be spilled or may adhere to the container. During the operation of mixing and grinding, evaporation occurs in volatile liquids. A certain amount of finished product adheres to the mixers, mills, etc., or is strained out as skins when the material is filled.

The amount of such loss can, of course, be determined definitely in regular factory production by actual measurement of volume or weight of raw material put into the process, compared with the quantity of finished product filled into containers.

Direct Manufactuing Cost

Productive labor employed in the actual production of manufactured products can be accounted for best by having all workmen report on daily time cards the hours of labor employed in mixing, grinding, thinning, or cooking, etc., of the individual product (see Figure 4).

Such labor should be assembled to accumulate the total applied to each product or group of products manufactured. The study of these figures, indicating the labor employed on each product, is a fruitful field for economy. Standards of labor cost should be set and the cost clerk can compare labor applied with such standards and bring excesses to the attention of the department foreman.

Non-productive or indirect labor employed in general work, not resulting directly in the production of manufactured products, should be assembled with other departmental general expenses and assessed against the individual product as a definite percentage of department burden, added to the productive labor.

Or, a standard may be set from figures so assembled for each product or group and such standard may then be used when figuring the cost of the individual product.

Power purchased from outside sources or generated in the local power plant, and maintenance of mills, mixers, and other machinery are directly chargeable to the product or group on the basis of the time the machinery is occupied. A standard cost per hour for each mill, mixer, or other equipment may be set by accounting which will accumulate the cost of power used and expense to repair and keep machinery in order. This sum to be divided by the number of hours the line of mills is operated.

These data will provide figures indicating the comparative cost of operating

mills of each type. Further record of the output of the mills will reveal the most economical mill for each kind of product ground.

Fuel for varnish fires can be best included in the manufacturing expense of a product on the basis of the time occupied. Cost per kettle hour is determined by accounting covering the fuel used divided by the number of hours the fires are operated.

IN OUT

PAINT FACTORY

Check No._____ Date_____ 19____

Department_____

	Formula Code No.	Hours
Mixing		
Grinding		
Thinning and Shading		
Filling		
Handling Raw Materials		
Non-Productive		

Total Hours - Regular Time_____

- Overtime_____

Name_____

Approved_____

Foreman

Fig. 4.

Such mill operating expense or varnish fire cost should be assessed against the individual product by recording the number of hours the product has occupied the mill or varnish kettle. Also, in this case standards of performance should be set for each product and deviation from such standards investigated.

A careful study of labor and mill time is of infinite help to the factory superintendent in economical operation of the plant. The improvement in manufacturing expense brought about by such methods thoroughly justifies the small cost of keeping the records.

The total labor and expense assessed against the individual product by the foregoing method may be considered as the direct manufacturing cost. Obviously, the

expenditure is the direct responsibility of the plant superintendent and foremen, and simple operating expense reports, indicating payroll and expense items compared with production, should be compiled for their assistance and for the information of the management.

Or, the manufacturer may prefer to set a standard labor and expense cost per 100 gallons for each product or group of products and include this direct operating expenditure into the cost of the finished product on a basis of standards. Such standards used can be currently compared with the expenditure by the usual method of recording total expenditure and total production and comparing same with the total cost calculated by the standard method.

Factory Overhead

The overhead in a factory comprises a large group of fixed charges and other expenses which cannot be assessed directly against any one product. Also, these expenditures continue all of the time and cannot be adjusted entirely in keeping with the volume of production. These are enumerated fully in the foregoing outline.

Taxes included should be only those on property, raw material, and merchandise value; and the Social Security tax. Income tax, Capital stock tax, excess profits, etc., should not be considered as factory overhead.

Depreciation charged into the cost of production should be that allowed by the U. S. Treasury Income Tax Division.

General average annual charge has been found to be approximately:

Building	2– 5% of original value
Machinery	3–10%
Furniture and Fixtures	10–20%

Distribution of Overhead

The most satisfactory way to absorb such overhead fixed charges, superintendence, general factory expense, etc., into the cost of manufactured products is to spread them on the basis of normal capacity operation of the plant, giving due consideration to recent and anticipated volume of business. It is conservative to use approximately 80% of rated full capacity production as the volume of product to take up all expenditure.

This is generally accepted as the best modern accounting practice. Any expenditure not absorbed on this basis is to be considered as a direct charge to profit and loss as the cost of idle plant, or unabsorbed overhead.

Thus, considering overhead expense at a normal rate keeps the cost of products more in line with the possible competitor whose plant may be fully occupied. Obviously, excessive overhead assessed against a product at times when production is low may have the effect of causing prices to be advanced, probably resulting in further serious loss of business.

Having determined the relation of factory overhead to direct manufacturing cost or labor and expense for plant operating at normal capacity, the overhead should be expressed as a per cent of general burden and added to the total labor and expense assessed to the individual product.

Or, the manufacturer may prefer to determine the overhead cost per pound or gallon of output by dividing total of overhead expenditure by the normal plant

output. Then, in figuring the cost of the product the overhead expense is added as a cost per unit of production.

Bulk Cost

The foregoing embrace all expenditures for raw materials used and the complete handling and manufacturing expense, labor, and factory overhead necessary to make the product in bulk ready for filling into containers. Regardless of the size of package into which the product may be filled for sale it is obvious that the cost of bulk material is the same for all size packages.

Package and Packaging Costs

These costs represent a large and variable feature of the cost of finished product. A schedule of standard costs for packages of all sizes should be prepared covering cost of container, label, case, etc., and the filling, handling, labeling, packing, etc., labor and expense. All these are required to fill, finish, and warehouse the product and prepare it for shipment to the customer.

To determine the cost to handle packages, the manufacturer should assemble all labor and expense incurred in filling, closing, labeling, and packing, also the total number of packages of each size filled.

Following is a schedule of units based on the relative cost to handle the different sized packages:

	Unit Factor
1/8 pint	1
1/4 pint	1
1/2 pint	1 1/4
1 pint	1 1/2
1/4 gallon	2 1/2
1/2 gallon	4
1 gallon	6
5 gallon	12
Drum	1 per gal.

Next, multiply the total packages of each size by the proper unit factor to determine the total number of units equal to 1/8th pints handled in the plant. The total of units divided into total expenditure determines the cost per unit, and through use of the factors, the cost of handling packages of each size can be obtained.

Complete Package Cost.—The following example illustrates the complete cost of a one gallon and a five gallon package:

One Gallon Package		*Five Gallon Package*	
1 Gallon Pail (per 100)	$10.00	5 Gallon Pail (each)	$0.50
1 Gallon Label	1.00	Per Gallon	0.10
25 Cartons (4 pails each) @ 0.15 each	3.75		
Packaging Cost (per 100)	8.00	Packaging Cost	0.03
Cost per 100 Gallons	$22.75	Cost per Gallon	$0.13

Factory Filled Cost

Factory filled cost embraces the complete cost of material in bulk with further addition to cover package, etc.; thus it includes all factory expenditure for the product ready for shipment to the trade.

Full Selling Cost

The expenditure incurred in marketing the product must be covered by the selling price before any profit results. These items of selling and distributing expense, enumerated in the outline, can be included in the cost most simply by a schedule of percentages providing for different classes of business. Large volume sales or contracts obviously cost less to sell than do small orders.

Special consideration should be given to the expenditure entailed in developing products for the needs of industrial concerns and for the service rendered later in maintaining satisfactory use of the product.

A careful study indicates that in many companies the selling and distributing expense average about as follows when compared to the complete factory filled cost of the product:

	Per Cent of Factory Cost
Bids for Large Volume Business	5 to 10
Contracts for Large Volume	15 to 20
General Industrial Business	25 to 30
Dealer Trade	30 to 50

It is recommended that every manufacturer make a careful survey of his own conditions and establish a scale of percentages to cover the expenditure to sell and distribute the product in relation to the complete cost of production. This percentage should then be added to factory filled cost to determine the full selling cost, and it should be definitely understood that no profit is realized unless the product is sold for a price above this figure.

Selling Price

The selling price of any product should give fullest consideration to:

Complete cost to manufacture
Selling and Distributing the individual product
Volume of business in prospect
Anticipated profit
Value of product to the consumer
Competitive prices on comparable product
Credit risk of the account
Technical service required by consumer

Profit

Profit should be considered as a per cent on selling price rather than as a per cent in relation to cost. The amount of the sale is the more tangible, and is, therefore, the logical basis against which selling expense and profit is to be considered. Such comparison also expresses the profit more conservatively.

Some consider profit as a per cent of invested capital. This is quite a proper basis to determine the final outcome of a business but such profit results only from proper relation between cost and price of individual products.

Summary

Reviewing the subject from the standpoint of per cent of the sales dollar, general observation indicates that business of the industry may be broken down about as follows:

Profit	5–10
Selling Expense	20–35
Mfg. Expense	5–25
Packages	5–15
Material Cost	40–60

COST ACCOUNTING IN PHARMACEUTICAL MANUFACTURING

By

MADISON CARTMELL *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Pharmaceuticals, to the layman, are medicines or drugs. The industry classifies each item as an "ethical" or a "proprietary" according to the method of sales promotion. Ethicals are promoted to doctors and pharmacists who establish the consumer market by prescribing the products to the public. Doctors' prescriptions are required for the purchase of many ethicals. Proprietaries are advertised directly to the public for self-administration. Relative to most industries, marketing cost is high and manufacturing cost is low for both classes of products.

In general, manufacturers produce either proprietaries or ethicals. Some large proprietary companies have acquired ethical companies which usually have been continued as separate entities. Most proprietary lines include only a few products —perhaps only one or two. All marketing emphasis is upon those trade names. Most ethical lines include many products, sometimes hundreds and even thousands. Then marketing emphasis is primarily upon the "house" and secondarily upon large volume "specialties." Company profits depend mainly upon large volume sales of a "few" products. Hence suitable ethical "specialties" have become "proprietaries" for a broader exploitation.

Origin of the Products

Some products are "happenchance" originations of an independent physician, druggist, chemist, or other professional. Some are developed in hospitals and medical colleges. Many new products, including most new ethicals, originate in manufacturers' research which also seeks to improve old remedies and to duplicate or improve upon competitors' new products, particularly if the market potentials are large. Hence identical or similar products are often promoted, sometimes actively, by two or more companies under numerous names and at various prices.

Research and development expense is an important item in the budget of all progressive ethical companies. Many proprietary companies engage in limited research. Most companies will purchase likely new products or formulas. The prices paid may include a royalty and usually discount future growth, and hence costs may be equivalent to a development program, particularly since the tangible assets purchased are usually relatively unimportant.

Any new or modified product undergoes extensive tests to demonstrate its

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efficacy and safety. All products' formulas, labeling, and advertising are subject to the strict regulations of the Federal and state governments.

Sources of Raw Materials

Materials or ingredients originate in botanical, chemical, animal, or mineral sources. Most are produced by comparatively simple processes, some are by-products, and others, such as the sulphas and penicillin, require elaborate processes. Although some ingredients require little further processing, perhaps no more than forming into tablets and packaging, to be ready for marketing to the public, most are purchasable in bulk from the producers.

Most pharmaceutical manufacturers merely compound their end products from materials or ingredients purchased from mass producers. However, some manufacturers may produce one or more ingredients, particularly if large quantities are used, and if some may be sold to others.

Organization of Laboratory or Plant

This description of cost accounting for manufacturing pharmaceuticals pertains particularly to the plant which purchases all ingredients and other materials ready for mixing. Regardless of the methods of marketing or the form of the product (liquid, dry, or greasy), almost all products are prepared by similar processes and equipment. Hence the costing methods are valid regardless of whether applied to proprietaries or ethicals, or both.

A tabulation of the processes in a typical plant and their grouping into departments follows:

Service Departments:

Plant Management Department Production Control Department Purchasing Department Personnel Department	These have the usual duties and functions of industrial plants and present no problems peculiar to this industry.
Maintenance Department Control Laboratory Research and Development Laboratory	These are often combined to suit individual needs.

Productive Departments	*Processes*	*Equipment and Facilities*
Mixing	Mixing or compounding of ingredients.	Using scales and other measuring devices, mixers of appropriate types, sifters and filters to insure purity and uniformity of products, and other equipment, such as for tablet making and coating.
Filling	Filling of containers, labeling, packaging, and packing.	Using, whenever practical, automatic equipment requiring a crew of operators. For example, one type fills containers, caps and labels the containers, and inserts them, together with a directional folder, into boxes. Another type of equipment fills and packages collapsible tubes. The products are

		then packed into cartons holding standard quantities ready for warehousing or shipping. When quantities are too small for use of automatic equipment, filling and related operations are performed by hand.
Warehouse	Warehousing and shipping.	Using the customary handling and other equipment.

Storerooms for raw materials and work-in-process are adjuncts and parts of the succeeding operations and, whenever practical, materials are transported in pipe lines (by pumping or gravity) or by conveyors.

Some further segregation of processes and facilities based upon specialization may be made in a large plant, particularly one manufacturing a varied line. The manufacturer with large volume proprietaries or specialties is likely to organize the mixing and filling facilities into one unit for all low-volume products. He may then have one or more specialized and possibly almost identical departments, each completely equipped to produce one large volume proprietary or specialty. The advantages of this arrangement offset the disadvantages of some equipment remaining idle at times for considerable periods, when workers must be shifted to another department. Such occurrences are minimized through long-term planning and leveling of the production programs.

Production Order System

Production orders for products should originate in the finished product stock records of the production control department. There the sales estimate, shipping order, production order, inventory, and related data are recorded for convenient coordination. Proprietaries and specialties may be ordered once each month. Miscellaneous ethicals are ordered as frequently as justified provided quantities are adequate to secure optimum cost considering all factors such as productive capacity, storage expenses, and possibilities of obsolescence and damage. Each order is numbered, and a separate series of numbers for each product line facilitates the accounting.

II. How to Design the Cost System

What Information Is Required

The cost system must be designed in this industry to yield the maximum of managerial control data with a minimum cost. It is usually essential to determine:

1. The cost and efficiency of each operation.
2. The effectiveness in utilizing materials, manpower, and plant facilities.
3. The cost of each product, and the income-cost relationship of each important product and class.
4. The data for preparation of analytical operating reports and finally the profit-and-loss statement and balance sheet.

Data presented to top management must be in an intelligible summarized form for determining broad plans and policies. It should insure that operating factors are applied effectively. It may also receive the more detailed data prepared for

supervisory executives to indicate whether day-to-day operations function effectively and regularly.

Considerations in Designing the System

In some industries the cost system is designed primarily to formulate price policies for individual products. In the pharmaceutical industry, prices, once established, are changed infrequently. Maintenance of the optimum spread between sales price and cost requires continuous low-cost production. Hence the cost data must be timely and focus attention upon irregularities and inefficiencies so that they may be corrected, and upon favorable happenings so that they may be exploited and perpetuated.

The "Standard" Cost System is Favored

While historical or "actual" cost systems can be used, the trend in the industry is toward the "standard" type. It is favored because it easily produces control data described above and other data for determining the relative profit contributions of important products and classes of products.

The standard type is also especially favored for the pharmaceutical industry because it points up variations or "variances" from norms, or predetermined standards upon which the operation of an enterprise should be planned and budgeted. Even though manufacturing costs may be a minor percentage of the sales price, variances between standard and actual manufacturing costs should be watched very carefully because:

1. Small variances per unit amount to considerable sums on large-scale production. sometimes millions of units. Such small variances appear insignificant in unit costs developed by actual cost plans, but as large amounts when accumulated by standard costing.
2. Large variances per unit on small orders, such as miscellaneous ethicals, can offset all expected profits. Unless segregated and accumulated in totals and by causes, such variances may appear as unavoidable and inherent in the nature of the product or processes.
3. The effectiveness of similar productive units can be compared.
4. Rigid control of detail costs is an integral step in maintaining tight product control. Formulas and quality can be easily contaminated through carelessness, such as in not mixing ingredients thoroughly and in not properly maintaining the measuring devices on automatic equipment.

III. Description of the Cost System

The most important steps in establishing a standard cost system in this industry are as follows:

1. Design the profit-and-loss control report for top management (Figure 1).
2. Design the standard cost of products sheet (Figure 2).
3. Design the reports for supervisory operating executives. Examples are:
   Individual Worker's Time, Production and Efficiency Card (Figure 3).
   Daily Labor Waste Report (Figure 4).
   Monthly Overhead Analysis Report (Figure 5).
4. Establish cost standards for materials, labor, and overhead.
5. Establish the procedures for carrying out the cost system and producing the desired data.
6. Set up the required Chart of Accounts.

Profit-and-Loss Statement Format

The profit-and-loss statement is the most important managerial control report and all cost methods are pointed toward producing the appropriate data. Comparison of Figure 1 with similar forms shows three significant differences—each of these is an important key to control. The form secures:

Separate and complete profit-and-loss analyses for each class of product and for principal products or types within classes.
Comparison of budgeted and actual figures of major significance.
Variances between actual and standard (the expected) costs of manufacture.

These control data enable management to know—

Where and why the profits or losses occur.
Whether policies and plans as represented by budget figures are proving successful.
What activities are more or less effective than expected.

The statement often prevents uncertainties and unpleasant surprises as to what is happening. For example, the manufacturer of diversified products may easily but unconsciously alter the emphasis of marketing promotion for classes or products; profits may decline unknowingly for such reasons as important changes in costs of materials; or sales may be affected by new competitors or by new remedies threatening to supersede the old.

Variances Used

The following general accounting variances are appropriate for most manufacturers in this industry:

Name of Variance	*For Accumulating the Difference Between*
Materials—Price	Standard and actual costs of raw materials.
Materials—Usage	Standard and actual quantities of materials used. Scrap, cost of reworking products, and variations between standard and actual yields are also included.
Labor—Rate	Standard and actual rates of pay for productive work, plus overtime premiums, night shift bonuses, vacation allowances, holiday pay, and all other payments in excess of standard rates.
Labor—Efficiency	Standard and actual direct labor costs due to inefficiencies of management and workers, and not originating in rates of pay.
Overhead—Spending	Budgeted and actual expenses for whatever capacity is operated.
Overhead—Capacity	Budgeted expense for whatever capacity is operated and the overhead earned on production completed.
Inventory Adjustments	Ledger and audited values of inventories.

If overhead expenses in general records are normally accumulated by departments (both service and productive), probably no changes will be necessary in those accumulation accounts. Otherwise an account for each department is generally established.

Variance accounts are often established, at least one for each type of variance and preferably as a matter of convenience an account for each product or class of products as shown by asterisks on Figure 1. Other asterisks on Figure 1 suggest

JOHN DOE PHARMACEUTICAL CO.

Consolidated Profit-and-Loss Statement for the Month of March, 1946.

	GRAND TOTAL	PROPRIETARIES				ETHICALS			
		TOTAL	A	B	C	TOTAL	SPECIALTY M	SPECIALTY N	MISC.
Gross Sales			*	*	*		*	*	*
Less:									
Returns			*	*	*		*	*	*
Allowances			*	*	*		*	*	*
Cash Discounts			*	*	*		*	*	*
Outward Freight			*	*	*		*	*	*
Total Sales Deductions									
Net Sales - Actual									
Net Sales - Budget									
Less:									
Cost of Sales at Standard			*	*	*		*	*	*
Gross Profit at Standard									
Less: Variances from Standard									
Materials - Price			*	*	*		*	*	*
Materials - Usage			*	*	*		*	*	*
Labor - Rate			*	*	*		*	*	*
Labor - Efficiency			*	*	*		*	*	*
Overhead - Spending			*	*	*		*	*	*
Overhead - Capacity			*	*	*		*	*	*
Inventory Adjustments			*	*	*		*	*	*
Total Variances									
Gross Profit - Actual									
Gross Profit - Budget									
Less:									
Development and Research			*	*	*		*	*	*
Selling			*	*	*		*	*	*
Administrative			*	*	*		*	*	*
Total Selling and Administrative									
Net Profit - Actual									
Net Profit - Budget									

Fig. 1. Profit-and-Loss Statement.

The asterisks indicate the ledger accounts maintained to accumulate the desired analytical data.

separate sales, sales deduction, development and research, selling and administrative accounts for each product or class of products. While not absolutely necessary, separate accounts are highly desirable for convenience and as a means of preventing errors in allocations.

How Variances Are Allocated

Variances are usually cleared to the appropriate variance accounts immediately upon being determined and after being apportioned to products. They are apportioned to products in accordance with the proportions for which each is responsible. The principles of apportionment are similar for all variances, and the techniques are simple for most, while others require considerable care. When a particular product is definitely "responsible" the charge is made to it. But when it is "happenchance" that one particular product is involved when the variance occurs, or when it is not solely responsible, the variance is often apportioned to all products that could have been involved.

The principle is illustrated as follows: Aspirin may be used in one product, alcohol in several. A materials price variance on aspirin purchases can be charged only to one product, but a price variance on alcohol must be apportioned among all products in which alcohol is used and on the basis of the quantities budgeted to be used for each. The apportionment is on the *expectation* of use during the year rather than usage during the period of purchase.

The principle is further illustrated with an example of labor efficiency variance. A filling machine, which processes two or more products or lines, breaks down while processing Specialty B. During the time required for repairs the workers are paid although idle. On the principle that the machine has been worn while processing several products and might have broken down while any product was in process, Specialty B is penalized only for its percentage of all production to be processed on that machine.

To insure that variances are apportioned fairly, the accumulations against any product or line are subject to review. This review can be made easily from the day to day variance analyses by causes. When advisable, reapportionment is made although this step should be infrequent because care exercised in the original transactions prevents any error of consequence.

Costing of Individual Products

A form to assemble costs of individual products is given in Figure 2. Reference will show the various details of compilation. The costs for old products are based upon standards for each increment of cost, and for proposed new products upon estimates of what those standards will be. The development of cost standards for materials, labor, and overhead is described later.

Revision of Standard Costs

Revisions may be made at any time to conform with changes in standard formulas, wage rates, manufacturing methods, prices for materials, etc. Although each should be reviewed once each year to avoid overlooking changes needed, revisions should be relatively infrequent. They should only follow "permanent" changes in cost increments.

Date

Product

Standard Cost for

Packed in Cartons Containing

Expected Yield per Mix or Batch

Lbs Tablets Cartons

Description	INGREDIENTS Std. per Batch Quantity	Unit	Standard Cost Per Unit	Total
PACKING MATERIALS				
Container				
Label				
Insert				
Package				
Carton				

SUMMARY OF STANDARD COSTS Element	Cost per Carton
Ingredients	
Packaging Materials	
Total Materials	
Labor - Mixing	
- Filling & Packing	
- Warehousing	
- Total	
Overhead - Mixing	
- Filling	
- Warehousing	
- Total	
Total Standard	
Allowance, if any, for Materials Usage Variance	
Grand Total	

	OPERATIONS	LABOR Machine No.	Batches per Hour	Time per Batch	Rate per Hour	Standard Labor	OVERHEAD Standard Rate	Per Unit	Standard Overhead	Total L+O Cost
MIXING DEPT.	Mixing - 1st Stage							Hr		
	- 2nd Stage							Hr		
								Hr		
	Sifting							Hr		
								Hr		
	Tablet Making							Hr		
	Tablet Coating							Hr		
			Cartons per Hour	Time per 100						
	Filling and Packing							Hr		
	Warehousing and Shipping							Carton		

Fig. 2. Standard Cost of Products Sheet.

Analyses for Supervisory Executives

Appropriate daily, weekly, or monthly reports on the effectiveness of productive operations are usually prepared by the cost and other departments. Top management may receive them—especially if operations are ineffective. These should detail the accomplishments and variances by cause and circumstances. Executives may then be informed of conditions and may supervise with confidence in their understanding of day-to-day results. An analysis by product is of secondary interest provided that variances may be finally recorded in the proper accounts.

Typical reports might be: Figure 4, Daily Labor Waste Report; and Figure 5, Monthly Overhead Analysis Report. Others are used to promptly advise management of exceptional happenings.

How the Standards are Created

All standards are usually based upon and anticipate efficient manufacturing activities. Standards might be developed as follows:

Materials—Quantities.—The research laboratory should establish a standard formula for each product. This formula should state the quantities and grades of ingredients and packaging materials to produce and package each product. It should also give the operations to be used and the standard yields after each operation.

Materials—Prices.—The purchasing department should estimate the unit price at which each material should be purchasable under normal conditions and in conformity with basic policies, and upon terms providing for delivery f.o.b. plant and cash discount. These estimates, or revisions, when approved, become the standards.

Labor—Rates.—Every operation should be classified as to the type of labor required, and a standard wage rate established for performing each operation.

Labor—Efficiency.—Every operation should be time studied and a standard hourly production rate should be established which would be expected to be attained by every efficient worker assigned to that operation.

Overhead Rates.—A budget of overhead expense should be established for operating each department at normal capacity. The latter may be based upon the objective of operating one shift in each productive department for 2000 hours per year, equivalent to forty hours per week for fifty weeks after allowing for vacations and holidays. An allowance of 5% for interruptions may be made. The normal capacity for each productive department is set at 1900 hours. Service departments should be balanced with productive departments, and normal capacities established on the same bases.

Standard overhead rates per hour for the mixing and filling departments are determined by dividing the budgeted overhead for normal operations by 1900 hours times the number of machines in each center. These rates are used in calculating overhead increments in the standard product costs and in calculating debits to in-process.

The standard overhead rate for the warehouse department should be on a somewhat different base. If packed cartons are stored for approximately the same average period, the warehouse overhead rate may be determined by dividing the budgeted overhead expense for normal operations by the normal production in terms of cartons of finished products. This rate may be used for determining costs of

products. But for determining monthly variances, separate rates may be set for receiving a packed carton into stores, for storing a carton, and for shipping a carton. When approximately the same, an equitable rate for each activity would be one third the over-all carton rate.

How the Data for the Cost Summary Are Obtained

Computing the Sales Deductions

The treatment of "cash discounts" and "outward freight" on Figure 1 is not conventional. Cash discounts are often considered to be modifications of sales prices by the industry when offered to all customers.

The suggested treatment of the important freight cost is intended to secure for management the burden resulting from plant location policies when products are sold at a uniform price f.o.b. delivery point.

Finding the Cost of Sales

The "cost of sales at standard" amount may be conveniently determined by multiplying the number of units shipped, less resalable returns, by the standard cost per unit. The units shipped can be tabulated from the finished product stock records to which all shipments to customers and resalable returns could be posted from operating reports. The standard unit cost of each product is usually recorded in the stock record heading. Complimentary shipments of products for sampling, etc., are chargeable to selling expense.

Calculating the Materials-Price Variance

This step may be performed as follows: Vendors' invoices when approved by the purchasing department are passed to the vouchers payable department where cash discounts are deducted; receiving reports, after routine tests of the materials to insure their quality, are posted to the stock records, and the standard costs for the materials and their usage for particular products, as recorded in the stock record headings, are entered on the receiving reports; the reports then are forwarded to the vouchers payable department for extending the standard values of the materials and for matching with the vendors' invoices. The resulting entries in the vouchers payable register are illustrated below:

If the actual cost (after discount) is $1000 and the standard cost is $900—

Dr.	Raw Materials Inventory	$ 900	
	Proprietary A—Materials Price Variance	60	
	Specialty M—Materials Price Variance	40	
Cr.	Vouchers Payable		$1000

If the actual cost is $900 and the standard cost $1000—

Dr.	Raw Materials Inventory	$1000	
Cr.	Vouchers Payable		$ 900
	Proprietary A—Materials Price Variance		60
	Specialty M—Materials Price Variance		40

These above entries disregard any clearing accounts which may be used for accumulating income tax figures.

All transportation invoices are generally charged direct to the variance accounts because the standard costs include this item, and this treatment saves clerical work.

Calculating the Materials—Usage Variance

The product formulas are known to the production control department. It ordinarily prepares stores requisitions for the ingredients needed on each production order—one requisition for each batch or mix. After posting to the stores record, requisitions are then dispatched to the storekeeper, in accordance with the day-to-day production schedule. He delivers the materials in batch lots to the mixing or compounding machine. Materials that cannot be most conveniently handled in containers are delivered by other means, such as by a pipe line with its meter and control valve located in the storeroom. Batch lot deliveries are convenient and prevent errors in following formulas.

Packaging materials would not be requisitioned in advance but tallied as delivered to processing. Bulky items like bottles and cartons are delivered as needed, and labels and inserts in quantities approximating a day's production, or as needed for small orders. The tallies, like requisitions, are posted to the stock records.

Compounding variances may be calculated as follows: Each batch or mix is measured for comparison with the standard yield; if more than a trifling difference is found, the control laboratory (which functions as an inspection department) and the processing supervisors will determine whether the formula has been followed; each mix also may be tested for purity and standard quality.

Filling operation variances might be calculated similarly: Since each batch quantity delivered to the filling machines is known, the standard quantity of finished products (packages) is easily determined. This quantity is compared with the actual output to determine differences and serves as another step in maintaining quality. If many more packages than expected are obtained, the containers probably contain less than stated on the label, and hence are not salable. On the other hand, fewer packages than expected may be obtained. Such variances usually are caused by failure of the automatic measuring device on the filling machine.

All variances—mixing and filling—can be picked up on the departmental production tallies by the control laboratory which may order scrapping or rectification with a charge to usage variance. Each important variance, its cause and the action taken, should be reported by memoranda from the laboratory to operating executives and to the cost department. If a loss is significant costwise, the cost department would promptly issue a supplementary report so that no phase of the mistake is overlooked, and accumulate the charges for end of the month journalization. Minor differences not requiring drastic action would be evaluated on the production tallies.

There are also wastes in packaging materials. Some bottles break in handling, and when automatic equipment goes "haywire," some labels and inserts will be damaged and even filled bottles may be broken and then scrapped without salvaging the contents, which might be contaminated with chips of glass. Such scrap may be accumulated, measured, or weighed, and reported to the cost department for evaluating and reporting to supervisory executives who watch losses for indications of carelessness that many contaminate the care taken to maintain the quality of products. These wastages are charged to usage variance.

The product cost sheet (Figure 2) provides for an allowance for materials-

usage variance in recognition that some loss will occur, particularly of packaging materials. Under such considerations a reasonable allowance may be included in the product cost.

Because of the short time interval between issuances of materials and packaging of almost all products, no accounting transfer of materials from stores to in-process and from in-process to finished products need be made—all may be considered as remaining in stores until the products are finished when the transfer would be from raw materials direct to finished product inventory. Exceptions to the short processing time, such as storing and seasoning a mix for a few days, may be disregarded to maintain the simplified accounting practice.

Calculating the Labor Variances

Both the efficiency and rate variances can be compiled on the Workers' Time and Production Cards (Figure 3). The efficiency variances originate in failures to produce standard quantities of products per hour resulting from machine breakdowns, material failures, and other idle periods during which workers are paid, and from the inefficiencies of slow, inexperienced, and indifferent workers. When the calculations are completed, the variances can be summarized on the daily labor

Machine or Production Unit_____ No._____

Worker_____ No._____

Starting Time | Finish Time | Elapsed Time | Hrs.

Order Number	Product	Quantity Produced	Standard Hourly Production	Standard Hours Credited

Variances			Worker's Hours	Total Standard Hours
Rate				
Efficiency			Worker's	Standard Labor
Cause			Rate	Rate
			Worker's	Standard Labor
Total			Earnings	Earned

Fig. 3. Individual Worker's Time, Production, and Efficiency Card.

Labor Waste In Dept. - Month of 19

	PAYROLL				MANAGEMENT RESPONSIBILITIES								LABOR RESPONSIBILITIES					
Day	Total	Direct	In-direct	% In-direct to Direct	Total	Rates	% of Standard Direct	Machine Break-down	Waiting Materials	Waiting Orders		Misc.	Total	% of Standard Direct	Slow Worker	New Worker		Misc.
1																		
2																		
3																		
4																		
30																		
31																		
Mo.																		

Fig. 4. Daily Labor Waste Report.

waste reports (Figure 4) for the information of supervising executives. The workers' cards supply the supporting details.

The waste reports are convenient tabulations of the standard labor "earned" and the labor variances preparatory to journalizing the debits to the in-process and variance accounts.

Calculating the Overhead Variances

Each productive and service department is a separate center for accumulating overhead. The expense for each service center is distributed to productive centers on appropriate bases as described in Part 1.

These variance amounts may be determined on the overhead analyses (Figure 5) which should be prepared for each productive department. The spending variance is regarded as a manufacturing responsibility, and the capacity variance as a sales or marketing responsibility. These data are used for preparing the month end journal entry debiting the in-process inventory account for overhead earned; debiting (or crediting) the appropriate variance accounts, and crediting the appropriate overhead accumulation accounts. In apportioning the variances among the product lines, the budgeted or expected production of each is used.

OVERHEAD ANALYSIS FOR MONTH OF MARCH, 1946.
WAREHOUSING AND SHIPPING DEPT.
Operating Rate for Month: 84%

ITEM	OVERHEAD EXPENSES		
	ACTUAL	BUDGET	SPENDING VARIANCE
Supervision . .	$ 848 94	$ 796 50	$ 52 44
Maintenance . .	262 46	272 85	10 39
Taxes & Insurance	76 65	75 82	1 82
Depreciation . .	128 32	128 32	----
Distributed Chgs	1,641 38	1,587 29	54 09
Total	$6,035 07	$5,824 66	$210 41

1. Cartons Received During Month	439,816
2. " Shipped " "	542,924
3. " in Storage end of "	768,380
4.= 1+2+3 Carton Units for Month	1,751,120
5. Standard Overhead per Unit	$0.003
6.=4X5 Overhead Earned	$5,253.36
OVERHEAD-CAPACITY VARIANCE	$ 571.30

Fig. 5. Monthly overhead analysis report with details of calculations of variances.

Inventory Adjustments Variance

Much of this variance results from ineffective work by factory personnel, such as in forecasting purchasing requirements or in caring for products. To it are cleared all adjustments to inventory accounts, regardless of cause.

A COST SYSTEM FOR THE PHOSPHATE ROCK MINING INDUSTRY

By
IRVING D. DAWES *

I. DESCRIPTION OF THE INDUSTRY

Phosphate rock is one of the most important and most necessary of all materials and has many basic uses. The largest by far is in the production of fertilizers to provide the phosphorus, one of the three principal ingredients of commercial fertilizers. The others are nitrogen and potash. While a certain amount of phosphate rock is applied as such directly to the soil for fertilizer purposes, the phosphorus contained therein becomes available to the plant much too slowly for ordinary purposes. Usually, therefore, ground phosphate rock is treated with sulphuric acid to make what is known as superphosphate which is the base for most mixed fertilizers. Phosphate rock is used also for the production of elemental phosphorus by treatment at great heat in electric furnaces. The phosphorus thus produced is used for many chemical and food products, such as phosphoric acid, phosphates for baking purposes, and for the manufacture of cleaning compounds, water softeners, and many other products.

Phosphate rock is the result of marine deposits in the geological past. In the United States the chief deposits are in the states of Florida, Tennessee, Idaho, Utah, and Montana. At present the greatest production is from the Florida deposits which furnish approximately 70% of the total output. Tennessee produces slightly over 25%. The remainder comes from Idaho and Montana where the deposits are very large but are too remote from the points of use to permit successful competition with the Florida and Tennessee sources as far as the principal farming areas are concerned.

The deposits occur in strata of varying thicknesses and are covered by overburden, the thickness of which varies with the topography of the region where located. In Florida the overburden is usually sandy and of not too great depth, thus being easy and economical to remove and giving an advantage costwise over other phosphate regions. Formerly, in many deposits having a large proportion of small particles to pebble rock, less than half of the potential rock could be extracted. This was because the screens and separators in the usual washing process are too large to prevent a large proportion of the "fines" from being washed away. In recent years, however, the successful application of the "flotation process" to the phosphate rock industry has more than doubled the output of rock by making possible the recovery of these fine particles. This process has likewise enabled the re-working of old debris piles produced many years ago and consisting of fine rock and associated materials. These piles were treated formerly simply as waste from the extraction of pebble rock.

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Mining Methods

The mining methods described here are those used in the Florida field where most of the phosphate rock is produced, but many of them are common to other fields as well.

First the area to be mined is stripped of trees, sod, sand, and other material until the layer of phosphate rock is exposed. This work is done by huge draglines costing several hundred thousand dollars each with booms that may be as long as 100 to 200 feet or more, and carrying buckets having a capacity of from 10 to 20 cubic yards. Usually the stripping is done just ahead of the actual mining and frequently at night to prepare the ground for the next day's mining. Because of its high investment and overhead cost and in order to obtain the largest possible production, it is most important to operate the draglines as many hours in the day as possible. The same dragline may be used for excavating the rock deposit, the output of which is known as the "matrix." This is a mixture of phosphate rock, sand, clay, and other materials. The dragline dumps this matrix into a field pit from which it is pumped to the washer which may be located a very considerable distance away, perhaps half a mile or even more. High-pressure water guns are used to wash the matrix into the pit as it is dumped there by the dragline bucket, and also to furnish the water to carry the material through the pipes. Booster pumps are located at various intervals along the pipe lines to assist in the flow to the washer. It is necessary to move the draglines, pipe lines, and pits frequently as the deposit in one location becomes exhausted.

Before either stripping or mining is started, however, it is first necessary to "prospect" the mining property to learn the location, thickness, and grade of the rock deposits. This is usually done by boring a specified number of holes for a given area and analyzing the contents removed. It is also necessary to perform certain "development" work. This involves the preparation of roads, dikes, ponds, water systems, electric power lines, pipe lines, etc.; also the moving of the draglines to the property. The latter is frequently a very expensive operation if moving is for great distances and across public highways, as this would require dismantlement and re-erection. Both prospecting and development, and particularly the latter, involve the investment of large sums in advance of mining. These are usually carried as deferred charges and are applied to the cost of phosphate rock on a per ton basis.

Processing Methods

The washer is a high, skeleton steel structure provided with tanks, rotary screens, "scrubbers," etc., for the purpose of washing foreign matter, such as silica, clay, and slime, from the phosphate rock. The matrix from the field is pumped to the top of the washer and carried by gravity down through successive operations until the pebble rock is recovered in various sizes free from other materials. In passing through the washer a great amount of fine particles of good phosphate rock get by the screens and can only be recovered by the flotation method, as already noted. The water as it comes out of the washer is, therefore, in the form of a slurry containing fine particles of phosphate rock, as well as some clay and slime. This water is pumped first to a hydro-separator, where a large part of the slime is removed, and then to the flotation plant. Here it is treated with oil and soapy

reagents which, on agitation, form myriads of small bubbles, each of which holds a particle of fine phosphate rock in suspense. From these bubbles the particles of rock are recovered.

The output of liquid from the washer plant may be either too great or too little at any one time for the efficient operation of the flotation plant. This condition can be corrected and the system kept in balance, however, by the use of a "surge pond." If the washer is producing for the moment a greater amount of liquid than can be absorbed by the flotation plant, the surplus is by-passed to the surge pond. Correspondingly, if the output of the washer is too low or if that plant should happen to be shut down, the flotation plant will draw upon the surge pond for the additional material needed.

There is a large amount of silica (sand) remaining from the flotation operation that is pumped to tailings ponds where it is allowed to settle. The slime and water that accompany the sand are pumped to slime ponds where the remaining solid matter also is allowed to settle, after which the clear water is drawn off for re-use by the washer and flotation plants in the water circulation system.

The wet rock produced by the washer and flotation plants is next transported to a "wet storage" which usually consists of very large piles out in the open. Ordinarily the rock is analyzed and graded before being placed in the piles so that each pile will represent a certain grade. The wet storage is usually located at the main base of operations which may be many miles from the location of the washer and flotation plants, the material being transported there by railroad. These plants must be moved from time to time to new locations as deposits are mined out, although by proper planning of location and deposits to be mined it may be possible to keep them in one area for a long period of time, perhaps five to ten years or even more.

Adjacent to the wet storage will be found the drying and grinding equipment, also the buildings and bins for the storage of the dried rock, likewise cranes, transportation, and other handling and shipping facilities. The wet rock is drawn from wet storage and dried in rotary dryers. Some of the dried rock is shipped unground to users, but a considerable proportion is ground. In the latter case it goes from the dryers to the grinding machines, after first being allowed to cool. Then it is sent to the storage bins to await shipment.

A flow sheet for a typical phosphate rock mining operation is given on Exhibit 1. It shows also where certain deferred charges and general overhead expenses are applied. Its study at this point will help to make the following clearer and more understandable.

II. How to Design the Cost System

The mining and processing of phosphate rock involve very heavy operations, much expensive equipment, and a great amount of power, labor, repairs, and depreciation. Any adequate cost system must be designed, therefore, to give due weight and effect to these elements and to provide information that will insure their most economical, efficient, and productive use.

The whole production cycle divides readily into certain operations that serve as natural cost centers. The first of these covers the dragline which does the very heavy job of stripping overburden and mining the rock. As already stated, the dragline is a very large and expensive piece of equipment, upon which depend both

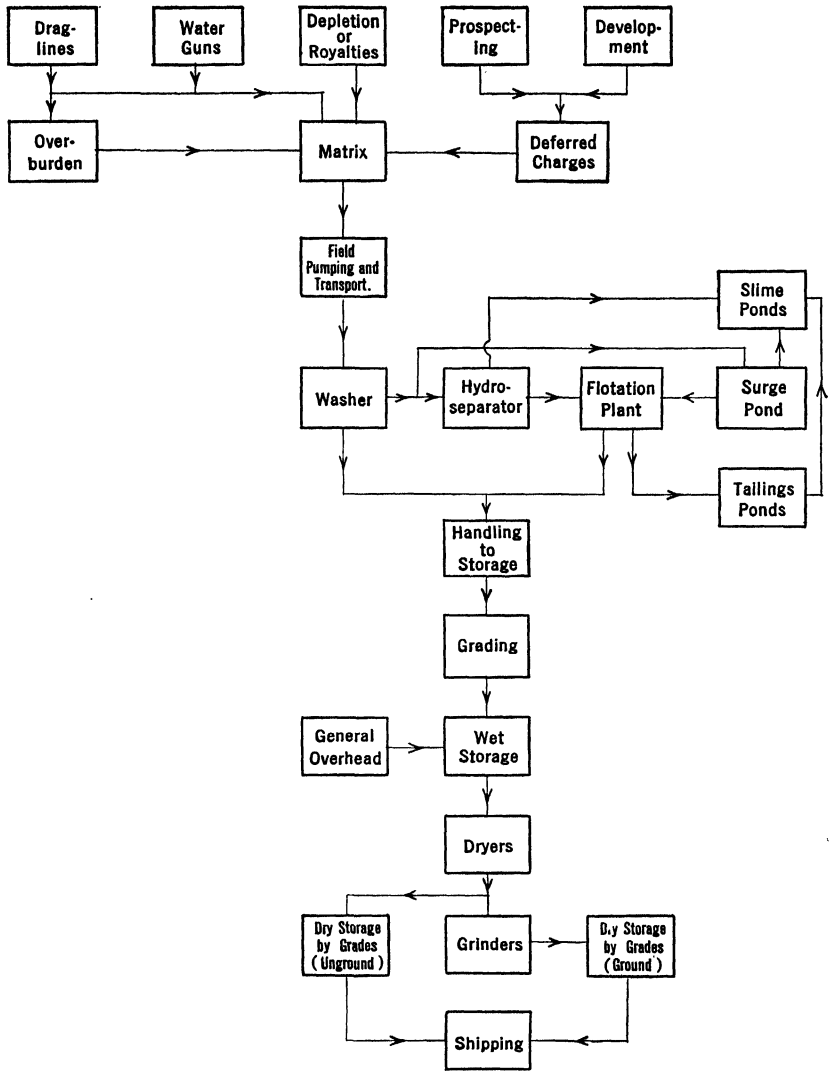

Exhibit 1.

the productivity and the economy of the whole mining operation. Its initial cost of several hundred thousand dollars involves a large annual cost for depreciation, whereas—because of the heavy work done and the complexity of the machine—operating, power, and repair costs are also very heavy. The total cost per hour amounts, therefore, to a very large figure, whether operating or idle, and it is most important not only that the machine be shut down as little as possible for adjustment, repairs, moving to other locations, etc., but also that it make the maximum number of swings and dips per hour with a full bucket each time. For these reasons, therefore, the dragline operations should constitute a separate cost center with

detailed costs developed for the guidance of the operating management. A schedule of such costs appears on Exhibit 2 (a)-1.

The production of the dragline is usually reported in total cubic yards handled, this information being obtained by counting the number of dips and multiplying by the average yardage content of the shovel. Dividing the total cost by the total cubic yards handled gives the average cost per cubic yard, which is one of the vital statistics of the whole mining operation. Another important one is the relation of the quantity of overburden handled to the yardage of matrix. Obviously, the cost per cubic yard of matrix delivered to the washer will be much greater from deposits having a heavy overburden than those with a relatively light one, assuming the same thickness for the matrix. A much thicker matrix could, of course, offset the cost of a deep overburden. The proportion of cubic yards of overburden to that for matrix is, therefore, an important barometer for the operating management from day to day and week to week, and the cost system should be set up to provide this information.

In transporting the matrix to the washer a tremendous volume of water and matrix must pass through the pipe lines. This involves a great expenditure of power for pumps at various points on the long pipe lines used. Hence cost information regarding this phase of the operation is another requisite of a good system.

The next natural cost center is the washer where processing of the matrix occurs and wet phosphate rock is produced in pebble form. There is comparatively little labor used in the operation of the washer itself but a great deal of power is required for pumping and for operating the various rotary screens and other moving equipment. The relationship of input in the form of cubic yards of matrix to the output of pebble rock in tons, and also the operating costs per ton recovered are both vital to the operating management and should be brought out clearly by the cost system.

Following the washer comes the flotation plant operation from which the production of phosphate rock will be equal to or even greater than that of the washer, the proportion for each varying with the type of deposit being mined. Both the recovery of rock and unit costs per ton for power, labor, reagents, and repairs are very important considerations in the operation of this plant, and must not be overlooked in the construction of the cost system.

The production of the washer and flotation plants is transported to "wet storage," material from each being combined there. The cost of the consolidated rock will vary with the relative proportions of the two classes as each will have a different cost. The cost system, therefore, must show clearly the quantities and values of each that make up the total production and value of the consolidated rock.

The remaining operations that should be shown separately by the cost system are drying, grinding, and shipping. All three are important elements in the cost of the wet rock and sufficient cost figures for guidance and control should be provided.

Use of Standard Costs

The production of phosphate rock is very well adapted to the use of standard costs with standards being set for each of the main cost centers described and for the more detailed items if desired. The use of such standards is an important part of the cost system to be described.

EXHIBIT 2

Month of_____ MINING DEPARTMENT OPERATIONS _____Months to_____194__

This Month		Last Month		*Wet Rock* ITEM	Months This Year		Months Last Year	
Amount	Per	Amount	Per		Amount	Per	Amount	Per
	Ratio			*(a) Field Mining Costs* *Production—Cubic Yards*				
240,000	1.00			Matrix				
180,000	0.75			Overburden				
420,000	1.75			Total Cubic Yards Moved				
	Total Cu. Yds.							
400				Labor—Supervisory				
2,000				Labor—Direct				
300				Labor—Indirect				
300				Operating Supplies				
1,500				Repairs				
200				Depreciation				
12,000				Dragline—Total Cost				
2,000				Bulldozers—Total Cost				
1,000				Water Circulation				
100				Miscellaneous				
19,800	0.0472			Total Cost—Matrix and Overburden				
19,800	0.0825			Cost Applied to Matrix				
19,200	0.0800			Standard Cost				
(600)	(0.0025)			Differential—Favorable (Unfavorable)				
	Cu. Yd. Matrix			*(b) Field Pumping and Transportation*				
—0—				Labor—Supervisory				
6,000				Labor—Direct				
100				Labor—Indirect				
4,000				Power				
200				Operating Supplies				
3,000				Repairs				
500				Depreciation				
100				Miscellaneous				
13,900	0.0579			Total Cost—Pumping and Transportation				

Schedule

Month of_____ MINING DEPARTMENT OPERATIONS _____Months to_____194___

This Month Amount	This Month Per	Last Month Amount	Last Month Per	ITEM	Months This Year Amount	Months This Year Per	Months Last Year Amount	Months Last Year Per
				(b) Field Pumping and Transportation Cont'd.				
14,400	0.0600			Standard Cost				
500	0.0021			Differential—Favorable—(Unfavorable)				
33,700	0.1404			Total Cost to Washer				
33,600	0.1400			Standard Cost				
(100)	(0.0004)			Differential—Favorable—(Unfavorable)				
				(c) Cost of Washer Operations				
300				Labor—Supervisory				
3,700				Labor—Direct				
200				Labor—Indirect				
5,000				Power				
400				Operating Supplies				
3,000				Repairs				
1,500				Depreciation				
1,500				Water Circulation				
200				Miscellaneous				
15,800	0.0658			Total Washer Operations				
16,800	0.0700			Standard Cost				
1,000	0.0042			Differential—Favorable—(Unfavorable)				
49,500	0.2062			Total Handling Cost Through Washer				
50,400	0.2100			Standard Cost				
900	0.0038			Differential—Favorable (Unfavorable)				
	Gr. Ton			*(d) Cost of Wet Washer Rock*				
32,000				Production—Gross Tons				
7.5				Ratio—Number of Cu. Yds. of Matrix to One Ton				
				Washer Rock Yield				
32,000	Gr. Ton			Total Yield				
31,467				Standard Yield				
533	Gr. Ton			Differential—Tons				
960	1.80			Differential—Value				
49,500				Total Handling Cost as per Above				
—0—				Royalties				

Schedule

Month of_____ MINING DEPARTMENT OPERATIONS _____Months to_____194__

This Month Amount	This Month Per	Last Month Amount	Last Month Per	ITEM	_____Months This Year Amount	_____Months This Year Per	_____Months Last Year Amount	_____Months Last Year Per
				(d) Cost of Wet Washer Rock Cont'd.				
3,200				Depletion				
480				Prospecting				
2,560				Development				
55,740	1.7410			Total Direct Cost—Washer Rock (Wet)				
57,600	1.8000			Standard Cost				
1.860	0.0590			Differential—Favorable (Unfavorable)				
				(e) Cost of Flotation Operations				
36,000				Production—Gross Tons				
1.125				Ratio—Flotation Production to Washer Production				
300				Labor—Supervisory				
6,000				Labor—Direct				
400				Labor—Indirect				
10,000				Power				
500				Operating Supplies				
2,500				Repairs				
4,000				Depreciation				
3,000				Water Circulation				
6,000				Reagents				
4,500				Royalties				
200				Miscellaneous				
37,400	1.0390			Total Cost Flotation Operations				
36,000	1.0000			Standard Cost				
(1,400)	(0.0390)			Differential—Favorable (Unfavorable)				
				(f) Cost of Flotation Rock				
37,400				Total Cost Flotation Operations as Above				
—0—				Royalties				
3,600				Depletion				
540				Prospecting				
2,660				Development				
44,200	1.2278			Total Direct Cost—Flotation Rock				

Schedule

Month of_____ MINING DEPARTMENT OPERATIONS _____Months to_____194__

This Month Amount	This Month Per	Last Month Amount	Last Month Per	ITEM *(g) Total Cost Wet Rock*	Months This Year Amount	Months This Year Per	Months Last Year Amount	Months Last Year Per
68,000				Total Production (Gross Tons) Washer and Flotation Rock as per Above				
				Mixing				
55,740				Total Direct Cost Washer Rock as per Above				
44,200				Total Direct Cost Flotation Rock as per Above				
99,940	1.4697			Total Direct Cost				
102,000	1.5000			Standard Cost				
2,060	0.0303			Differential—Favorable (Unfavorable)				
				Wet Storage and Transportation				
13,000	0.1912			Wet Storage and Transportation Cost				
13,600	0.2000			Standard Cost				
600	0.0088			Differential—Favorable (Unfavorable)				
				General Expense				
16,000	0.2353			General Expense				
17,000	0.2500			Standard Cost				
1,000	0.0147			Differential—Favorable (Unfavorable)				
128,940	1.8962			Total Cost—Wet Rock				
132,600	1.9500			Standard Cost				
3,660	0.0538			Differential—Favorable (Unfavorable)				
	Cu. Yd.			*Exhibit 2 (a)-1 Dragline Costs*				
				Dragline Costs—Dragline No. 1				
300				Labor—Supervisory				
3,500				Labor—Direct				
500				Labor—Indirect				
4,000				Power				
300				Operating Supplies				
1,000				Repairs				
2,000				Depreciation				
400				Miscellaneous				
12,000	0.0286			Total Cost				
420,000				Cu. Yds. Removed				
0.0286				Cost per Cu. Yd.				
450				Operating Hours				
26.70				Cost per Operating Hour				
932				Cu. Yds. per Operating Hour				

Schedule

III. Description of the Cost System

The first step in establishing a cost system is to set up the cost centers and the cost accounts applicable to those centers. The following cost centers are suggested:

1. Field Mining
2. Field Pumping and Transportation
3. Washer Operations
4. Flotation Plant Operations
5. Wet Storage
6. Drying
7. Grinding
8. Dry Storage
9. Shipping

The various cost accounts applicable to these cost centers should include the following:

1. Labor—Supervisory
2. Labor—Direct
3. Labor—Indirect
4. Power
5. Fuel
6. Operating Supplies
7. Repairs
8. Depreciation
9. Draglines
10. Bulldozers
11. Water Circulation
12. Reagents
13. Royalties
14. Depletion
15. Prospecting
16. Development
17. Miscellaneous

The accounts given are not necessarily complete and others should, of course, be added to fit the particular case. The same account numbers are intended for use in all the cost centers, although, of course, some centers may not require every account listed. The account number for any operating item is determined readily by combining the number of the cost center shown in the first group with the applicable cost account number in the second group. Examples of this are:

1.2 = Direct Labor—Field Mining
3.2 = Direct Labor—Washer

It will be noted from the field mining cost (Exhibit 2(a)) that draglines and bulldozers are shown at total cost, although it is important that detailed costs be given for this equipment. It becomes necessary, therefore, to set them up as sub-cost centers. In such cases the same cost account numbers will be used as for the main cost centers, except in a third position, as per the following examples:

1.9.7 = Repairs—Draglines
1.10.2 = Direct Labor—Bulldozers

Charges to the various cost centers and cost accounts described above will be made in the usual way from payroll distributions, supply requisitions, cash vouchers, journal entries, etc. Their accumulation and posting by account numbers will automatically group them into the cost centers and produce the cost sheets desired, as shown by the various cost exhibits appended.

Below are presented comments upon each of the several cost exhibits. They are intended to make the proposed cost system clearer and to amplify what has already been stated. The figures shown on the exhibits, however, are solely for the purpose of making them more understandable. They are purely arbitrary and are not intended to represent, either actually or proportionately, the costs of any phosphate rock mining company. Unit costs are given in total only and not for the individual items, since such details are not necessary for the purposes of the example, although they would be most desirable for any operating management.

Field Mining Costs—Exhibit 2(a)

The first item on this schedule is the total cubic yardage of material moved by the dragline, this being split into the two elements of matrix and overburden. It will be noted that in the example given the ratio of matrix to overburden was 1.00 to 0.75. This ratio is an important barometer from month to month. If, for example, the standard cost of rock should have been established on the basis of a ratio of 1.0 to 0.90, then the ratio shown on the exhibit is favorable, but if in another case it were to be 1.00 to 1.25, there would be a very appreciable increase in the cost of rock because of the excessive overburden encountered.

The exhibit shows also the various cost items for field mining, of which the most important is that for the dragline which is the heart of the whole operation. Only the total cost for the dragline is shown on this schedule, but, because of the great importance of dragline costs, as already stated, a detailed schedule for them should be prepared each month similar to Exhibit 2(a)-1.

It will be noted that after the total cost and the cost per cubic yard have been determined for the combined matrix and overburden removed, this total is thrown against matrix alone, thus increasing proportionately its cost per cubic yard. Thus is determined first the cost per cubic yard of the combined material, which has great operating importance, and then the cost of the matrix after absorbing the overburden. This absorption is necessary because the overburden has no value in itself.

It should be noted also that with this operation occurs the first application of a standard cost and the development of a standard cost differential. Standard costs are likewise shown for each of the succeeding cost centers and operations. They are then summarized on a separate schedule (Exhibit 4) entitled "Standard Cost Differentials" which will be explained later.

Dragline Costs—Exhibit 2(a)-1

There should be one of these schedules for each dragline operated. Besides the usual operating and other expenses, it should reveal various types of costs, such as cost per cubic yard of material moved, hours operated, cost per operating hour, etc., as shown on the exhibit.

Field Pumping and Transportation Costs—Exhibit 2(b)

This schedule is self-explanatory. It provides valuable cost information for an important and expensive part of the work, the cost of which should be isolated and distinguished from the other operations. It will be noted that unit costs are now on the basis of cubic yards of matrix only where in field mining they were computed for total cubic yards of both matrix and overburden. This schedule combines its transportation cost with the cost of field mining to obtain the total field cost or

total cost to washer. In other words, the processing of phosphate rock starts with the washer operation and everything before that represents field costs.

Cost of Washer Operations—Exhibit 2(c)

The washer is one of the most important operating units. It receives through the pipe lines from the field many cubic yards of matrix made up of varying portions of phosphate rock pebbles and particles, sand, clay, and water. It recovers phosphate rock in pebble form and of various sizes, with the rest of the mixture going to the flotation plant or waste ponds. The ratio of phosphate rock recovered to the cubic yards of matrix processed is, therefore, a very important index of the operations, giving information regarding the grade of the deposit being worked and the proportion of washer rock contained therein. Such information is compiled daily as part of the production operation, but for cost purposes would be used only for the monthly exhibit and for explaining any variation in total or individual unit costs that might be caused by fluctuations in yield. This ratio is shown on the schedule together with the detailed costs of the washer operations and a comparison with standards.

Cost of Wet Washer Rock—Exhibit 2(d)

On this cost schedule appears first the total handling cost of wet washer rock as developed from the previous exhibits. At this point are applied certain elements that are part of the cost of the rock in the field and that, chronologically at least, should have been applied to the field mining costs. It is, however, more convenient to apply them at this later point as they are set up on a per ton basis and previous costs are for cubic yards. The items referred to are depletion, royalties (if mining is done on leased property), prospecting, and development. It has already been noted that prospecting and development costs are incurred in advance of mining and must be deferred until rock is mined against which they may be applied. This is usually done at a fixed rate per ton, set (with a sufficient safety factor) to absorb the amounts deferred by the time the deposits are exhausted.

This schedule shows only the total direct costs applicable to wet washer rock. The remaining costs, representing general overhead, will be applied at a later stage.

It will be noted that at this point production is first expressed in terms of gross tons, the previous units having been cubic yards. This gives an opportunity to measure the yield which, in the example given, is shown at 32,000 gross tons out of 240,000 cubic yards of matrix, giving a ratio of 7.5 cubic yards of matrix to one ton of washer rock. Even though the item be wet rock the quantities are always expressed on a dry-ton basis because of the varying content of moisture.

Cost of Flotation Rock Operations—Exhibit 2(e)

The first item appearing on this schedule is the output of flotation rock. In the example given this is shown as 36,000 tons compared with 32,000 tons for the washer, a ratio of 1.125 to 1.000. This is an interesting and valuable operating ratio, particularly as a measure of the type of deposit being worked, assuming, of course, no feed from or to the surge pond. The production of the flotation plant will be either larger or smaller than that for the washer from day to day and month to month because of variations in type of feed and other operating factors and these differences are significant and important to the operating management.

The balance of the schedule covers the usual items of operating cost and comparison of the total with the standard.

In the cost system being described the flotation plant receives its feed from the washer or surge pond at no cost. It may well be argued that the flotation material should stand its proportionate cost for mining and field transportation. As a practical matter, however, the proper amounts of such items would be most difficult to compute as the material from the field varies so widely in its content of washer and flotation rock. There is no practical way to measure the input to the flotation process and production can only be determined from the output of wet phosphate rock. Moreover it is combined with the washer rock in wet storage before going to the dryers as shown on the flow chart (Exhibit 1). Since the cost of the consolidated rock includes all the cost incurred by both types and it is that rock that is shipped, no harm is done by failure to apportion field mining costs in earlier parts of the operation only to bring them together again at the consolidated stage.

Total Cost of Flotation Rock—Exhibit 2(f)

At this point the costs for prospecting, development, depletion, and royalties (if any) are applied to the flotation rock. The application is made in this manner in order that the operating costs of the flotation plant itself may be shown separately for information and control purposes. No comparison with standard is made at this stage as these particular costs would be applied on a standard basis anyway and no differentials would result.

Total Cost Wet Rock—Exhibit 2(g)

This exhibit combines the costs of washer and flotation rock that are brought forward from their respective cost sheets. At this point the cost of transportation and handling to wet storage is added, also general expense. The last item includes all the general overhead of the entire mining operation both in the field and at headquarters where the wet rock is stored, and drying, grinding, and shipping operations are performed. This item will include general management and office expense, insurance, taxes, office and clerical supplies, housing expenses, and the many other items not chargeable specifically and directly to production.

General expense is applied at this point in the operation for accounting convenience. Strictly speaking, part of it could be assigned to the drying, grinding, dry storage, and shipping cost centers, but as these items are simply added later to give the total cost of the shipped rock, there is no point in breaking up general expense into small pieces only to put it together again. Hence it is more practical to apply it to the cost of wet rock before the latter branches off into other channels in the flow of production.

It will be noted that this cost is a combination of washer and flotation rock of differing costs, the first being shown at 1.7410 and the second at 1.2278 per ton in the example given. Since the cost of one is considerably less than the other, it is easy to see that the cost of the combined rock will change very considerably as the proportions of the two types of rock change.

Drying Costs—Exhibit 3(a)

The first item appearing on this schedule is the production. Since the feed to the dryers is from the wet storage inventory, the production has no direct relation-

EXHIBIT 3

Month of_____ MINING DEPARTMENT OPERATIONS _____Months to_____194___

This Month		Last Month		ITEM	____Months This Year		____Months Last Year	
Amount	Per	Amount	Per		Amount	Per	Amount	Per
				Dry Rock				
				(a) Drying Costs				
30,000				Production—(Gross Tons)				
300				Labor—Supervisory				
3,000				Labor—Direct				
400				Labor—Indirect				
800				Power				
5,000				Fuel				
200				Operating Supplies				
1,500				Repairs				
900				Depreciation				
500				Miscellaneous				
12,600	0.4200			Total Drying Cost				
12,000	0.4000			Standard Cost				
(600)	(0.0200)			Differential—Favorable—(Unfavorable)				
				(b) Dry Storage Costs				
30,600				Wet Rock—Dry Basis—Gross Tons				
30,000				Dry Rock—Recovered—Gross Tons				
600				Shrinkage—Gross Tons				
1,000	1.657			Shrinkage—Value				
3,000				Storage—Handling Expenses				
4,000	0.1333			Total Dry Storage Cost				
4,200	0.1400			Standard Cost				
200	0.0067			Differential—Favorable (Unfavorable)				
				(c) Grinding Costs				
20,000				Production—(Gross Tons)				
300				Labor—Supervisory				
2,000				Labor—Direct				

Schedule

Month of_____ MINING DEPARTMENT OPERATIONS _____Months to_____194__

This Month		Last Month		ITEM	Months This Year		Months Last Year	
Amount	Per	Amount	Per	*Exhibit 3 (Cont'd.)*	Amount	Per	Amount	Per
200				Labor—Indirect				
4,000				Power				
100				Operating Supplies				
1,500				Repairs				
1,000				Depreciation				
200				Miscellaneous				
9,300	0.4650			Total Grinding Cost				
10,000	0.5000			Standard Cost				
700	0.0350			Differential—Favorable (Unfavorable)				
				(d) Shipping Costs				
60,000				Rock Shipped (Gross Tons)				
300				Labor—Supervisory				
2,000				Labor—Direct				
400				Labor—Indirect				
4,000				Power—(Locomotives)				
100				Operating Supplies				
1,500				Shipping Supplies				
500				Repairs				
500				Depreciation				
200				Miscellaneous				
9,500	0.1583			Total Shipping Costs				
9,000	0.1500			Standard Cost				
(500)	(0.0083)			Differential—Favorable (Unfavorable)				

Schedule

ship to the production of wet rock shown on the previous schedule and may be considerably more or less. Usually, however, it will approximate the production of wet rock.

The schedule shows the usual cost items for an operation of this type, the most important of which is usually fuel. Drying costs tend to remain steady from month to month so long as an even production is maintained and in the absence of special circumstances. Hence variations from standard cost are not apt to be so great as those for the more fluctuating operations.

Dry Storage Costs—Exhibit 3(b)

This schedule consists of two principal items, one being the handling and other expenses covering the operation of the dry storage, and the other the shrinkage resulting from the drying operation.

This shrinkage does not represent the loss in weight of water from the drying operation as the feed to the dryers is already measured on a dry-ton basis. Certain mechanical losses also occur during the drying process, resulting in a slight loss in weight for which allowance should be made. In the example given this has been set at 2% or 600 tons. It would perhaps be more proper to show this item as an element on the schedule for drying costs but it seems more desirable not to mix an item of material with the operating costs for drying so it has been included as part of the dry storage schedule.

Grinding Costs—Exhibit 3(c)

Here again the amount of production has no specific relationship to either wet or dry rock produced, particularly since much phosphate rock is shipped unground. The principal item of cost is for power because of the heavy nature of the operation. The grinding costs likewise tend to remain fairly steady so long as production is uniform and heavy repair costs are not incurred.

Shipping Costs—Exhibit 3(d)

This is similar to the other schedules with the usual items of operating expense and the comparison with standard costs.

Standard Cost Differentials—Exhibit 4(a)

This is simply a summary of the standard cost differentials or variances for the month produced by the various operations as shown on their separate schedules. It gives both in summary and total form the financial measure of the variations of the operating costs from their budgeted standards. Any large amounts will call attention to those points where operations may be either particularly favorable or unfavorable. One or two brief statements appear necessary to make clear the examples given.

It will be noted from the schedule of cost for wet washer rock that the total differential shown amounts to $1860.00. This is a combination of all the preceding differentials or variances and not an additional one. Particular attention should be given to the differential resulting from "yield." This comes from the number of tons of phosphate rock recovered being in better proportion to the cubic yards of matrix than contemplated when the total standard cost for wet washer rock was set.

The mixing schedule shows a differential of $2060.00 but on the summary of

differentials the mixing differential is given as only $1600.00. The difference of $460.00 represents the net of the previously shown favorable differential of $1860.00 for washer rock and the unfavorable one of $1400.00 for flotation rock.

EXHIBIT 4

STANDARD COST DIFFERENTIALS

(a) Summary of Differentials	*Favorable*	*Unfavorable*
Field Mining		600
Field Pumping and Transportation	500	
Washer Operations	1000	
Washer Rock—Yield	960	
Flotation		1400
Mixing	1600	
Wet Storage and Transportation	600	
General Expense	1000	
Drying		600
Grinding	700	
Dry Storage	200	
Shipping		500
Totals—Differentials	6560	3100
Less Unfavorable	3100	
Net Favorable Differentials	3460	

*(b) Costs Per Ton**	*Actual*	*Standard*	*Differential*
Wet Rock—Direct Costs	1.4697	1.5000	0.0303
Wet Rock—Storage, Transportation and Gen. Exp.	0.4265	0.4500	0.0235
Drying	0.4200	0.4000	(0.0200)
Grinding	0.4650	0.5000	0.0350
Dry Storage	0.1333	0.1400	0.0067
Shipping	0.1583	0.1500	(0.0083)
Total Costs Per Ton	3.0728	3.1400	0.0672

* Entirely fictitious—No relationship to actual costs.

Standard costs have been shown only in total for the various cost centers. There is no reason, of course, why separate standards cannot be set for each of the items of operating costs in a cost center and individual variations determined. This, however, would entail a very great amount of clerical work for the determination of the monthly differentials. Usually there are only two or three major items of cost in each group and the work can be reduced greatly by computing differentials only for those items.

Standard costs having real use and value can be set only after careful and thorough study of the various operations and from experience with actual costs over a considerable period of time. Phosphate rock mining operations are usually on such a large scale, however, that costs are apt to show less violent fluctuation than would occur in activities of lesser magnitude. It is possible, therefore, to set standards which will not only be very useful and satisfactory as a measure of actual performance but can also be used for inventory and cost of sales purposes. This

makes it possible to compute currently, and without waiting for the books to be closed, the gain or loss on individual shipments. Many other useful purposes will be found for the standard costs.

The monthly total net differential may be treated in various ways. For example, if the first month of the fiscal year produces a credit differential but less favorable conditions are expected for succeeding months, it may be best to hold the differential as a reserve instead of applying it as a credit to earnings for the month. Conversely, unfavorable differentials should perhaps be charged off against current earnings rather than being allowed to accumulate in deferred charges and necessitating heavy write-offs later in the year.

Costs Per Ton—Exhibit 4(b)

This schedule shows the unit cost for the various operations and the total cost per ton for the rock shipped. There is given also a comparison of the actual costs with the standards.

General Comments

In the phosphate mining industry there are, of course, many differences in detailed methods among the various companies, but in general their operations are rather similar and standard. It is believed that the cost system presented, therefore, will be applicable in most cases, but subject to such adjustments as may be desired to meet special circumstances or personal preferences. It has been designed to accumulate costs at natural points and where they will give maximum information for use and control by those responsible for the operations. It is recommended that the individual in charge of each operating center be given monthly cost schedules similar to those illustrated. In this way much greater value and action should result from the compilation of the costs than if they are prepared simply for the information of the higher executives.

The presentation of this cost system necessarily had to be brief but use of forms and examples has been made to take the place of detailed descriptions and much wordage. It is believed that any competent cost accountant will not find the system difficult of understanding or application and will be able to fill in the details that have not been shown here because of lack of space.

All cost figures used in the exhibits presented are entirely fictitious and have no relationship whatever to actual costs.

COST ACCOUNTING IN PRINTING PLANTS

By
J. GORDON HILL *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

In general the output of a printing plant consists of various forms (usually referred to as commercial stationery) designed for use in the conduct of a business, governmental or service organization, as well as the familiar types of forms for personal use, such as announcements, invitations, etc. (usually referred to as social stationery).

These products may be further classified according to the character of the workmanship performed, such as printing, engraving, lithographing, manifolding, etc. Although the great bulk of the output of a printing plant has found use in the operation of an office or on the desk of some individual, there have been developed in recent years certain special uses for the product of a printing plant; among these are color lithograph products for display advertising, labels for standardized products, etc.

A type of service by the printing industry that has found favor with many large organizations consists of an undertaking whereby all the needs of a business in the printing line are supplied under contract for progressive delivery covering an extended period of time. Such an arrangement has been found to be of mutual advantage to the printer and his customer, as a result of economies that can be effected both in the use of raw materials (principally paper stock) and in the attainment of maximum results from an operational standpoint. These advantages are clearly demonstrated to the printer from a study of his cost finding facts; indeed it may be said that the practice in the trade had its origin in the urge to find ways and means to reduce costs of supplying its products for the current needs of large organizations.

Origin of Products

In considering the subject of printing, we have to deal with an art or a skill. Although materials and equipment are used in its operation, they are so small a contribution as to be eclipsed by the greater concept of an accomplishment brought about largely by human ingenuity. To trace the origin of the art of printing to its real source might actually take us back to the hieroglyphics on the Pyramids of Egypt or the cuneiform writings of the Phoenicians. We may be brought still nearer to the source by the scene of the monk in his cloister, patiently etching out with pen and parchment the sacred volumes of Holy Writ which have come down to us through the ages. Leaving these ancient scenes, however, we may find a more suitable stage for the first act of our drama in the advent of the printing

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press in the fifteenth century. With all the other advancements which this great event ushered in for the benefit of mankind, the modern art of printing may be said to have had its real origin.

Sources of Raw Materials

In a strict sense, the raw materials of the printing industry are limited principally to paper of various kinds, type and type metals, lithograph stones and engraving plates, printing inks, and other incidental supplies. In a broader sense however, the resources of the industry are found in two major elements of an up-to-date organization. They are, first and most important, a trained personnel, and, second, equipment of appropriate design, adequately serviced and maintained.

By far the greatest factor in the success of the industry is found in the fitness of its personnel. In few other industries is the quality of the product so dependent upon, or indicative of the efficiency of its personnel. This applies not only to those skilled in all phases of the "graphic arts," but to those having to do with selling, accounting, and administration.

The physical equipment of the industry depends upon many factors peculiar to the individual business, such as size or volume, character of product, and competitive conditions. There are so many allied businesses ready to serve the printing industry, such as typesetting, press work, photo engraving, etc., that a small plant finds it advisable to limit its equipment to the major requirements of its regular output. At the other extreme are plants equipped to enter the more competitive field of producing large quantities for special needs, such as advertising, printed matter for elections by governmental bodies, etc.

Organization of Plant

Based upon years of experience (some of which were not too joyful), the printing industry has developed a procedure by which prices are based upon costs that are all inclusive, in the sense that they embrace all outlays from the moment of contact with the customer to the final delivery of the product. In conformity with this concept, an efficiently organized printing plant treats all outlays as costs, although a large sector thereof is not directly related to actual production. Accordingly, the entire plant is organized into the following departments arranged in the natural order or process through which the customer's order passes from beginning to end:

Sales Department—through which customers' orders originate.

Plant Office—embracing plant management, production planning, purchasing, personnel, cost accounting, billing, general accounting and administration.

Storeroom—receiving raw materials (principally paper stock) cutting to order and dispensing to operating departments.

Operating Departments—grouped according to type of product, which in turn determines the manufacturing process and equipment used—such as (a) printing and binding (b) lithographing (c) engraving.

Shipping and Delivery—receiving from operating departments goods which are required to fill customers' orders and delivery thereof to customers or transportation agencies.

Service Departments—concerned principally with maintenance of property and equipment.

Production Order System

The origin of, and to some extent the character of, the production order depend upon the occasion for its need. Most orders have their origin with the customer through the sales department. Orders for the production of more or less staple types of product, which are intended to be carried in stock in anticipation of customers' orders, are of course originated by the plant office in cooperation with the sales department.

Customers' orders are of two general classes: (1) Those that are more usual and constitute the larger part of customers' orders, covering definite quantities of a specified printed form or product; and (2) those that cover all a customers' continuing needs for printed matter and which are supplied as needed by the customer under contracts providing for progressive delivery, as already mentioned.

Upon receipt from the sales department of a customer's order of the first class mentioned above, a job order is issued by the plant office. Separate series of forms numbered serially are used for each of the several operating departments of the plant. Job orders are in the form of an envelope of suitable size as a convenience for jacketing the various relevant documents, such as the customer's order, the printer's "copy," proofs, etc.

For goods to be manufactured for a customer under contract, usually referred to as "contract goods," and for goods to be carried in stock, careful and thorough planning is required in the plant office as a preliminary to the issue of job orders. To accomplish the objective of producing this class of product at minimum cost with delivery timed to meet the needs involved, the various forms to be supplied must be fitted together so as to gain all the advantages of low-cost production. This is accomplished by using all (or as much as practical) the paper stock of a standard size supplied by the paper manufacturer, thereby eliminating waste or reducing it to a minimum; and by assembling in one makeup all the printed forms to fit the paper stock selected so as to produce the number of impressions required with but one run of the presses (or equipment for other processes). Further savings of cost result from such planning by reducing to a minimum nonchargeable time in the operating departments, as well as in minor operations incidental to those of the makeup and run.

Upon issue of a job order originating in any of the several ways described, notations are made thereon of the quantity and kind of product ordered, as well as such necessary information as date, name of customer, etc., followed by detailed specifications of the quantity, kind, and size of paper stock or any other materials to be used. Indications are also made on the job order as to the various processes by which the work progresses to completion, and notations of delivery to the shipping department.

After completion in the plant office job orders are sent to the materials storeroom, where the required paper stock or other materials are prepared for internal delivery to the department of the plant requiring their use. In many cases the paper stock called for by a job order will have to be cut to the size specified from the standard size carried in stock, involving some waste, which should be held to a minimum. In the event that the material required by a job order is not carried in stock, a purchase order is issued by the purchasing department of the plant office. Thence the job order accompanies the work as it progresses in the order indicated

to the various departments of the plant, ending with the shipping department, when it is returned to the plant office.

II. How to Design the Cost System

What Information Is Required

As a tool of efficient management, a cost system for the printing industry should develop data to indicate:

1. Costs in total and per hour of each basic element making up the total cost of operating for a fixed period of time.
2. Periodical statements of various overhead expenses arranged according to established classifications as to character, and grouped by departments or functions. While these do not constitute direct operating costs, they are applied thereto as a loading so as to develop all-inclusive hourly rates.
3. Variances between basic cost data and prior standards developed from studies of the foregoing data, as tests of the accuracy of charges to customers.
4. Financial statements of conventional form, exhibiting financial position and results of operations.

It is highly important to see that the cost data entering into the first two of the foregoing periodical statements agree in total with the profit-and-loss statement exhibiting general results of operations for a similar period.

Considerations in Designing the System

Although materials used constitute a large cost factor, they present no great difficulty in their accounting and control.

As labor is in many respects the determining factor entering into the prime cost of printing, and as it is also used as a basis for applying the burden of indirect charges, the importance of sound methods of maintaining payrolls and procuring an accurate distribution of labor charges is readily realized.

In the printing industry, unusual emphasis is placed upon costs, as they constitute the only reliable basis for making charges to customers. Not only must these charges be sufficient to cover costs (including the wages of capital in the form of a reasonable return on investment) but they should be so controlled and minimized as to place an individual plant in an advantageous position under the keenly competitive conditions that exist in the printing industry.

Indirect costs are a smaller factor, but they are more difficult to control and subject to such variance that it is important to provide complete data for all overhead expense in such form as to afford budgetary control and the means of correcting inconsistent excesses.

The "Standard" Cost System Is Favored

The principles of standard costs have long been recognized, and to that end uniform systems of accounting have been encouraged in the printing industry. It must be admitted, however, that the practical application of standard costs in most plants has been limited to their use as a basis for billing customers. Such plants have relied upon the conventional periodical statement of profit and loss to indicate the extent of efficiency in their operation.

With the better integrated plants, there is now a definite trend toward extending the use of the standard cost principles as a means of controlling costs so as to reduce them to the lowest minimum consistent with quality. From the standpoint of management, it is no longer satisfying to peruse a profit-and-loss statement and conclude that operations have been efficient because a financial profit is indicated. More alert management is now interested in setting up goals in the form of sales quotas upon which to project operations and departmental expense budgets that are consistent with such quotas. By recording data with respect to these goals at the beginning of a projected period (yearly, quarterly, or monthly, as circumstances warrant), a reasonable basis is established by which actual performances may be measured so as to bring to light inconsistencies that may be subject to correction.

III. Description of the Cost System

For the purposes of accomplishing the objectives of a cost system for the printing industry, as outlined above, the following forms and procedures are necessary:

1. Design the profit-and-loss control report for top management (Figure 1).
2. Design the sheet for development of all inclusive hourly production rates for each process (Figure 2).
3. Design the reports for supervisory operating executives, consisting of:
   Operating Payroll Data (Figure 3).
   Monthly Overhead Analysis Report (Figure 4).
4. Establish (and revise as necessary) standards for materials, labor, and overhead, as bases for development of hourly rates, as per Figures 1-a and 2.
5. Establish other procedures for carrying out the cost system and producing the desired data.
6. Set up the required Chart of Accounts.

Profit-and-Loss Statement Format

As in most lines of business, this statement is the one of greatest interest to the management of a printing plant. It demonstrates the effectiveness (or the deficiency) of the methods of management designed to control costs and set fair standards for billing customers. It also affords proof of the accuracy of the accounting by which the results are exhibited. Comparison of Figure 1 with similar forms of profit-and-loss statements shows a number of features that are particularly adaptable to the printing industry and assure adequate control of costs extending to all manufacturing processes entering into the output of the plant. These features are:

Completely integrated details of costs developed from the initial step in manufacturing down to the final product; both as to each process and as to all operations for a month, or other period.

Comparison of budgeted (or standard) and actual costs and other operating data.

Reconciliation of variances between actual and standard (or projected) costs and other such data.

JOHN DOE PRINTING COMPANY

PROFIT AND LOSS STATEMENT FOR MONTH OF MARCH, 1946

	Total		Printing & Binding		Engraving		Lithographing	
	Amount	Pct. of Net Sales	Amount	Pct. of Net Sales	Amount	Pct. of Net Sales	Amount	Pct. of Net Sales
Gross Sales	$ x		$ x		$ x		$ x	
Less: Returns and Allowances	x	x%	x	x%	x	x%	x	x%
Net Sales	x	100	x	100	x	100	x	100
Cost of Sales:								
At Standard	x		x		x		x	
Variances	x		x		x		x	
Actual	x	x	x	x	x	x	x	x
Gross Profit—Actual	x	x	x	x	x	x	x	x
Commercial Overhead Expense:								
Selling:								
Budget	x		x		x		x	
Variances	x		x		x		x	
Actual	x	x	x	x	x	x	x	x
Administrative:								
Budget	x		x		x		x	
Variances	x		x		x		x	
Actual	x	x	x	x	x	x	x	x
Total—actual	x	x	x	x	x	x	x	x
Operating Profit—Actual	x	x	x	x	x	x	x	x
Other Income:								
Cash Discounts (Net)	x		x		x		x	
Miscellaneous	x		x		x		x	
Total	x	x	x	x		x		x
Net Income (Before Deduction of Federal Income Tax)	x	x	x	x	x	x	x	x

Fig. 1. Profit-and-Loss Statement.

STATEMENT OF COST OF SALES FOR MONTH OF MARCH, 1946

	Total		Printing and Binding		Engraving		Lithographing	
Materials:								
Used on Job Orders Completed:								
Direct Purchases		$ x		$ x		$ x		$ x
Storeroom Issues		x		x		x		x
Storeroom Expense:								
At Standard	$ x		$ x		$ x		$ x	
Variances	x		x		x		x	
Actual		x		x		x		x
Total		x		x		x		x
Operating Wages:								
At Standard	x		x		x		x	
Variances	x		x		x		x	
Actual		x		x		x		x
Factory Overhead Expense:								
At Standard	x		x		x		x	
Variances	x		x		x		x	
Actual		x		x		x		x
Work in Process—decrease (increase)								
At Standard	x		x		x		x	
Variances	x		x		x		x	
Actual		x		x		x		x
Shipping & Delivery:								
At Standard	x		x		x		x	
Variances	x		x		x		x	
		x		x		x		x
Grand Total:								
At Standard	x		x		x		x	
Variances	x		x		x		x	
Actual		x		x		x		x

The above figures for Grand Total agree with Cost of Sales, per Figure 1.

Fig. 1-a. Cost of Sales.

These control data constitute efficient tools of the management in applying tests which indicate the extent to which objectives have been accomplished, such as—

Upholding profits to an adequate standard or disclosing any adverse conditions preventing such profits.

Determination of the extent to which actual results confirm predetermined policies based on sales quotas, plant layout, employment and expense budgets, or disclose weaknesses therein that should be corrected.

Study of the effect of major variations in volume or character of actual accomplishments, as related to projected results, particularly as to future policy.

Consideration of the consistency of prices charged customers, both with respect to costs and in the light of competitive conditions.

In addition to showing results of operations on the conventional basis of financial results, the statement shows variances therein from predetermined standards. The main statement shows such results in summary form by departments, with further detail supplemented as to cost of sales. In support of the totals shown by the main statement, complete details are shown by Figure 2 for each process in all departments of the plant, and the manner of reconciling the two statements is indicated by the footnotes of Figure 2. Although the extent of detail for all processes of a large plant appear quite formidable, they nevertheless afford the only adequate basis for a study by the management of the results of operations of the entire plant. With such data available, there is no reason why a weakness in the setup should not be brought to light in any department.

Variances Used

In the printing industry, it is important to remember that the predetermined standard costs constitute the bases for billing customers. With the addition thereto of a percentage for normal profit, the final price charged for a particular order is determined. Hence, variances from such standards indicate the trend of the business toward profit or loss.

In general, variances may be allocated to two major factors: (1) Wage costs, and (2) volume of business. Although materials are of course a cost factor, they are not subject to variance as to price, except under unusual circumstances which will be discussed later.

Variances in wage costs are attributable to conditions which relate principally to extent and circumstances under which the available manpower can be used to greatest advantage consistent with incoming orders. The principal objectives are (1) to reduce to a minimum the number of nonchargeable hours of the productive personnel, and (2) to avoid or minimize overtime resulting in premium wages over normal rates. Basic wage rates need not be a cause of variances, because changes therein as a result of a new agreement with employees can usually be anticipated in time to revise the standard costs before they are put into effect. However, if wage increases are made retroactive and have not been anticipated in revised standards, they become a very definite cause of variance and have a serious effect on operating results when they do become effective, as indicated by the profit-and-loss statement. Problems may also arise in consideration of wage costs, if it is the practice to pay operating employees for holidays or make allowances for vacations. Such factors

DEVELOPMENT OF ALL-INCLUSIVE HOURLY PRODUCTION RATES
For Month of March, 1946

Operation_____ Department_____

	Actual		At Standard		Actual	
	Total	Per Hour (1)	Total	Per Hour (1)	O-Over Total	U-Under Per Hour (1)
Operations:						
Hours (actual time):						
Total	x		x		x	
Nonchargeable	x		x		x	
Chargeable	x		x		x	
Wages:						
At Normal Rates (Actual Hours)	$ x	$ x	$ x	$ x	$ x	$ x
Overtime Premium	x	x	x	x	x	x
Total (2)	x	x	x	x	x	x
Factory Overhead Expense (3)	x	x	x	x	x	x
Shipping and Delivery (3)	x	x	x	x	x	x
Operating Cost (4)	x	x	x	x	x	x
Commercial Overhead Expense:						
Selling (3)	x	x	x	x	x	x
Administrative (3)	x	x	x	x	x	x
	x	x	x	x	x	x
Total Production Cost	x	x	x	x	x	x
Profit		x		x		x
Hourly Rate		x		x (5)		x

(1) Based on chargeable hours.
(2) Total of these items for all operations agrees with Operating Wages, per Statement of Cost of Sales—Figure 1-a.
(3) Total of these items for all operations agrees with Monthly Overhead Analysis Report—Figure 4.
(4) May be reconciled with Cost of Sales (Figure 1) by combining all operations and adding materials and work in process adjustment.
(5) Used as basis for billing customers, pending subsequent revision.

Fig. 2. Hourly Rates.

however need not give rise to appreciable variances, because they can be predetermined over a period of a year and included as a part of standard costs.

The remaining causes of variances may be considered under the general heading of overhead expenses of the various groups indicated by Figure 2. Variances therein can be ascribed to two causes: (1) Actual spending more or less than the predetermined budgets, and (2) a volume of business (expressed in terms of chargeable hours or cost of operating wages) greater or less than the predetermined standards.

All variances in costs will also be reflected in the inventory of work in process at the end of any accounting period, but such are a relatively small part of the total of costs for the period. Similarly any finished products that are not billed to customers, but are carried as inventories are also subject to some adjustment to reflect actual rather than standard costs, but this is a problem of general accounting rather than cost accounting.

How Variances Are Allocated

A proper basis for study of variances is afforded by the data used in the development of hourly production rates (Figure 2) together with the overhead analysis (Figure 4). It is not intended that the data shown by these exhibits with respect to budgets and standards be included in the accounting records as such. It is considered more practical to limit the accounting to the conventional records of actual costs and expenses. As to budgets and standard costs, these exhibits may be used as an original record to be made prior to the insertion from the accounting records of similar actual data.

As a result of the routine preparation of the statements illustrated by Figures 2 and 4, the variances from standard may be seen and studied with respect to each operating department of the plant. Further analysis of these exhibits will indicate the character of the variances as already discussed.

Costing of Individual Operations

Figure 2 exhibits the procedure for developing costs for each operation of the several departments of the plant. The hours and amount of wages are derived from the data shown by Figure 3, which in turn is prepared from the current payrolls. Details of sundry indirect costs indicated by Figure 2 are shown by Figure 4. The procedures for allocating these indirect costs to the individual operations are explained later.

Revision of Standard Costs

Because standard costs in the printing industry determine selling prices, it is of vital importance to make continual studies of actual costs so as to revise the standards on the basis of variances which appear to be other than of a transitory character. With the data shown by Figure 2 for a recent period, revisions may be made with respect to any cost factor indicating a more or less permanent variance from previous standards, so as to develop a revised hourly rate for any operation affected by the basic change under consideration.

Analyses for Supervisory Executives

From the standpoint of general management, the monthly profit-and-loss statement (Figure 1) is of vital interest. If it indicates generally satisfactory results,

OPERATING PAYROLL DATA

For Period Ended_____

	Hours (actual time)				Amount of Wages				
	Nonchargeable		Chargeable		At Normal Rates		Overtime Premium		Total
	Actual	Standard	Actual	Standard	Actual	Standard	Actual	Standard	Actual
Printing and Binding:									
Hand Composition ..	x	x	x	x	$ x	$ x	$ x	$ x	$ x
Platen Press	x	x	x	x	x	x	x	x	x
Etc.	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x
Engraving:									
Hand Engraving	x	x	x	x	x	x	x	x	x
Power Press	x	x	x	x	x	x	x	x	x
Etc.	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x
Lithographing:									
Art Process	x	x	x	x	x	x	x	x	x
Offset Press	x	x	x	x	x	x	x	x	x
Etc.	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x
Grand Total	x	x	x	x	x	x	x	x	x

Fig. 3. Operating Payroll Data.

OVERHEAD ANALYSIS
For Month of March, 1946

	Actual	Budget	Actual O-Over U-Under
Property:			
Rent	$ x	$ x	$ x
Wages	x	x	x
Depreciation of Building	x	x	x
Maintenance and Repairs	x	x	x
Heat and Light	x	x	x
Insurance	x	x	x
Taxes	x	x	x
Supplies	x	x	x
Other Expense	x	x	x
	x	x	x
Distribution on Basis of Floor Space:			
Operating Departments	x	x	x
Storeroom	x	x	x
Shipping and Delivery	x	x	x
Selling	x	x	x
Administrative	x	x	x
	x	x	x
Storeroom:			
Salaries and Wages	x	x	x
Property Expense—Distribution	x	x	x
Depreciation of Equipment	x	x	x
Insurance	x	x	x
Taxes	x	x	x
Other Expense	x	x	x
	x	x	x
Distribution:			
Basis—Materials Used	x	x	x
Expense:			
Per Cent	x	x	x
Amount	x	x	x
Factory Overhead:			
Direct Charges to Operating Depts.:			
Property Expense—Distribution	x	x	x
Maintenance and Repairs	x	x	x
Depreciation of Equipment	x	x	x
Operating Supplies	x	x	x
Fuel and Power	x	x	x
Insurance	x	x	x
Type and Accessories	x	x	x
Spoilage	x	x	x
Other Expense	x	x	x
	x	x	x

Fig. 4. Monthly Overhead Analysis.

OVERHEAD ANALYSIS
For Month of March, 1946
(Continued)

	Actual	Budget	Actual O-Over U-Under
Distributed to Operating Depts.:			
Supervision	$ x	$ x	$ x
Salaries and Wages—General	x	x	x
Maintenance and Repairs	x	x	x
Supplies and Expense	x	x	x
	x	x	x
	x	x	x
Shipping and Delivery:			
Salaries and Wages	x	x	x
Property Expense—Distribution	x	x	x
Wrapping and Shipping Supplies	x	x	x
Parcel Post, Freight, and Cartage	x	x	x
Auto Depreciation and Expense	x	x	x
Depreciation of Equipment	x	x	x
Insurance	x	x	x
Taxes	x	x	x
Other Expense	x	x	x
	x	x	x
Selling:			
Salaries and Commissions	x	x	x
Travel and Auto Expense	x	x	x
Advertising	x	x	x
Property Expense—Distribution	x	x	x
Depreciation of Equipment	x	x	x
Insurance	x	x	x
Taxes	x	x	x
Spoilage	x	x	x
Other Expense	x	x	x
	x	x	x
Administrative:			
Executive Salaries	x	x	x
Office Salaries	x	x	x
	x	x	x
Bad Debts	x	x	x
Collection and Credits	x	x	x
Depreciation of Equipment	x	x	x
Donations	x	x	x
Dues and Subscriptions	x	x	x
Insurance	x	x	x
Legal and Special Service	x	x	x
Miscellaneous	x	x	x
Office Expense	x	x	x
Postage	x	x	x

OVERHEAD ANALYSIS
For Month of March, 1946
(Continued)

	Actual	Budget	Actual O-Over U-Under
Property Expense—Distribution	x	x	x
Stationery and Supplies	x	x	x
Taxes—General	x	x	x
Telephone and Telegraph	x	x	x
Travel and Auto Expense	x	x	x
	x	x	x

particularly as to variances from standard, there need be no great concern on the part of the management as to past accomplishments.

The greater concern of management is to be forewarned of conditions that will have an adverse effect on future operations through major variances from standard costs. An efficient management should require of department heads special reports as much in advance as possible of changes which are likely to take place having a major effect on standard costs. The more important of such changes are as follows:

1. Wage rates or working conditions contemplated by new agreements, including their retroactive effect.
2. Necessity for overtime involving wage premiums, as a result of increased volume and/or shortage of manpower.
3. Plans affecting plant facilities, either buildings or equipment, occasioned by breakdowns, improvements, or replacements.
4. Volume of sales, materially at variance with standards, which not only disturbs sales quotas as related to sales force, but has an over-all effect on distribution of overhead expenses to total cost of operations.
5. Substantial changes in price of purchases, particularly with respect to amount of stock on hand in proportion to current usage.

How Standards are Created

Except as to major changes in the character of output which occur infrequently, if at all, the operating results of a printing plant are more or less uniform and continuous as to character. Hence the easiest approach to the development of standards is a thorough familiarity with past accomplishments. Upon such bases, the standards are set up in the natural order of usage as follows:

Materials.—The cost of materials, as such, does not enter into the determination of standards, because the purchase cost of materials, plus inward delivery, is included in the bill to the customer. (A possible exception to this general rule would arise in a situation where as a result of an unexpected change in purchase costs, the stock on hand would have to be billed to customers at current prices rather than original cost. It is believed that such differences in cost of materials should be made the subject of general accounting rather than as a factor of costs.) It is necessary, however, to set a standard as to the total cost of materials to be used on productive orders for a given period, as a basis for distribution of overhead

expense for the storeroom, as indicated by Figure 4. This standard cost of materials should of course be consistent with the total production of the plant, which in turn is based upon the sales quota for the given period.

Operating Wages.—For each operation of the various departments, standards are to be set for a given period as to the following data indicated by Figure 2:

Hours (Actual Time):	
Total	x
Nonchargebale	x
Chargeable	x
Wages:	
At Normal Rates (Actual Hours)	x
Overtime Premium	x
Total	x

These standards of course are consistent with the number of employees in the respective departments, which in turn is based upon the current flow of job orders. To attain the standard in practice, job orders for contract goods (as previously mentioned) may be used to advantage in utilizing available time not required for other customers' orders from time to time.

As a further measure of efficiency of individual operations in any department, it will be found helpful to set up collateral standards by making time studies, against which the actual hours charged to a particular job order may be checked. This is especially important in case of job orders for which firm bids have been made to customers, or in case there is some question by customers concerning the reasonableness of bills covering orders for which no bids were made or prices quoted.

Overhead Expenses.—The rate (or percentage) of overhead expenses of the various groups (applied to the direct or prime costs) is the result of two factors—the amount of the expenditures for overhead, and the volume of work by which they must be absorbed. In setting standards the interdependence of these two factors should not be overlooked. To the extent possible, the budgeted amounts should be consistent with the volume of business which may be reasonably anticipated. It is obvious however that some groups of overhead expense are subject to greater control than others. At one extreme is the group for property expense, which is more or less fixed by lease or ownership of the premises, regardless of the volume of business. Expenditures for other groups may be regulated more or less to current trends of the business.

The most important group of overhead expense relates to the selling department and calls for the best of ability in management. The crux of the problem is to maintain a proper balance between expenditures made and results obtained in the form of customers' orders. To this end sales quotas should be set and records of customers' orders maintained as to each individual directly engaged in selling. A flow of business of as steady a pace as possible not only reduces the selling expense directly applicable thereto, but affords the plant a basis for planning its operations with the maximum of efficiency.

HOW THE DATA FOR THE COST SUMMARY IS OBTAINED

Finding the Cost of Sales

As has already been mentioned, cost accounting for the printing industry comprises both the determination of individual job costs and total processing costs. This involves the work of summarizing details of individual job costs as to materials used and operating costs by departments and processes.

Materials Used

Materials used from stores are charged to job orders from requisitions. Those purchased direct for a specific job order are charged from a purchase requisition and checked against related purchase invoices. Monthly totals, summarized from job orders, are charged to the respective general accounts for each of the operating departments shown by Figure 1. No provision is made for variances in material costs, as they are charged at cost, plus inward delivery (except in the case of any adjustment of original cost to current prices of stock on hand, to which reference has already been made).

Operating Wages

As to chargeable hours, cost records for job orders are posted from daily time reports for each individual or machine employed; and totals for each job order become the basis for billing customers at standard hourly rates. These daily time reports are reconciled with the total time shown by periodical payrolls, from which the operating payroll data (Figure 3) are prepared for wages, as well as hours, and the latter is the basis for entry in the respective general accounts for each of the operating departments shown by Figure 1. Further details of wage costs are developed for each process as indicated by Figure 2.

The principal causes of variances in labor costs are (1) the extent of non-chargeable hours, and (2) the wage premiums for overtime. These are shown in total for departments by Figure 1-a and for processes by Figure 2.

Overhead Expense

For each of the items shown by Figure 4, an account is to be maintained in the general accounts for overhead expenses. For property and storeroom the method of distribution is indicated by Figure 4. Under factory overhead direct charges are to be determined for each operation on appropriate bases and other charges are to be distributed to the various operations affected on an equitable basis. Shipping and delivery, selling, and administrative expenses are to be distributed to operations on the basis of total prime cost consisting of operating wages, plus factory overhead expense.

Work in Process

At the end of each month (or other accounting period) a summary is to be made of job orders in process as to the number of chargeable hours for each process and computations made of the total amounts of actual and standard costs of such hours at the rates shown by Figure 2 for wages and factory overhead expense. The increase or decrease of these totals, as compared with those at the end of the prior period is to be shown as indicated by Figure 1-a.

Operating Accounts

For factory operations a series of accounts is to be maintained for each process, grouped by departments. Each account covers one process and may be provided with analysis columns for the data shown by Figure 2 for hours and wages, with additional columns for each item of direct factory overhead expense (as shown by Figure 4) and for distribution of other factory overhead expense and shipping and delivery expense. The totals of these process accounts will be controlled by cost of sales accounts for each department and with adjustment for work in process will be in agreement with the totals shown by Figure 1. To these totals will be applied the distribution of commercial overhead expense to develop the totals shown by Figure 2.

COST ACCOUNTING IN RADIO MANUFACTURING

By
H. J. MYERS *

I. DESCRIPTION OF THE INDUSTRY

Classification of the Industry

Radio, prior to the war was thought of as being largely the manufacture and sale of home receiving sets. Developments during the war have added many varieties and uses especially when two-way communications and television are taken into account—all of which is a part of the radio industry. Many industrial uses are developing which are specialized applications of electronics. However, the largest volume of the radio industry is obtained from the manufacture and sale of the "home receiving sets," the automobile receiving sets, and the equipment associated with broadcasting. Included in the same classification of product is the television set now being introduced to the public.

The radio industry is essentially an assembly type industry. It puts together materials and parts which become mechanical and electrical subassemblies and final assemblies. Companies differ in the amount of parts they make for their own use but the problems associated with an assembly industry all apply to the radio industry.

Origin of Products

The origin of a radio set is largely the product of the combination of sales research and engineering development. The sales research is always anticipating what can be sold to the public. In this way they are guided by the types of sets previously sold and by keeping informed of latest developments in the engineering laboratory. Then by close cooperation with the engineers new developments are merged into variations of former models or entirely new models developed to incorporate those new ideas believed to be acceptable to the public if properly promoted.

The keystone of the entire radio industry is its engineering laboratories. Production techniques are important, but without the engineering developments the production geniuses would have little with which to work. Radio is highly technical and for that reason the engineering laboratory must be the point of direct origination for all models as they are first introduced to the production departments to be manufactured.

Sources of Raw Materials

The radio industry, like the automobile industry which preceded it and from which many of the most successful techniques were borrowed, had developed a

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large "parts industry." The parts industry has become specialized in making various parts and, because of the large volume of such parts when combined for the industry, is able to make them both better and cheaper than each individual set manufacturer could do for itself. Therefore, the sources of raw materials are mainly two—

1. Steel and wire mills—the real raw material for the radio industry.
2. Parts fabricators—Purchased parts.

In addition to the above two, depending on the company, the lumber industry may be a source for cabinets, and the chemical industry furnishes finishing materials.

There are plating materials and other operating supplies obtained from many sources but, in all, this is minor in amount when compared with the two major sources listed.

Organization of Plant

The organization of each plant will vary considerably, depending on many variable factors. However, this description of cost accounting will be based on an average organization confined to the manufacture of home sets and leaving out the specialized products. Since the problems are those surrounding the assembly industry, the addition of more departments to take care of the specialized activities and provision for the collection of expenditures in accordance with the same principles herein will readily take care of any additional extensions of operations necessary.

The organization should logically follow the natural steps in developing the products which are—

1. Engineer the product.
2. Plan the facilities required and procure them.
3. Plan and procure the materials.
4. Plan the operations and set up necessary departments to produce the product.

In order to obtain control over costs of operating, it is essential to set up an organization so that responsibility can be placed. The minimum number of departments to accomplish the tasks to be performed should be set up and recognized as "units of responsibility." A department should be a clear-cut activity that must be performed. It also becomes a cost collection center for all expense items. Each one should be in charge of someone. In smaller companies more than one department or activity may be supervised by the same individual, whereas in larger operations each separate activity may be in charge of a full-time supervisor. The organization should fit the activities to be performed and not the personnel. In order to obtain cost control, the accounting structure must fit the organization so that costs can be collected according to "units of responsibility" without the need for allocating, prorating, or dividing any expenses.

Figure 1 is a simple organization chart which embodies the principles just set forth. In general the average company's organization will consist of quite a few service or contributing activities and not quite so many producing activities. A summary of the departments might appear as follows:

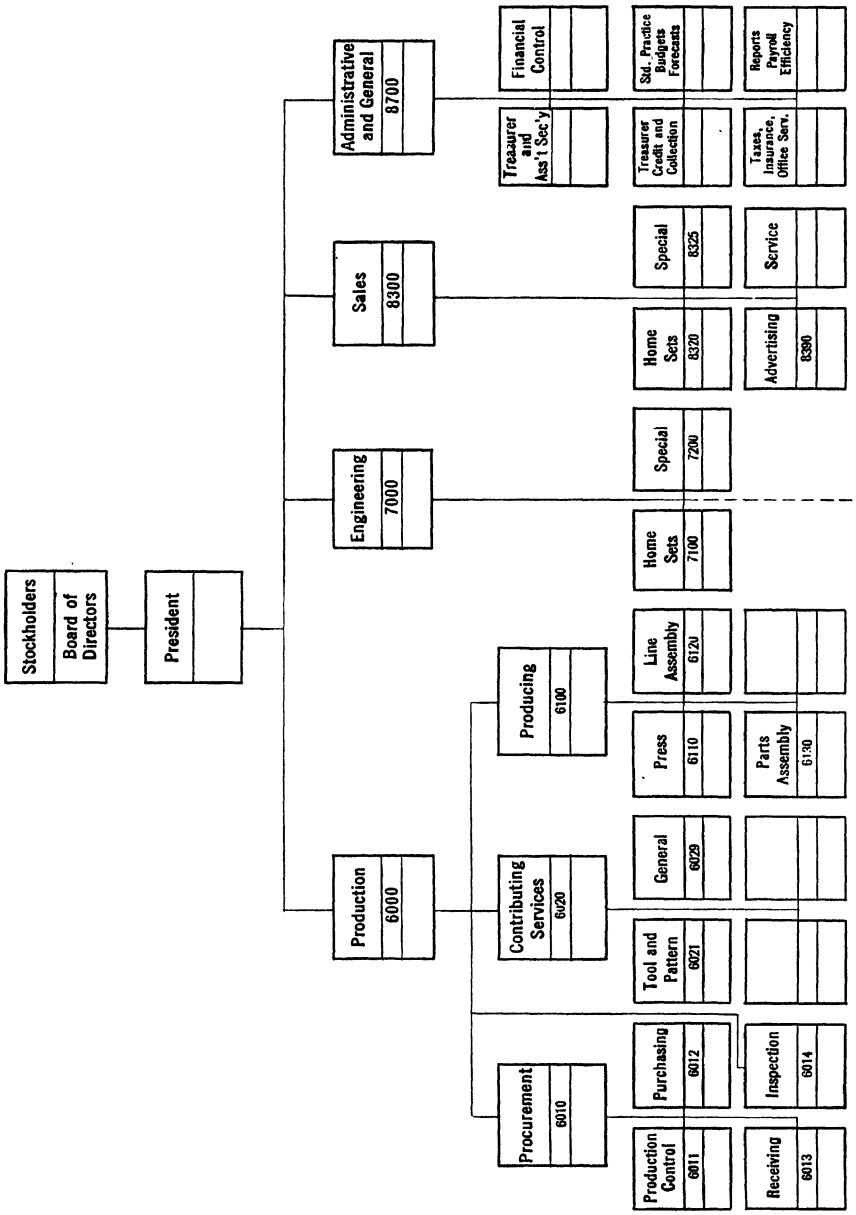


Fig. 1. Numbers shown are department numbers.

	Departments
Preparation—	Engineering—including drafting.
Procurement	1. Material, Planning, Scheduling, and Production Control. 2. Purchasing. 3. Receiving. 4. Incoming Inspection.
Contributing	1. Tool Room. 2. Maintenance. 3. Shipping and Finished Goods. 4. Process Engineering and Time Standards. 5. Watch and Janitor Service. 6. General Factory.
Producing	1. Parts Fabrication. 2. Subassembly. 3. Main Assembly Lines including Packing.
Sales and Administrative	1. Sales—Field Men. 2. Sales—Office and Administration. 3. Advertising Supervision. 4. Administration—General. 5. —Financial. 6. —Secretarial.

Production Order System

The production order system used for the radio industry is really more a system of production releases based on a master production schedule. It is so designed that production is released for one or more models at one time. Usually a whole group of models are included in one release. The quantities for each model may be increased or decreased at any time depending on the relation of orders booked in comparison with the production releases for the corresponding models. Initial releases of production are based on a master schedule of models that furnishes the basis for the quantities.

Production Releases Control All Components

When a production release is issued it authorizes the planning and procurement of all parts to be purchased and also the components to be fabricated in the company's own plant as well as the purchase of the raw materials therefor. Hence, there is no production order to be issued for each part or component since the parts lists, bills of materials, and labor route sheets provide the basis for operation and instructions and the production release automatically establishes and authorizes the production of specified items in balanced quantities necessary to produce the models in the quantities listed on the master schedule. All production is therefore controlled according to the various part numbers.

II. How to Design the Cost System

What Information Is Required

The radio industry is essentially a line-production application to a mass-production problem. As a result, planning of production costs requires the consideration of small fractions of a cent per model. It is therefore essential that the actual operating costs be controlled; otherwise the savings made in the planning of costs may be more than lost in actual operations. Cost control, therefore, is the prime requisite because costs and pricing must have been planned in advance.

Some of the essential elements that must be controlled, and the reports that must be provided to indicate the effectiveness of the responsible operating individuals are the following—

1. The planned cost of all elements for each product or model.
2. The effectiveness in the use of materials, manpower, and plant facilities by those responsible for their supervision.
3. Data for current operating control and analysis of variations from planned operations.
4. Data for all the necessary monthly financial reports on operations that furnish analysis of differences from budget by causes and responsibility.

Reports, and the sources of the information entering into them, must be designed and organized so as to be quickly and simply collected and summarized thereon. Copies should be provided to the operating personnel to inform them promptly of the results of their efforts.

Considerations in Designing the System

The success of any business is measured by the continuing and consistency of the profits earned. Profits in the radio industry can only be realized if they are first planned in a master budget and then injected into the pricing policy of the company. This is the first step in profit planning. A second essential step is a plan of cost control technique and its effective application to the operating problem. The proper attitude of the managerial group toward the objectives of the plan is also essential or the effectiveness of the established techniques will be impaired.

In order to accomplish the objectives just set forth, a plan must be evolved that will measure all performance. Cost control technique is really a measuring technique and the entire plan must keep it in mind. Ways and means of obtaining this objective must be developed.

Standard Cost System Most Generally Favored

Every kind and variety of cost system may be found in use somewhere in the industry. However, the system recommended by the National Electrical Manufacture's Association, to which the radio industry belongs, for all kinds of electrical manufacture is what is commonly called the standard cost plan. The standard cost plan, with complete budgetary control, is most generally used in the larger and most successful members of the industry. It is not necessarily used by the greatest number of the industry, but those using it produce the largest percentage of the total volume. The trend since the war is toward more and more cost control and standard cost accounting is cost control.

The standard cost plan requires that—

1. All operations be planned in advance.
2. All operations be measured.
3. All variances and/or exceptions be tabulated, and classified by cause and by responsibility.

The trend since the war is toward more and more cost control not only in the radio industry but in all industry. Contrary to most popular belief, a standard cost system is not necessarily a means of promptly determining costs because if enough is spent to keep up an actual job cost system, a cost of a job can be determined in total almost immediately after its completion. But, cost control is impossible and for continuous production, costs at any intermediate stage of production is not ascertainable without a shutdown and inventory. With a standard cost system—

1. Costs are determined or planned in advance of production and there are no other costs except costs of variances which are costs of inefficiencies or unplanned operations.
2. Cost control is obtainable.
3. Cost of cost accounting is radically reduced.

III. Description of the Cost System

The Objectives and Their Approach

The objectives to be attained in the radio industry with the aid of a cost system are to—

1. Set up standards of performance for all elements and all activities in the business.
2. Set up a financial goal—the budget.
3. Develop reports for top management that give, at a glance, all the pertinent financial control information (profit and loss and variance statements).
4. Set up an organization chart reflecting lines of authority and responsibility.
5. Develop a chart of accounts around the organization for the collection of data according to responsibility and for the summarization of expenditures in the form that will fit into the profit-and-loss statements.
6. Develop product costs in advance of production based on the standards.
7. Account for all exceptions to the standards and classify and report them according to—
   (a) causes
   (b) sources (responsibility).

Profit-and-Loss Statement

All the work in connection with any accounting system must be tempered by the kind and form of the profit-and-loss statement. Therefore it is well to first design a profit-and-loss statement that will present the data to top management in proper form and in a way so that it can be read quickly. Then develop the rest of the system and reports so that they all lead up to the ease of preparing of the profit report.

The profit-and-loss report and all other reports subsidiary thereto must be developed so that they contribute to the attainment of the various objectives set forth in the next preceding section.

INCOME BUDGET COMPARISON

19___ Report No.____

Line No.	Particulars	This Month This Year		This Year To Date	
		Budget	Actual	Budget	Actual
A	B	C	D	E	F
1	Units Produced				
2	Units Sold-Gross				
3	-Returns				
4	-Net				
5	Net Sales ($) Actual	$100,000	$105,000		
6	Standard Manufacturing Cost of Sales	75,000	80,000		
7	Standard Gross Profit Less Price Difference	25,000	25,000		
8	Cost Variances Absorbed	3,000	5,000		
9	Actual Gross Profit	22,000	20,000		
10	Expense_____-Advertising				
11	-Sales-Service-Etc.				
12	-Administrative				
13	-Total	9,000	10,000		
14	Net Operating Profits	13,000	10,000		
15	Income Credits	1,000	800		
16	Gross Income	14,000	10,800		
17	Income Charges	2,000	1,800		
18	Net Profit Before Taxes	12,000	9,000		
19	Provision for Income Taxes				
20	Net Profit				
21	Surplus Charges-Direct				
22	-Dividends				
23	-Total				
24	Net Increase or (Decrease) in Surplus				
25	Net Profit per Share on ( )				
26	Units Returned to Units Sold %				
27	Average Price per Unit Sold $				
28	MANUFACTURING COSTS AND VARIANCES				
29	Material Purchases-Standard				
30	-Variances				
31	-Ratio				
32	Labor Standard				
33	-Variances				
34	-Ratio				
35	Burden -Standard				
36	-Variances -Expense				
37	-Volume				
38	-Total				
39	-Ratio				
40	Total -Standard				
41	-Variances				
42	-Ratio				
43	ANALYSIS OF NET PROFIT VARIANCE				
44	Sales Actual at Standard Prices		$107,000		
45	Net Profit Variance (C18-D18)		(3,000)		
46	Price (44D-5D)		(2,000)		
47	Volume (44D-5C) X 52C		1,750		
48	Variety (44D X 51C)-ED		250		
49	Admin. (13) + Non-Oper. (15-17) (Col. C-Col. D)		(1,000)		
50	Manufacturing Variances (8C-8D)		(2,000)		
51	Standard Cost % To Net Sales	75,0			
52	Gross Profit % To Net Sales	25,0			
53	Variances Absorbed % To Net Sales				
54	Advertising % To Net Sales				
55	Sales Expense % To Net Sales				
56	Administration Expense % To Net Sales				
57	Income Crs. & Chgs. % To Net Sales				
58	Income Tax % To Net Sales				
59	Net Profit % To Net Sales				

Fig. 2.

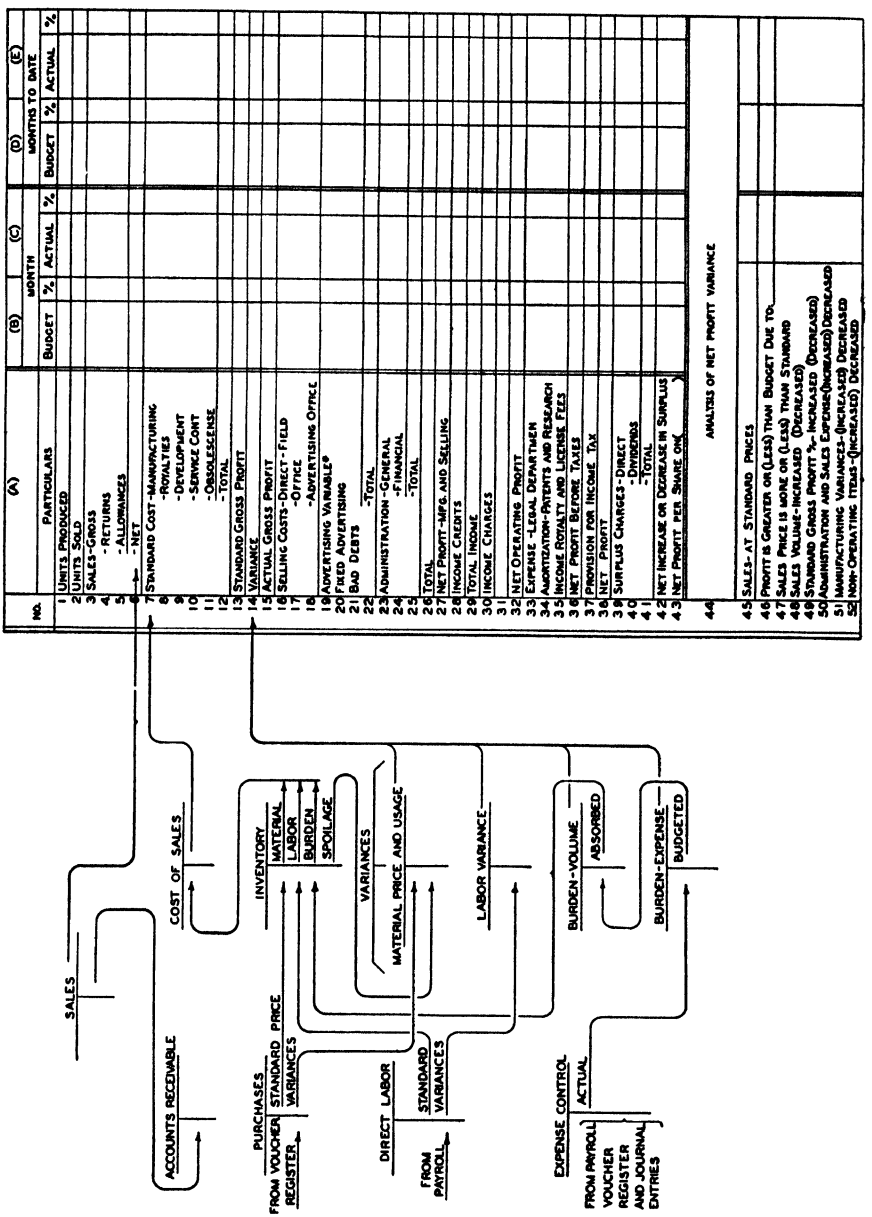


Fig. 3. Flow of Costs between Cost Accounts and Operating Statement.

Figure 2 is an example of a profit-and-loss statement designed to furnish top management cost control information and budget comparisons.

Figure 3 is a chart illustrating the flow of costs between cost accounts and the operating statement (Profit and Loss).

Figure 4 is an example of a report of usual cost variances most common to the industry.

The profit-and-loss statement (Figure 2) is so designed that it can be used for one or more product lines. When more than one line of product is manufactured and sold, say three lines, there would be four separate reports used—one each for the three lines and one for the total reflecting the total for the entire business. The totals for any item would be the sum of the same items shown on the three subsidiary schedules or reports.

Month_____ 19_____

DETAIL OF VARIANCES	Month		Months to Date	
	Budget	Actual	Budget	Actual
Purchase Price				
Over Use and Spoilage				
Labor				
Burden—Expense				
—Volume				
—Departmental				
Specification Changes				
Substitutions				
Repairs to Parts—by Supplier				
—in Plant				
Provision For Inventory Adj'ts				
Engineering—Expense				
—Absorbed (cr)				
TOTAL OPERATING				
MATERIAL BURDEN				
Freight & Drayage				
Production Control				
Purchasing				
Receiving				
Inspection (Incoming)				
Materials Move				
Material Warehousing				
Absorbed in Costs (cr)				
Material Burden Variance				
TOTAL-ALL VARIANCES				

Fig. 4. Manufacturing Variance Report.

Variances Used

The variances used in the radio manufacturing business are the more commonly accepted variances for an assembly type industry. The variances listed on the manufacturing variance report, Figure 4, are the most common variances somewhat condensed. Further subdivisions of some of the variances may be made to suit the individual company management's preference and needs. A brief explanation of the variances will follow.

Variance	*To Accumulate difference between*
Material—Price	The price paid and the standard used in all product cost tabulations.
Material—Wage and Spoilage	Standard specified quantities and waste and/or spoilage that must be replaced.
Labor	This can be further broken down to reflect differences due to rates and differences due to efficiency. This can be done on a monthly report that shows the differences and then the net amount taken into the account or separate accounts provided to suit personal tastes. The report would show more detail than two accounts anyway.
Burden—Expense	Budgeted expense (fixed plus variable allowed for actual volume operated measured by standard) and the actual expense.
Burden—Volume	Actual volume, measured by standards, and planned or budgeted volume (that volume accepted for the annual normal budget and used as the *base* for establishing the standard burden ratio).
Burden—Departmental or "balance"	Difference in actual operating balance between departments as compared with the balance used when establishing standard burden ratio. If one over all rate is used for charging inventory but departmental rates are used for setting the monthly departmental budgets of expense for control purposes the total expense for all departments will be different than the total arrived at by multiplying the total standard labor (or hours) by the total standard burden rate. For small companies, or if production can be so well controlled that the flow is "even" and in "balance" through all processes there will be no need of this variance account. It is not in general use.
Specification Changes	Cost of additions or differences between materials omitted and those added by authorized changes.
Substitutions	Difference between cost (at standard price) of the materials and parts specified on parts lists and those substituted temporarily in order to keep production going.
Repairs to Parts—Supplier	Actual invoice cost of making repairs to parts damaged by handling and other causes and which are returned to the supplier because of need for its specialized skills and/or facilities; the repairs for which are authorized on a proper purchase order.
Repairs to Parts—in Plant	All those parts either company made or purchased, which are repaired in the plant the costs for which are collected against a special shop order.

Provision for Inventory Adjustment	This is charged with a predetermined percentage and an inventory reserve credited to take care of special write-offs and adjustments.
Engineering—Expense —Absorbed (Cr)	The radio industry is built entirely on intense engineering development continuously pursued. There are several ways of handling engineering but for the smaller company, or any company not maintaining large research staves, the method outlined herein is simple and practical. The total of the engineering department expense is transferred to this account as a debit and the amount absorbed into costs, based on a predetermined percentage of standard labor (or hours) or whatever base may be used, is credited to the account "absorbed." The difference between the two is a variance—a combination of volume and spending because engineering is mostly fixed expense.
Material Burden	
Freight and Drayage Production Control Purchasing Department Receiving Department Inspection (Incoming) Materials Move Material Warehousing Absorbed in Costs (Cr)	All of these accounts are totals of the corresponding departments expenses and are treated as a material burden. The difference between the departmental expenses and the amount absorbed at the standard rate is a variance.

Individual Products Costs

Costs of products are determined in advance of production. This is accomplished by pricing a copy of a bill of materials and/or parts list for each model to be made. The prices used are previously established standard material prices. It will be found that a very large quantity of the parts and subassemblies have been previously used and only a few will need to have new prices obtained or estimated.

Likewise, labor route sheets or operation lists show the man-hours required to perform all the operations on all parts and assemblies.

The cost summary, Figure 5, illustrates a satisfactory summary. To it are summarized all the direct costs. As many major items are shown separately as the management has real need for. The summarized entries are supported by the details contained in the parts list and labor operation or route sheets. The two direct cost elements are kept separate throughout. Material and parts costs represent exactly what all the materials and parts required will cost to purchase, priced at the standard material price without labor, burden, or even any material burden added. The same principle is followed for labor; labor hours only are shown and then are converted into value in total by only one pricing and extension.

Figure 5 illustrates with a filled-in example some of the principles just set forth. A separate sheet is provided for each model. Distribution is limited to top management including the sales manager. It is also the basis for costing sales.

STANDARD COST SUMMARY

Date _____ List Price				Model _____ Tool Cost	
Discount				Est. Qty.	
Net Invoice Price	Description				
Less Excise Tax					
Net Amount to Company					
Engineering to be Billed					
Tools to be Billed					

Cost of Components	Material		Labor (1)	Mfg.	Total
	Base	Burden ____ %	Base	Burden ____ %	Cost
Total Base Cost					
____ % Allowance for Manufacturing Variances					
Total Manufacturing Cost Before Royalties				(A)	
Royalty Calculations:					
Total Royalty Cost				(B)	
Total Cost to Manufacture (A + B)				(C)	
Standard Gross Profit ____ % and Amount				(D)	
Selling and Advertising Cost ____ % of (C)				(E)	
General, Administrative and Other Costs ____ % of (C)				(F)	
Total Distribution and Administrative Costs (E + F)				(G)	
Standard Net Profit ____ % and Amount (D − G)					

Fig. 5.

How the Standards Are Created

Standards, in general, are based on normal performance for efficient use of material, men, and facilities. They are attainable standards.

Material Quantity Standards.—Since a radio consists of many parts and subassemblies, there are many standards of quantity to determine. However, the quantities are entirely those specified on a parts list and the quantity of a raw material required to make the parts fabricated within the plant.

Material Price.—Prices of the various materials and parts should be estimated at the start of each year for the entire year. This is done by using the records on all the parts that have any history, but the historical record should not be the basis —it should only be a guide. The purchasing agent and the cost accountant should jointly agree on a price after taking into account the past record of various suppliers, possible new sources, modifications of specifications and/or tolerances, current price trends, and anticipated volume required. The price should be set so that if possible there would be no price variance on each item at the end of the year. This same procedure and reasoning should follow on all the hundreds and thousands of items to be used on all current or new models. The records must be checked and new prices shown and approved on every item. None must be missed even if some must be completely estimated. The job must be a complete one.

Labor—Rates.—In most cases the rates to be paid per hour for labor (even piece rates when used) are a part of a union contract in which case they are the standard labor rates. However, usually many types of labor with varying rates are covered. Therefore it is not practical to use every individual rate for all the types of labor included in the contract. As a result it is usually practical to compute a weighted average rate by departments, or certainly by specified groups to be used for costing purposes.

Labor—Hours.—True labor efficiency can only be computed by measuring the quantity of labor taken (actual hours) by the output in standard (standard hours) without any conversion to money or the introduction of any other variable. Therefore standards for efficiency measurement are also the standards for conversion to standard labor cost (standard hours extended by standard labor rates). The standard hours are in turn built up for each component and assembly, synthetically from basic time standards that have been tabulated from motion and time study. The time values shown on route sheets furnish not only the base for standard labor cost and measurement of labor efficiency but the route sheets with the time values furnish a medium of instruction to labor. They are really an instruction sheet showing the operations necessary and accepted as standard, the time allowed, and the pieces per hour that are normal for each operation. The detail of how to establish basic elemental time standards and their use is covered in a number of good books on time and motion study.

Burden.—The establishment of burden standards consists of a very complete study of the requirements for each department in terms of—

1. How much expense by each applicable classification is constant or continuing in fixed amounts regardless of production? These may be called "period costs." The standard is the amount determined for a "period of time."

2. What rate of expenditure should apply to other items? Such items are the variable or controllable costs and a standard rate to a man-hour, machine-hour, or standard labor dollar should be established.

The foregoing standards are only the basic standards that are to be used for budgeting, forecasting, and cost control. The budget rate to be used for absorbing expenses into inventories and also for completing a standard cost is determined by dividing the total fixed amounts set up for budgetary control by the budgeted base (standard labor, standard man-hours, or whatever else is used for a unit of measure). An example illustrating this is the following, using only a few of the usual departments in a radio manufacturing company:

	Service Departments				Productive					
	Maintenance		General		Parts		Subassembly		Lines	
	Fixed	Var. Rate	Fixed	Var. Rate	Fixed	Var. Rate	Fixed	Var. Rate	Fixed	Var. Rate
Salaries	$300	—	$1500	—	$300	—	$300	—	$400	—
Rent	—	—	800	—	—	—	—	—	—	—
Depreciation	—	—	1000	—	—	—	—	—	—	—
Taxes	—	—	500	0.040	—	—	—	—	—	—
Supplies, etc.	200	0.010	400	0.030	—	0.030	—	0.035	—	0.035
	—	—	300	0.020	—	—	—	—	—	—
Total	$500	0.010	$4500	0.090	$300	0.030	$300	0.035	$400	0.035

Summary of Above

	Fixed	Var. Rate
Maintenance Department	$ 500	0.010
General Factory Depts.	4500	0.090
Parts Fabrication	300	0.030
Subassembly	300	0.035
Lines Assembly	400	0.035
	$6000	0.200

The fixed amount of $6000 is a period cost. It applies to a period of one month regardless of the production volume.

The rate of 0.200 is a variable applicable to each standard labor dollar value of production.

Assume the budgeted (normal) standard labor for the current budget period is $6000 monthly. Then the standard burden rate would be—

$$\frac{\text{Monthly budget of fixed expense} \quad \$6000}{\text{Monthly budgeted standard labor} \quad 6000} = 100\%$$

Add to the above the variable rate of 0.20 or 20% and the standard burden rate would be 120% to the standard direct labor. This rate would be used unchanged for the period for which the current budget applies and variances therefrom calculated and recorded in the variance accounts.

Revision of Standards

The time for revising standards will vary considerably between companies and individuals. It will also vary as between basic standards and costs of completed

articles. The matter of when standards should be revised and how the revisions are to be handled should be established as a company policy and covered by Standard Practice Instructions.

Basic quantity standards, if carefully established, should never be changed.
Changes in methods, eliminating certain basic standards and/or adding others, require a change in the totals or over-all standard—yet the basic standards themselves remain unchanged.

Price standards (material and labor) should be changed each year if the trend is sharply up or down. Changes at other times should be limited to correction of major errors.

Changes of standard costs of completed models based on change orders can be changed currently and the standard costing of sales reflect the changes. However, better practice leaves model costs unchanged but calculates the cost of changes based on change order differences extended by the monthly production and charges (or credits) them to appropriate variance accounts.

Revisions of standards affecting detail operations and also materials should be effected by some method employing a formal change order procedure with copies going to everyone vitally affected. The change forms, perhaps differing in details, applicable to both material and labor, should be priced up at standard and the difference in standard cost tabulated. They should be tabulated by models so that the amount of increase (or decrease) will be known by models.

How the Data for the Income Budget Comparison are Obtained

Determining Net Sales

The radio industry is one of the industries that has been burdened for many years with an excise tax. There are two acceptable methods of invoicing excise tax. It may be billed as a separate item or it may be included in the total without showing it separately on the invoice. Regardless of how shown, it is preferable to deduct the amount for tax and record only the true sales amount. The tax is credited directly to an accrued liability account.

Returns and Allowances

Whether or not these items are shown separately on a statement is a matter of company policy.

Cost of Sales

The form illustrated, Figure 2, shows five separate items as cost of sales. The most important, of course, is that of standard manufacturing cost of sales. This consists of the total quantity of each model sold extended by the three separate cost elements of material, labor, burden. The source of the unit cost for these three cost elements is the cost summary, Figure 5. It also provides the cost of royalties. Royalties are treated as a cost of sales in the radio industry. The variance statement shows a space for variations in royalties. This is to take care of the standard amounts charged to cost of sales and taken from the cost summary Figure 5 and the amount actually paid thirty days later. The amount actually paid may differ slightly because price adjustments and a few other deductions are permitted for

payment of royalties, whereas the standard cost summary shows the amount based on the standard sales price which may be more or less the actual amount finally received.

Development Costs

The charge to this account would only apply for some new and different product. The charge here will originate from a predetermined percentage of sales estimated to absorb the engineering and development cost over the life of the sales for the product.

Also, a direct charge for a write-off of development expense accrued on a project that was abandoned because of doubtful commercial value.

Service Contingencies

Radio carries with it an obligation to give service for a limited period—usually 90 to 120 days. This period does not begin after shipment by the factory but rather after purchase by the consumer which frequently throws the service burden into the year succeeding the sales. Furthermore, in order to maintain good will a manufacturer will make field adjustments for service or supply parts long after sales have been made. Therefore some provision should be made out of current sales to take care of such charges when they occur without affecting the current operations. Therefore an estimated percentage of sales provides this charge and the contra is credited to a reserve for service contingencies.

Obsolescence

This is a current provision out of current sales to take care of unusual write-offs and/or inventory adjustments. The credit is to an inventory reserve.

Accounting for the Variances

The most important statement (or section of statement) is the breakdown of the variances which is illustrated by Figure 4. The costs that get into this statement is a direct measurement of the effectiveness of management. It shows whether or not improvement is being made.

Determining the Material Price Variance

The sooner a price variance can be segregated the better for control and simpler clerically. Therefore the price variance is most generally separated on the purchase invoice and charged to the variance account immediately.

Over Use and Spoilage

The charges to this account are obtained from summarized "spoiled work" or scrap reports.

Burden

Burden variance breaks down quite naturally into two different kinds—

1. Volume (capacity variance)
2. Expense (spending efficiency)

The amounts applicable to each is determined by the following entries—

(1) Dr Expense variance (actual)	$7250	
Cr Expense transfer account		$7250
(2) Dr Inventory @ standard rate	$6000	
Cr Volume variance		$6000
(3) Dr Volume variance—budgeted Amount	$7000	
Cr Expense variance		$7000

Assume the following—

Actual expense	$7250
Actual standard labor	5000
Budgeted standard labor	6000 per month
Budgeted fixed expense	6000 per month
Standard variable rate 20%	
Standard charge to inventory (5000 × 120%)	$6000

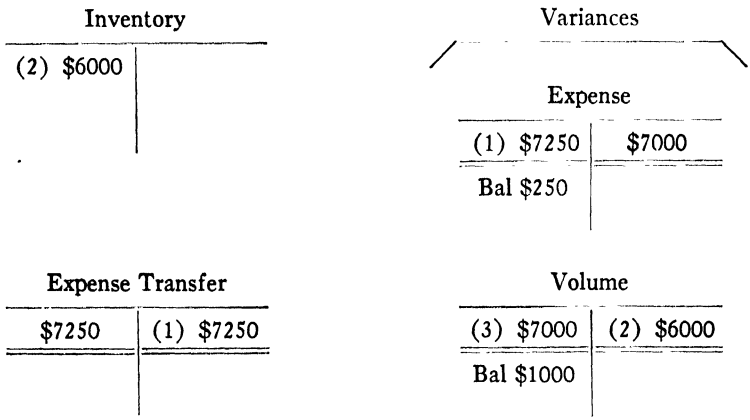
Then—

Allowed budget would be—

Fixed amount	$6000
Variable @ 20% of $5000 =	1000
Total budget allowed	$7000
Actual expense	7250
Spending variance	$ 250

Volume variance = 7000 — 6000 = $1000

The following "T" accounts, showing the three Journal Entries listed above entered will clearly illustrate how this works.



Burden—Departmental or Balance.—This was explained in the section, "Variances Used."

Analysis for Supervising Executives

The analysis for supervising executives consists mostly of operating efficiency reports (labor) and spoilage reports (material), both of which may be prepared daily or weekly depending on the requirements of the management. These daily or weekly reports provide the real control information for supervision guidance. There are other unit reports on production releases, production shipments, and orders received by models that provide unit control. Units properly controlled likewise control cost.

The more formal reports and analysis are the month-end analysis report, Figure 4, and the departmental expense comparison, Figure 6.

The current report on labor efficiency is probably the most effective report for supervision because it shows quickly the true efficiency of labor for the preceding period covered—daily if desired. Figure 7, labor control chart, illustrates how labor may be controlled by groups on a measured daywork basis. If group incentives are used a few more columns must be added to the reports.

Other Variances

The remainder of the variances shown on Figure 4—namely, Engineering Expense and Material Burden, are sufficiently explained under "Variances Used."

EXPENSE COMPARISON

Report No. _____
Month _____

Division	Unit	Unit Head	Unit No.

Particulars		This Month			Months To Date	
		Budget	Actual	Adjustments	Budget	Actual
Basic Data						
Spoiled Work						
Labor - Division or Plant - Standard						
This Department - Actual						
- Standard						
Salaries	01					
Commissions	03					
Hourly Indirect Wages	05					
Annual Vacation Pay Accrual	06					
Total Payrolls						
EXPENSE OTHER THAN PAYROLLS						
Taxes - Property	10					
- Social Security	11					
- Other	12					
Insurance - Employee Benefit	15					
- Property and Liability	16					
Supplies - Operating	20					
Repairs - Buildings and Equipment	21					
Postage	22					
Fuel	23					
Services - Electric Current	30					
- Water and Gas	31					
- Telephone and Telegraph	32					
- Professional	33					
Rent	40					
Depreciation	41					
Travel and Entertainment	50					
Donations	55					
Membership, Dues, etc.	56					
Expense Recoveries (Cr)	90					
Total - Before Service Transfers						
Services - From Other Departments	95					
- To Other Departments	96					
Total - After Service Transfers						

Fig. 6.

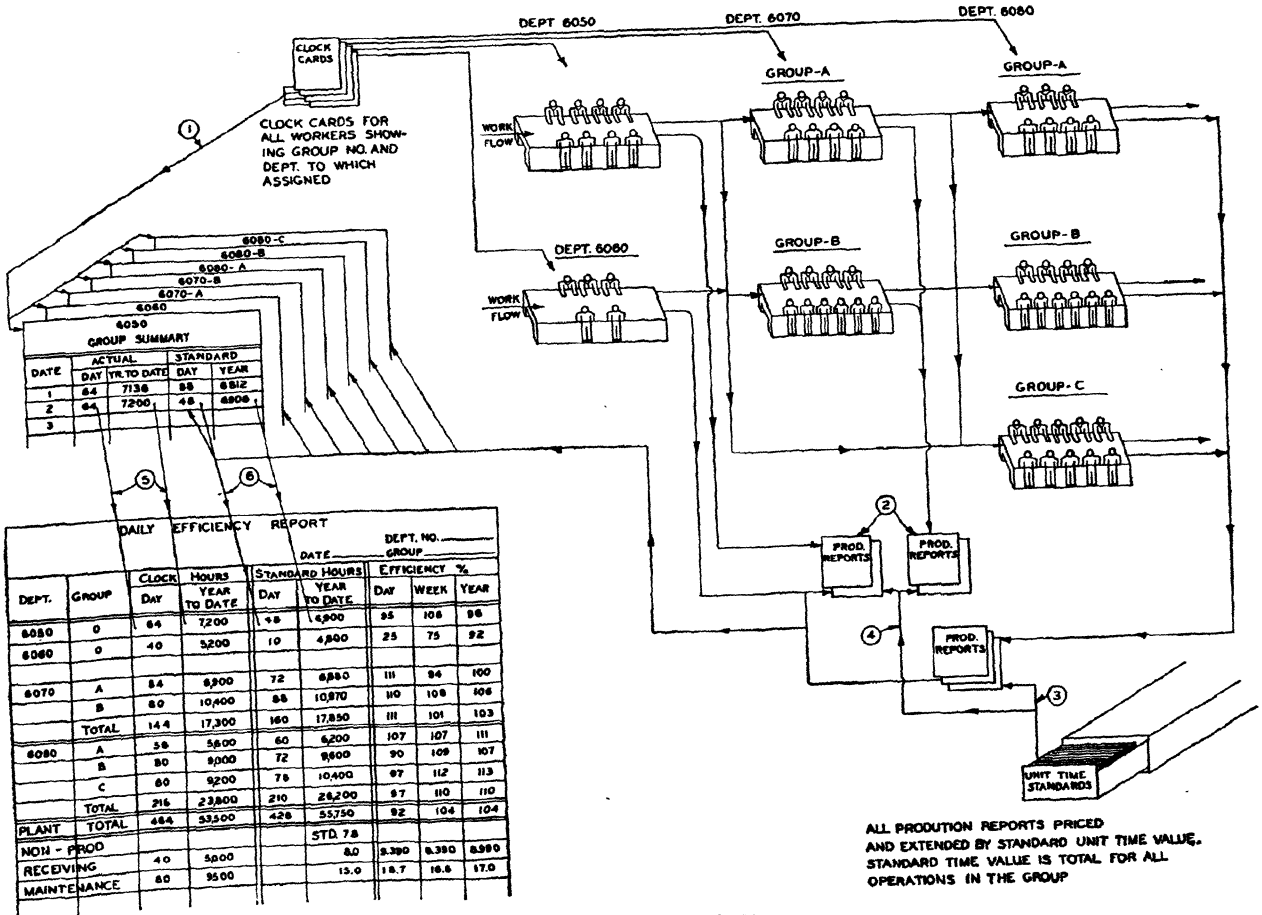


Fig. 7. Labor Control Chart.

COST ACCOUNTING IN THE RAILROAD INDUSTRY *

By

JOHN P. COLE †

I. DESCRIPTION OF THE INDUSTRY

Classification of Services

The railroad is primarily a service industry, engaged in the mass transportation of goods and persons. Its services divide generally into two classes, freight and passenger. Freight service embraces the transportation, in freight trains, of goods ranging from the smallest package to the mass movement of raw materials, livestock, produce, and manufactured goods. The principal function of passenger service is the transportation, in passenger trains, of passengers, mail, and express.

The railroads also render many auxiliary services. For example, in the transportation of perishable freight, refrigeration or heater services are provided when necessary. Grain elevators are operated in connection with the movement of grain, and livestock is fed and watered in transit. These constitute only a few of many accessorial services in connection with freight shipments. In addition, shippers are now availing themselves to a greater extent than ever before of "transit" privileges offered by the railroads. Under certain tariff provisions, shippers may store goods in transit, and in many instances may also process raw materials or semimanufactured articles en route to ultimate destination. In the final settlement, charges are based on the through rate from initial point of origin to final destination, although many months may elapse between the delivery of the shipment at the transit point and the reforwarding to destination.

In passenger service, accommodations are provided for passengers at stations, including restaurants, waiting rooms, etc. Passengers are fed en route through dining-car facilities, and sleeping accommodations are provided for overnight travelers in Pullman cars.

Principal Elements of Railroad Expense

The largest single element of railroad expense is labor, amounting generally to more than 50% of all expenditures. Unemployment compensation and railroad retirement taxes, which are directly related to employment of labor, also represent an increasingly important part of the over-all cost of operations. Other important items in operating expenses are fuel, and rail and tie replacements. Due to the vast

* This article is limited to over-all cost accounting, since the current development of unit costs through continuous processes in the railroad industry is neither essential nor practicable. In isolated cases where minimum or Interstate Commerce Act Fourth Section rates are involved, special studies are undertaken to develop approximate unit costs.

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physical plant necessary for nationwide mass-transportation service, depreciation of structures and rolling stock is likewise a substantial item.

In normal years the compensation of engine and train employees, including yard switching services, accounts for more than one fourth of the total labor cost. A slightly lesser amount, but usually in the neighborhood of 25% of the aggregate labor cost, is required for the maintenance and servicing of locomotives and cars. The compensation of maintenance of way and structures employees usually represents about 15% of the total labor bill. The remainder of the labor costs are distributed over agency forces, clerks, etc.

Sources of Motive Power

Since the beginning of the century, approximately 1% of the railroad mileage in the United States has been electrified. In recent years a number of roads have also introduced Diesel-electric locomotives, particularly in passenger and switching service. More than 90% of the locomotives in use, however, are steam. The principal fuel used in steam locomotives is bituminous coal. In many parts of the west, however, oil-burning locomotives are used, due to the inaccessibility of coal. A number of oil-burning locomotives have also been placed in operation in the south and east, for economy reasons.

Organization of the Railroad

Organizations on individual railroads vary considerably, but usually follow the same general pattern. The typical organization is set up according to functional responsibility, rather than according to type of operation. The organization is usually along the following lines of departmentalization, with department heads reporting directly to the chief administrative officer:

Operating Department
Traffic Department (Sales, Advertising, and Tariffs)
Legal Department
Accounting Department
Treasury Department
Purchases and Stores

The operating department is usually subdivided according to the following categories of work:

Maintenance of Way and Structures *
Maintenance of Equipment *
Transportation

Transportation operations are further divided into yard, station and train.

The primary operating unit of a railroad is the operating division, generally under the jurisdiction of a division superintendent. The number of operating divisions ranges from one or two on the smaller roads to thirty or more on the large trunk-line systems. On the largest systems, the road is divided into two or more regions, with a supervisory officer having jurisdiction over the divisions comprising each region.

* On some roads the Chief Engineer, Maintenance of Way and Structures, and the officer in charge of maintenance of equipment report directly to the chief administrative officer.

Interdependence of Railroads

Unlike most industry, the individual railroad does not furnish to its patrons the full product or service for which it contracts. A majority of freight shipments involve transportation over two or more separately owned or operated railroads. A substantial proportion of passenger traffic is likewise interline.

To achieve a maximum of speed and efficiency, it is necessary that freight shipments move from road to road without transfer of lading at junction points. Railroads are, therefore, built to standard gauge, and equipment must meet certain prescribed standards, to permit free interchange at junction points. The interchange applies principally to freight cars, settlements being made between the owning and using carriers on a daily rental (per diem or mileage) basis. Passenger cars are also interchanged in through service, but to a somewhat lesser extent than freight equipment. Locomotives are likewise sometimes interchanged for operating convenience.

Service and Production Units

The primary service unit on a railroad is the train, which in freight service ranges from one to more than a hundred cars. In passenger service the train ranges from two or three cars in light local service to fourteen or more cars on heavily traveled through routes. The principal production units are ton-miles in freight service and passenger-miles in passenger service. In mail and express service the railroads are merely the transporting agents of the U. S. Post Office Department and the Railway Express Agency. Compensation for mail service is based generally on space occupancy in the train, and, for express service, on net earnings of the Railway Express Agency, which is a subsidiary of the railroads. The volume of mail or express traffic is of direct concern to the operating departments of the railroad, however, to the extent of extra car or train requirements.

Railroad service units, or train-miles, do not necessarily fluctuate in proportion to production units, ton-miles, and passenger-miles. Schedules must be maintained and frequency of service provided to meet public demand. Costs in the railroad industry are, therefore, contingent, to a considerable extent upon the volume of train service made available to the public, rather than upon the actual volume of traffic, comparable to gross sales in other industries.

II. How to Design the Cost System

Essential Information

The cost system of the railroad must be designed to meet not only the needs of management, but also the requirements of Governmental bodies, which exercise regulatory powers over service, safety, and rates. The essential end products of the system are the determination of:

1. The cost and efficiency of maintenance of plant and rolling stock.
2. The cost and efficiency of each important phase of operations.
3. Data for budgetary control.
4. Data for operating reports, and income, profit-and-loss, and general balance sheet statements.

The cornerstone of railroad cost accounting is the prompt rendition of concise reports. In a manufacturing enterprise, a lag in sales, without corresponding lag in production, may mean merely a building up of inventories. In a service industry, there is no inventory of salable goods, and management must be continually on the alert to keep service attuned to public demands.

Unit Costs Not Practicable

Almost every one of the many millions of services that the railroads perform monthly, except possibly the transportation of identical shipments in the same train or the carriage of passengers in a single car between given points, has some characteristic which differentiates it, in the cost sense, from other traffic. Among other factors, density of traffic, length of haul, type of terrain, physical layouts at origin and destination, climatic conditions, etc., all have an important bearing upon costs. Delay in the completion of a haul, by reason of transit privileges, further complicates the matching of expenses with revenues. Even if it were possible to obtain a reasonably accurate apportionment of common expenses, such as maintenance of roadway and track, among the respective classes of service, the current allocation of costs to types of traffic benefited would be a tremendous, if not impossible, undertaking.

Some theorists, including the author of this article, have argued that accounting records could be maintained in such a manner as to permit derivation of average costs for particular types of traffic. Such costs would be meaningless, however, since little, if any, traffic moves under average conditions.

The absence of cost data for particular types of traffic presents no problem to management. In those isolated cases where minimum or Interstate Commerce Act Fourth Section Rates are involved, approximate unit costs are developed through special studies. A general policy of conforming rates to costs would not result, however, in a rate structure responsive to the demands of industry. If such a policy were adopted, the movement of low-rated commodities, such as sand and gravel, would be drastically curtailed or cease altogether, without a compensating increase in high-value commodities, which move freely at the higher rates. Obviously, therefore, the effect of rates upon traffic volume must be given primary consideration, if the inherent benefits of mass transportation are to be preserved. Elements, other than cost, to be given consideration in the establishment of rates include:

1. Value of service to shipper.
2. Value of article.
3. Nature of article.
4. Risk in handling.
5. Rates on similar articles.
6. Rates of competing carriers.
7. Competition between producers and producing areas.
8. Competition between articles and commodities serving like needs.

Objectives of Cost System

The railroad cost system is not designed to produce either unit costs or costs assignable to particular services. The Interstate Commerce Commission does require the separation of freight and passenger expenses. Since a considerable portion

of expenses is common to both classes of service, many arbitrary apportionments are necessary. The separations as made are of value only as a statistical yardstick, and it is generally conceded that the resultant totals do not reflect true costs of operation. When costs of performing a particular kind of service are required either by management or by regulatory bodies, the necessary information is obtained through special studies. In railroad costing, however, it must be recognized that the ultimate result under formula produces only approximations.

In the final analysis, one of the most important objectives of the railroad cost system is budgetary control. The system must, therefore, be so designed as to permit not only a post-mortem survey, but also to keep management currently informed of trends in operating revenues and expenses.

Standards of "Good Performance" Desirable

Although the railroad accounting system does not lend itself to the current measurement of full costs assignable to particular shipments or to the transportation of passengers between given points, many efficiency factors are derived by relating elements of cost to service units. In the railroad industry service units, such as gross-ton miles in freight service, car-miles in passenger service, locomotive-miles in switching service, and tons handled at freight stations correspond generally to production units in the manufacturing industry. In the administration of the budget, it is highly desirable to set up standards, based on past "good performance" on each of the respective operating divisions and at freight stations and loading and unloading docks and wharves. Substantial departures from prescribed standards can be analyzed promptly, reasons for excessive costs ascertained, and corrective measures taken.

RAILWAY OPERATING REVENUES

101. Freight
102. Passenger
103. Baggage
104. Sleeping car
105. Parlor and chair car
106. Mail
107. Express
108. Other passenger train
109. Milk
110. Switching
113. Water transfers—freight
114. Water transfers—passenger
115. Water transfers—vehicle and livestock
116. Water transfers—other
Total rail-line transportation revenue

131. Dining and buffet
132. Hotel and restaurant
133. Station train and boat privileges
134. Parcel room
135. Storage—freight
136. Storage—baggage
137. Demurrage
138. Telegraph and telephone
139. Grain elevator
140. Stockyard
141. Power
142. Rents of buildings and other property
143. Miscellaneous
Total incidental operating revenues
151. Joint facility—cr.
152. Joint facility—dr.
Total joint facility operating revenue
Total railway operating revenues

Fig. 1.

RAILWAY OPERATING EXPENSES

Maintenance of Way and Structures

201. Superintendence
202. Roadway maintenance
206. Tunnels and subways
208. Bridges, trestles, and culverts
210. Elevated structures
212. Ties
214. Rails
216. Other track material
218. Ballast
220. Track laying and surfacing
221. Fences, snowsheds, and signs
227. Station and office buildings
229. Roadway buildings
231. Water stations
233. Fuel stations
235. Shops and engine houses
237. Grain elevators
239. Storage warehouses
241. Wharves and docks
243. Coal and ore wharves
247. Telegraph and telephone lines
249. Signals and interlockers
253. Power plants
257. Power transmission systems
265. Miscellaneous structures
266. Road property—depreciation
267. Retirements—road
268. Deferred maintenance—way and structures—dr.
Deferred maintenance—way and structures—cr.
269. Roadway machines
270. Dismantling retired road property
270½ Road—amortization of defense projects
271. Small tools and supplies
272. Removing snow, ice and sand
273. Public improvements—maintenance
274. Injuries to persons
275. Insurance
276. Stationery and printing
277. Other expenses
281. Right-of-way expenses
Subtotal
278. Maintaining joint tracks, yards and other facilities—dr.
279. Maintaining joint tracks, yards and other facilities—cr.
Total—all road property depreciation and amortization of defense projects
Total—all other maintenance of way and structures accounts
Total maintenance of way and structures

Maintenance of Equipment

301. Superintendence
302. Shop machinery

RAILWAY OPERATING EXPENSES (Continued)

304. Power-plant machinery
305. Shop and power-plant machinery—depreciation
306. Dismantling retired shop and power-plant machinery
308. Steam locomotives—repairs
311. Other locomotives—repairs
314. Freight-train cars—repairs
317. Passenger-train cars—repairs
323. Floating equipment—repairs
326. Work equipment—repairs
328. Miscellaneous equipment—repairs
329. Dismantling retired equipment
330. Retirements—equipment
331. Equipment—depreciation
331½ Equipment—amortization of defense projects
332. Injuries to persons
333. Insurance
334. Stationery and printing
335. Other expenses
339. Deferred maintenance—equipment—dr.
Deferred maintenance—equipment—cr.
340. Major repairs—equipment—dr.
Major repairs—equipment—cr.
Subtotal
336. Joint maintenance of equipment expenses—dr.
337. Joint maintenance of equipment expenses—cr.
Total—all equipment depreciation and amortization of defense projects
Total—all other maintenance of equipment accounts
Total maintenance of equipment

Traffic

351. Superintendence
352. Outside agencies
353. Advertising
354. Traffic associations
355. Fast freight lines
356. Industrial and immigration bureaus
357. Insurance
358. Stationery and printing
359. Other expenses
Total Traffic

Transportation—Rail Line

371. Superintendence
372. Dispatching trains
373. Station employees
374. Weighing, inspection, and demurrage bureaus
375. Coal and ore wharves
376. Station supplies and expenses
377. Yardmasters and clerks
378. Yard conductors and brakemen
379. Yard switch and signal tenders

RAILWAY OPERATING EXPENSES (Continued)

381. Yard motormen
382. Yard switching fuel
383. Yard switching power produced
384. Yard switching power purchased
385. Water for yard locomotives
386. Lubricants for yard locomotives
387. Other supplies for yard locomotives
388. Engine-house expenses—yard
389. Yard supplies and expenses
392. Train enginemen
393. Train motormen
394. Train fuel
395. Train power produced
396. Train power purchased
397. Water for train locomotives
398. Lubricants for train locomotives
399. Other supplies for train locomotives
400. Engine-house expenses—train
401. Trainmen
402. Train supplies and expenses
403. Operating sleeping cars
404. Signal and interlocker operation
405. Crossing protection
406. Drawbridge operation
407. Telegraph and telephone operation
408. Operating floating equipment
409. Express service
410. Stationery and printing
411. Other expenses
414. Insurance
415. Clearing wrecks
416. Damage to property
417. Damage to livestock on right-of-way
418. Loss and damage—freight
419. Loss and damage—baggage
420. Injuries to persons

Subtotal

390. Operating joint yards and terminals—dr.
391. Operating joint yards and terminals—cr.
412. Operating joint tracks and facilities—dr.
413. Operating joint tracks and facilities—cr.

Total transportation—rail line

Miscellaneous Operations

441. Dining and buffet service
442. Hotels and restaurants
443. Grain elevators
444. Stockyards
445. Producing power sold
446. Other miscellaneous operations

Total miscellaneous operations

RAILWAY OPERATING EXPENSES (Continued)

General

451. Salaries and expenses of general officers
452. Salaries and expenses of clerks and attendants
453. General office supplies and expenses
454. Law expenses
455. Insurance
456. Relief department expenses
457. Pensions
458. Stationery and printing
459. Valuation expenses
460. Other expenses

Subtotal

461. General joint facilities—dr.
462. General joint facilities—cr.

Total general expenses
Grand total railway operating expenses
Operating ratio (ratio of operating expenses to operating revenues)

Fig. 2.

INCOME ACCOUNT

I. Operating Income

A. Railway Operating Income

501. Railway operating revenues
531. Railway operating expenses

Net revenue from railway operations

532. Railway tax accruals

Railway Operating Income

B. Rent Income

503. Hire of freight cars—credit balance
504. Rent from locomotives
505. Rent from passenger-train cars
506. Rent from floating equipment
507. Rent from work equipment
508. Joint facility rent income

Total rent income

C. Rents Payable

536. Hire of freight cars—debit balance
537. Rent for locomotives
538. Rent for passenger-train cars
539. Rent for floating equipment
540. Rent for work equipment
541. Joint facility rents

Total rents payable
Net rents
Net railway operating income

II. Other Income

502. Revenue from miscellaneous operations
509. Income from lease of road and equipment

INCOME ACCOUNT (Continued)

510. Miscellaneous rent income
511. Miscellaneous nonoperating physical property
512. Separately operated properties—profit
513. Dividend income
514. Income from funded securities
515. Income from unfunded securities and accounts
516. Income from sinking and other reserve funds
517. Release of premiums on funded debt
518. Contributions from other companies
519. Miscellaneous income
520. Delayed income credits

Total other income
Total income

III. Miscellaneous Deductions from Income

534. Expenses of miscellaneous operations
535. Taxes on miscellaneous operating property
543. Miscellaneous rents
544. Miscellaneous tax accruals
545. Separately operated properties—loss
549. Maintenance of investment organization
550. Income transferred to other companies
551. Miscellaneous income charges
557. Delayed income debits

Total miscellaneous deductions
Income available for fixed charges

IV. Fixed Charges

542. Rent for leased roads and equipment
546. Interest on funded debt:
(a) Fixed interest
547. Interest on unfunded debt
548. Amortization of discount on funded debt

Total fixed charges
Income after fixed charges

V. Contingent Charges

552. Income applied to sinking and other reserve funds:
(a) Income applied to capital funds under Governmental authority or other arrangements
(b) Increments to other special funds required to be retained therein and not subject to withdrawal except for purposes of the funds
546. Interest on funded debt:
(b) Contingent interest

Total contingent charges
Net income after fixed charges and other deductions

VI. Disposition of Net Income

552. Income applied to sinking and other reserve funds:
(c) Appropriations, allotments and payments of definite amounts to funds from income not includible in 552(a) or 552(b)

INCOME ACCOUNT (Continued)

553. Dividend appropriations of income
554. Income appropriated for investment in physical property
555. Stock discount extinguished through income
556. Miscellaneous appropriations of income
Total appropriations of income
602. Balance of income transferred to earned surplus

Fig. 3.

PROFIT AND LOSS ACCOUNT
(Earned Surplus)

Credits

Credit balance at beginning of year
Credit balance transferred from income
607. Miscellaneous credits

Debits

Debit balance at beginning of year
Debit balance transferred from income
613. Surplus applied to sinking and other reserve funds
614. Dividend appropriations of surplus
615. Surplus appropriated for investment in physical property
616. Stock discount extinguished through surplus
618. Miscellaneous appropriations of surplus
621. Miscellaneous debits

Net balance carried to Balance Sheet

Fig. 4.

CONDENSED INCOME STATEMENT *
Class I Railways of the United States
Year 1944

Operating Revenues	
Freight	$6,998,614,851
Passenger	1,790,305,288
Mail	130,245,809
Express	143,852,588
All Other	373,771,275
Total Revenues	$9,436,789,811
Operating Expenses	
Maintenance of Way and Structures	$1,263,291,756
Maintenance of Equipment	1,587,484,850
Traffic	136,744,342
Transportation	2,973,909,772
General	201,337,399
All Other	119,294,557
Total Expenses	$6,282,062,676

* Abstracted from Statistics of Railways of Class I, United States, Published by the Bureau of Railway Economics, Association of American Railroads.

Operating Ratio		66.57%
Net Operating Revenue		$3,154,727,135
Railway Tax Accruals		1,846,043,134
Net Operating Income		$1,308,684,001
Hire of Equipment	$ 152,013,718	
Joint Facility Rents	50,343,135	202,356,853
Net Railway Operating Income		$1,106,327,148
Other Income		211,347,311
Total Income		$1,317,674,459
Miscellaneous Deductions		41,377,047
Income Available for Fixed Charges		$1,276,297,412
Fixed Charges		566,400,041
Income after Fixed Charges		$ 709,897,371
Contingent Charges		42,708,969
Net Income		$ 667,188,402

Fig. 5.

The provision of and adherence to cost standards, when related to current traffic trends, is also valuable in forecasting net earnings and in the allocation of funds for maintenance purposes, including expenditures for programed replacements, additions and betterments, etc.

Railroads not only develop cost standards, but operating performance standards as well. These are developed with the view to obtaining the maximum efficiency commensurate with adequate service to the public. Many of the operating statistics are significant indices of operating efficiency, even when unsupported by related cost or man-hour data. For example, an increase in *gross-ton miles per train mile* is generally indicative of greater operating efficiency, which will be reflected in lower wage costs per 1000 gross-ton miles. Other significant statistical indices are the average load per car in freight service, and the ratio of loaded to empty freight car miles.

III. Description of the Cost System

Origin of the Railroad Cost System

The operating revenue, operating expense, income, and profit-and-loss accounts are prescribed by the Interstate Commerce Commission. (For lists of accounts and format of reporting, see Figures 1, 2, 3 and 4; and for the over-all application thereof, see Figure 5.) The accounting classifications are the outgrowth of many years of cooperative effort on the part of railway accounting officers, in conjunction with regulatory authorities. While the universal application of budgetary control, in the modern sense of strict accounting supervision, is a more or less recent development, railroad management has always been concerned with the control of costs. The accounting classifications, which were developed with emphasis on cost controls, are readily adaptable to budgetary control.

Operating Statistics

The Interstate Commerce Commission also requires detailed operating statistics, from which significant averages may be derived. The basic data from which the principal performance units are derived are indicated below:

Freight Train Performance

1. Miles of road operated
2. Train-miles
3. Locomotive-miles
4. Car-miles (separated between loaded and empty)
5. Gross ton-miles (locomotives and tenders)
6. Gross ton-miles (cars, contents, and cabooses)
7. Net ton-miles (revenue and nonrevenue)
8. Train-hours

Passenger Train Performance

1. Miles of road operated
2. Train-miles
3. Road motive-power miles
4. Passenger-train car-miles
5. Train-hours
6. Net ton-miles of freight in passenger trains

Yard Service Performance

1. Yard switching locomotive-hours—freight
2. Yard switching locomotive-hours—passenger

Revenue Traffic

1. Miles of road operated—freight service
2. Miles of road operated—passenger service
3. Number of revenue tons carried
4. Number of revenue tons carried one mile
5. Freight revenue
6. Number of revenue passengers carried
7. Number of revenue passengers carried one mile
8. Passenger revenue
9. Passenger service train revenue
10. Passenger train-miles
11. Passenger carrying car-miles

Fuel and Power

1. Cost of fuel and power (yard and train)
2. Quantities of fuel and power (yard and train)
   (a) Yard switching service
   (b) Road freight service
   (c) Road passenger service
3. Quantities of fuel and power purchased and produced
4. Cost of fuel and power (at point of purchase or production)

Motive Power and Car Equipment (At Close of Month) *

1. Locomotives assigned to yard switching service
2. Locomotives assigned to road freight service

* These data, when correlated with other data, permit evaluation of the effective use of equipment, including the computation of car-miles per car-day, net ton miles per car-day, etc.

3. Locomotives assigned to road passenger service
4. Motor cars owned
5. Freight cars on line
6. Freight cars owned
7. Passenger cars owned

These basic data, together with the operating expense subdivisions (Figure 2), furnish management with the tools for determination of operating efficiency and economy. On most large railroads, the operating expense aggregates (except those common to the entire system) and related statistical units are accumulated by operating divisions, thus permitting more detailed analysis and control of costs.

The statistical reports are separated into many subdivisions, which are too detailed for discussion in this treatise. The Interstate Commerce Commission also requires detailed reports of commodities handled in freight service, and revenues derived from each class of commodity. Monthly reports of salaries and wages by employee groups are also required.

Use of Operating Statistics in the Analysis and Control of Costs

Some of the more important statistical factors used by management in the analysis and control of costs are indicated below:

Freight Operations

Wage cost per 1000 gross-ton miles
Fuel cost per 1000 gross-ton miles

Passenger Operations

Wage costs per car-mile
Fuel cost per car-mile

Yard Service

Wage cost per car handled
Wage cost per locomotive-mile *
Fuel cost per locomotive-mile *

Station Forces

Labor cost per ton of freight handled
Wages per shipment—agent and office force

General

Ratio of Expenses to Revenues:

(a) Maintenance of way excluding depreciation
(b) Total maintenance of way and structures
(c) Maintenance of equipment excluding depreciation
(d) Total maintenance of equipment
(e) Traffic expense
(f) Transportation
(g) Miscellaneous operations
(h) General Expenses
(i) Total expenses

* No actual record is maintained of yard locomotive miles. The mileage is computed at the rate of six miles per locomotive hour.

No attempt is made under regular accounting procedure to spread superintendence over related accounts, nor to allocate expenses of general supervision to the respective departments. Those expenses are segregated in the operating statement, however, and the relationship of supervisory expenses to other expense is readily ascertainable. Expenses of direct supervision, such as pay of roadway section foremen are distributed according to the work performed. The pay of shop foremen, as well as shop overheads, such as light, heat, etc., is included in a clearing account and distributed over the work performed. Store expenses are distributed over the cost of material.

The Operating Ratio

The percentage of expenses to revenues is commonly referred to as the "Operating Ratio," which is universally used by railroad management and the Interstate Commerce Commission as an index of operating performance. Caution should be used, however, in evaluating the operating efficiency of one road, as compared to another, on the basis of the operating ratio alone, since there are many factors such as type and density of traffic, terrain traversed, etc., which affect the operating ratio. Operating expenses, moreover, do not include equipment rents, joint facility rents, and taxes, which must be given consideration in determining the net results of operation. In view of the enormous physical plant required for railroad operation, there must be a substantial margin between operating revenues and operating expenses to cover rents and taxes and provide a moderate return on invested capital.

Budgetary Control of Costs

Budgetary control is particularly essential in the railroad industry. Cheap and efficient mass transportation is largely dependent upon prompt realization of attainable economies. Careful planning is also necessary for control of maintenance expenditures, including programed replacements, additions, and betterments, etc.

A reasonably accurate forecast of prospective revenues is a prerequisite of budgetary control. Current records are maintained of carloadings by principal commodities, including cars received from connections, and average revenues per car for each commodity, which form the basis of the freight revenue forecast. Revenues from passenger, mail, and express traffic are estimated on basis of current and seasonal trends.

Estimates of expenditures, based upon past performance, are made, and funds are allotted to the various departments. Rail and tie replacements are generally programed on an annual basis, with the heaviest expenditures occurring in the seasons suitable for such work. Many carriers use equalization reserves to spread the expense more equitably over the monthly periods. Consideration is also given to rental, tax, and interest requirements. The completed budget reflects the estimated net income, after provision for all charges, including interest.

Sound administration of the budget is effected by keeping management informed, through daily and periodic reports, of the trend of operating revenues and operating expenses. Management is also furnished with daily and cumulative statements, reflecting costs in relation to service units in freight-train, passenger-train, yard and station operation. These reports, which are broken down by operating units, permit management to trace to the source any substantial variances from standards of good performance, and take immediate corrective measures where necessary.

COST ACCOUNTING IN THE RAYON INDUSTRY

By

S. D. RICKMAN *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

The production and manufacture of rayon and its related by-products has, to the layman, remained a rather mysterious process. However, to the scientific mind it has been rather a matter of assembling a group of known facts and applying them in a common sense manner. "Rayon" is the generic name of filaments made from various solutions of modified cellulose by pressing or drawing the cellulose through a narrow opening and solidifying it in the form of a filament by means of some precipitation medium. This definition has been properly acceptable to the U. S. Department of Commerce, rayon being classified as follows, determined by the process of manufacture:

1. Acetate rayon
2. Viscose rayon
3. Cuprammonium rayon
4. Nitrocellulose rayon

The following pages, devoted to cost accounting in the rayon industry, are applicable only to item number one above (acetate rayon plant operation), the subject being entirely too voluminous to make any attempt to cover all four of the above-mentioned items.

Origin of the Product

Products in the rayon industry are constantly being improved and many new types of rayon are being produced in the research laboratories maintained at each large plant for this purpose. Therefore, identical or practically identical products are on the present market, such as Celanese Rayon, Viscose Rayon, etc. Research and development constitute an important cost item in the budget of each progressive rayon manufacturing concern, all new items undergoing extensive tests to demonstrate their safety and durability.

The four methods of making rayon today differ mainly in the chemicals used to dissolve cellulose into a solution suitable for spinning, the solutions in each of the four methods being forced through fine holes in spinnerets or jets and, on the other side, the filament in some way being coagulated into thread.

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The first patent for making artificial silk was granted in England in 1855 to Audemars, a chemist of Lausanne, Switzerland. He, knowing that the silkworm derived its cellulose from feeding on mulberry leaves, also used the mulberry tree as his source for cellulose. He took the fibrous inner bark of the tree and treated it with nitric acid. He dissolved it in alcohol and ether to form collodion, the liquid which we sometimes put on cuts to form "new skin." To this mixture he added a gum in a further effort to simulate real silk. It did not occur to him that it would be plausible to force this solution through a spinneret or jet, as does the silkworm via its glands in spinning a cocoon, but instead he formed threads by dipping needles into the solution and drawing them out. However, Audemars was not successful in producing artificial silk of any commercial value. From this beginning, the nitrocellulose process was developed.

The second process for making artificial silk came about through the development of a copper ammonium solution for dissolving cellulose.

The third method discovered for the production of artificial silk has proved to be by far the most successful commercially, as it was found that cellulose, when treated with disulphide of carbon in the presence of caustic soda, was converted into a golden yellow compound that dissolved readily in water. A solution of this plastic was found to be of such viscosity that the name "viscose" was given to it.

The fourth method, the cellulose acetate process formulas, was discovered by Cross and Bevan in 1894, but was not marketed in any large quantities until 1910 or shortly thereafter when the brothers, Camille and Henry Dreyfus, began production of acetate dope for airplane wings and other commercial products in England and America.

From these beginnings the rayon industry has had a rapid rise. Rayon, the comparatively new and most versatile of textile fibers, has won its way into many new textile fields and has so established itself with the public in its variety of beautiful fabrics that it is now in third place as a world textile fiber. As stated heretofore, it had its beginning in this country in 1910, and now reveals the following statistics:

Year	*Production (Lbs.)*	*Consumption (Lbs.)*
1920	10,000,000	10,000,000
1930	127,000,000	117,000,000
1935	256,000,000	251,000,000

Rayon is a product of no one person's ingenuity and of no one group's activity. It was evolved from several sources of thought, both related and independent. France started the nitrocellulose process; Germany developed the cuprammonium process; England introduced the viscose process; and in the United States was spun the first cellulose acetate. In the inspiration and clarity of the original idea, and in the fidelity with which it was carried out within a comparatively few years, we see the drama of a new industry fulfilling a human desire and need.

Sources of Raw Materials

Raw materials originate in botanical, chemical, etc., sources, such as cotton linters, wood pulp, acetic acid, purchased in carload lots, and are acquired from various concerns throughout continental United States.

Organization of Plant

A tabulation of the processes in a typical acetate rayon plant and their grouping into departments are shown in Exhibit 1.

For each of the departments in Exhibit 1 there is an expense account carried as part of the cost ledger as well as a fixed asset account carried in the plant ledger as shown in Exhibits 2 and 3.

Accounting for fixed assets plays an important part in the costing of an acetate rayon plant, not only from a depreciation standpoint as shown in Exhibit 4, but for the reason that each plant estimate of capital expenditure or work order carries not only the capital portion of the expenditure but also the expense portion.

It might be well to pause here in the analysis of plant organization and state that the manufacture of acetate rayon has seven distinctive steps as follows:

1. Making of acetic anhydride. The production of acetic anhydride is carried out by allowing chlorine gas to act on anhydrous sodium acetate.
2. Steeping cellulose pulp in acetic acid.
3. Acetylation by adding the acetic anhydride.
4. Precipitation—drawing off acetic acid and recovering the solid cellulose acetate.
5. Making the spinning solution or dope.
6. Spinning yarn.
7. Winding, coning, or cutting yarn.

EXHIBIT 1

Production Departments

Drying, Grinding, Blending of Cellulose Acetate
Stabilizing and Washing of Cellulose Acetate
Acid Storage
Neutralizing Plant
Acetylating of Cellulose Acetate
Cotton Treatment and Storage
Precipitation
Chemical Stores
Acetone Recovery
Spinning
Jet Drilling
Jet Cleaning
Jet Assembly
Preparation
Textile
Twisting
Cheese Twisting
No. 19-A Yarn Twisting
Staple Yarn Dept.
Backwinding for No. 19 Yarn
Doubling
Cheesing
Cone Winding

Service Departments

Electrical—General
Boiler House
Cellulose Acetate Block—Electrical
Staple Department
Warehouse
Waste Yarn Washing—Electrical
Machinery House
River Pump House and Wells
Acetone Recovery Electrical
Spinning Electrical
Textile Electrical
River Pump House Equipment
Cellulose Acetate Refrigeration Plant
Cellulose Acetate Compressed Air Services
Vacuum Service
Laboratory Analytical
Engineering Stores
Pump Repair Shop
Spun Stores and Bobbin Repairs
Physical and Chemical Testing Laboratories
Waste Yarn Washing—General
Spinning Refrigeration
Air Conditioning
Examination and Packing
Staple Development and Research
Warehouse and Shipping
Textile Development
Air Conditioning—Textile
Reclaiming Boxes and Packing Materials
Textile Refrigeration
Staple Treatment and Baling
Textile Workshops
Power Generation

Administrative Departments

Office, Shops and Stores
General
Plans, Maps and Surveys
Telephone and Telegraph
Cafeteria
First-Aid Stations
Fire Stations
General Offices
Drafting Office
Traffic and Transport

EXHIBIT 2

DEPARTMENTAL EXPENSE ACCOUNTS—ACETATE RAYON PLANT

SUB BREAKDOWN OF Y-3 IN COST LEDGER

Factory General Expense:

100	Management and General
101	Main Office
102	Accounting and Costs
103	Payroll
104	Purchasing
105	Employment
106	Billing
107	Watching and Fire Protection
108	Auto Transportation and Trucking
108-1	Rubbish Disposal
108-2	Service to Stores
108-3	Maintenance of Service Cars
109	General Stores
110	Maintenance of Railroad Sidings
111	Traveling Expenses
112	Telephone, Telegraph, and Postage
113	Stationery and General
114	First Aid
115	Internal Tractors
116	Taxes
117	Fire Insurance
118	Workmen's Compensation Insurance
119	S. S.—Unemployment Insurance
120	S. S.—Old Age Pension
121	Garages
122	Air Lines
123	Refrigeration Lines
124	Steam Lines
125	Water Lines
	1. Maintenance of Well Water Lines
	2. Maintenance of River Water Lines
126	Sewers and Drains
127	Roadway and Fences
128	Lighting Plant Site
129	Yard
130	Porters and Janitors
131	Freight, Express, and Cartage
132	Transportation
133	Maintenance of Heating
134	Care of Grounds
135	Sprinkler System
136	Inventory Adjustment
137	Maintenance of Buildings
138	Trucking
138-1	Tractor No. 10
138-2	Tractor No. 11

138-3	Celco Trucking Tractor No. 12
138-8	Trailers
139	Telephone Service
	Factory General Expense (Cont'd.)
140	Vacuum
141	Compressed Air
142	Library
143	Suggestion System
144	Foremen Instruction
145	Cafeteria
146	Staff Sales Expense
147	First Aid Training
148	Suggestion Trial Expense
149	Gas Mains
150	Maintenance of Water Tanks
151	Rag Washing
152	Giles Golf Club
153	Off Loading Cellulose Acetate
154	Fireless Locomotive Service
155	Maintenance of Incinerator
	Trades Departments:
201	Engineering General
202	Development
203	Drafting Office
204	Machine Shop
205	Carpenter Shop
206	Electrical Shop
207	Pipe Shop
208	Cellulose Acetate Workshops
209	Blacksmith Shop
210	Paint Shop
211	Welding Shop
212	Tin Shop
213	Instrument Shop
214	Rigging Shop
	Service Departments:
301	Boiler House
301-1	Boiler House—Ash Handling
301-2	Boiler House—Coal Handling
301-3	Boiler House—Feed Water Treatment
302	Electric Power Distribution
303	River Water
304	Well Water
305	Refrigeration
402-1	Dept. 8—Crystallizers
402-2	Dept. 8—Acetylizers
402-3	Dept. 8—Ripening Tanks
402-4	Dept. 8—Dope Pumps
403-1	Dept. 9—Precipitators
403-2	Dept. 9—Dewatering Conveyor
403-3	Dept. 9—Dope Pumps

405-1 Dept. 2—Flume
406-1 Dept. 6—Pumps
407-1 Dept. 7—Pumps in Vat Yard
408-1 Dept. 1—Bagging Cellulose Acetate
412-8 Dept. 10—Unloading Acid Cars and Drums

Cellulose Acetate Section:

400 Cellulose Acetate General
401 Cotton Preparation
402 Acetylizing
403 Precipitating and Washing
405 Stabilizing
406 Acid Storage
407 Dilute Acid Clarification
408 Drying, Grinding, and Blending
411 Cellulose Acetate Laboratory
412 Department 10
412-1 Cleaning Towers
412-2 Cleaning Vaporizers and Repairing Coils
412-3 Cleaning Main Still Reboiler, Main Still and Main Still Condenser
412-4 Cleaning Tanks in Solvent Room
412-5 Repairing Main Feed and Effluent Preheaters
412-6 Repairing Sparge Condensers
412-7 Repairing Product Coolers
413 Department 10—Laboratory
414 Department 39
414-1 Cleaning, Testing, and Repairing Furnace Coils
414-2 Repairing Cyclones
414-3 Cleaning and Repairing Pots
414-4 Cleaning Main Still Reboilers and Repairing Coils
414-5 Cleaning Primary Boilers and Repairing Coils
414-6 Cleaning Dirty Product Stills and Repairing Coils
414-7 Cleaning and Washing Main Still
415 Department 39—Laboratory
416 Department 8 Laboratory
417 Acid Purification
420 "S" Spinning

Spinning Section:

500 Spinning General
501 Acetone Recovery
502 Jet Assembly and Cleaning
503 Jet Repairs
504 Cloth Cutting
505 Mixing, Filtration, and Storage
506-1 Spinning (Filament)
506-2 Spinning (Staple Tow)
507 Bobbin Stores and Repairs
507-1 Bobbin Stores and Repairs—Filament Yarn
507-2 Bobbin Stores and Repairs—Staple Tow
508 Spun Filament Yarn Examination
508-2 Spun Tow Examination
509 General Testing and Analytical Laboratory

510 Physical Testing Laboratory
514 Air Conditioning
515 Pump Repairs
516 Waste Recovery
517 Jet Drilling
518 Cellulose Acetate Conveying System
519 Spinning Workshop
520 Spinning Development
511 Celairese No. 50

Textile Section:

600 Textile General
601 Twisting
602 Twisting Bobbin Examination
603 Coning
604 Cone Examination and Packing
610 Cheese Twisting
611 Cheese Twisting, Examination, and Packing
613 Twisting (200 Gram Bobbin)
613-1 Reeling and Inspection 200 Gram Bobbin
614 Backwinding
615 No. 19 Yarn Twisting—1. Combination yarn.
616 Doubling
617 No. 19 Yarn Examination
618 No. 19 Yarn Air Conditioning
618-1 No. 19 Yarn Refrigeration
618-2 No. 19 Yarn Air Conditioning, Other
619-1 Label Printing—Coning
619-2 Label Printing—Twisting, Cheesing
619-3 Label Printing—Staple Yarn
620 Textile Development
621-1 Box Building
621-2 Box Repairing and Box Reclaiming
621-3 Cone Tube Reclaiming
621-4 Carton Reclaiming
621-5 Burlap Reclaiming
621-6 Reconditioning and Striping of 4 DM Shipping Spools
621-7 Reconditioning and Striping of 4″ Fiber Bobbins
621-8 Buffing Cone Tubes
621-10 Cheese Tube Reclaiming
622 Warehousing and Shipping
623 Air Conditioning
623-1 Air Conditioning—Refrigeration
623-2 Air Conditioning—Air Conditioning
624 Maintenance of Bobbin Transporters
625 Overhauling Textile Carrier Units
626 Textile Workshop

Staple Section:

700 Staple Treating
701 Treated Staple Baling
702 Staple Samples
703 Staple Treating and Cutting, Black Yarn

Staple Yarn Section:

800 Staple Yarn General
801 Celaspun—Picking
802 —Carding
803 —Drawing
804 —Roving
807 —Spinning
808 —Cone Winding—(Singles)
809 —Skein Winding—(Singles)
810 —Doubling
811 —Cone Winding—(Doubles)
812 —Skein Winding—(Doubles)
813 —Packing
821 Celawol—Picking
822 —Carding
823 —Drawing
824 —Slub Roving
825 —Intermediate Roving
826 —Fine Frame Roving
827 —Spinning
828 —Cone Winding—(Singles)
829 —Skein Winding—(Singles)
830 —Doubling
831 —Cone Winding—(Doubles)
832 —Skein Winding—(Doubles)
833 —Packing

Development and Research Section

850 Staple Development

EXHIBIT 2A

LEDGER ACCOUNTS USED IN CONTROLLING COST LEDGER

Acct. No.	*Account Name*
Y-3	Expense Ledger Control Accounts Nos. 100 to 850
Y-4	Process Ledger Control Accounts as Scheduled
Y-5	General Ledger Control Accounts Nos. B-1 to 8-30 as Shown on Form N-161-A, and as Scheduled
Y-6	Accrued Charges and Prepaid Expense
Y-7	Trucking Reserve
Y-8	Vacation Wage Reserve
Y-9	Cheese Tube Reserve
Y-10	Internal Bobbin Reserve
Y-11	Deferred Maintenance Reserve
Y-12	Cost of Sales Reserve
R-18	Raw Materials
R-19	Operating Supplies
R-20	Packing Supplies
R-21	Coal

EXHIBIT 2B

PROCESS LEDGER CONTROL ACCOUNTS—"Y-4 ACCOUNTS"

Acct. No.	*Account Name*
B	Factory and Process Ledger Control
R	Inventories
S	Work in Process Inventories—Labor and Expense
T	Work in Process Inventories—Materials
U	Finished Stock Inventories—Product Class
X	Departmental Expense Accounts
Y	Miscellaneous Cost Ledger Accounts
	Other Controls
3	Spinning in Process *

* The following formula gives an estimate rate made in advance and is estimated on full running time. All charges not absorbed by this rate are redistributed through a supplemental rate featured as idle time:

$$\frac{\text{Total productive labor plus total machine hours}}{\text{Total number machine hours}} = \text{Machine rate to be applied to product for each hour of spinning machine operations.}$$

4	Yarn in Process
5	Staple in Process
6	Staple Yarn in Process
8	Waste in Process
9	Yarn and Fabric in Warehouse
10	Research

EXHIBIT 2C

ACCOUNTS MAINTAINED IN PROCESS LEDGER

Cost Ledger Accounts. "U" Breakdown of Control # 9

Acct. No.	*Account Name*
U-100	Treated and Baled Staple
U-105	Special Tow
U-110	Yarn on Spools
U-120	Yarn on Cones
U-130	Yarn on Twisting Cheeses
U-140	Yarn on Skeins
U-150	Waste
U-200	Fabric

EXHIBIT 3

PLANT LEDGER ACCOUNTS USED IN CONTROLLING ALL FIXED PROPERTIES—

ACETATE RAYON PLANT

Buildings

1 PL	1001	Textile
	1002	Spinning
	1003	Boiler House
	1004	Pump House
	1005	Workshops and Stores
	1006	Carpenter Shop
	1007	Office
	1008	Yard Field Building
	1009	Cafeteria
	1010	Departments 10 and 39
	1011	Cellulose Acetate
	1012	Machinery House
	1013	Chemical Storage
	1014	Waste Washing
	1015	Pressure Filter House
	1015-1	Pump House; No. 1
	1015-2	Pump House; No. 2
	1015-3	Pump House; No. 3
	1015-4	Pump House; No. 4
	1015-5	Pump House; No. 5
	1016	Steel Garages
	1017	Gate House (Watchman)
	1018	Locomotive Shed
	1019	Gileshire Farmhouse and Outbuildings
	1020	Cellulose Acetate Workshop
	1021	Oil Storage Shed
	1022	Passageway between Spinning and Textile
	1023	Substation (Steel)
	1024	Storage Sheds A, B, and C
	1025	Storage Yard
	1026	Incinerator

Machinery and Equipment

2 PL	2101	Acetone Recovery
	2102	Cloth Cutting
	2103	Mixing and Filtration
	2104	Spinning
	2105	Pump Repairs
	2106	Jet Assembly and Cleaning
	2107	Jet Repairing
	2108	Staple Tow Cans
	2109	Physical and Chemical Testing Laboratory
	2110	Spun Examination and Bobbin Stores
	2111	Air Conditioning—Spinning
	2112	Spinning Miscellaneous and General
	2113	Waste Yarn Recovery

Machinery and Equipment (Continued)

	2114	Jet Drilling
	2115	Underground Solvent Storage Equipment
	2116	Spinning Workshop
	2117	Celairese No. 50
	2201	Twisting
	2202	Twisting Examination
	2203	Coning
	2204	Coning Examination and Packing
	2205	Air Conditioning—Textile
	2206	Textile—Miscellaneous and General
	2207	Textile Workshop
	2210	Cheese-Twisting
	2214	Backwinding
	2215	No. 19 Yarn Twisting
	2216	Doubling
	2301	Staple Department
	2351	Staple Yarn Department
	2352	Staple Development and Research
2 PL	2401	Yarn Warehouse and Shipping
	2402	Pump House
	2402-1	River Pump House Equipment
	2402-2	Deep Well Pump House Equipment
	2403	Water Mains
	2404	Fire Lines
	2405	Sprinkler System
	2406	Steel Water Tanks
	2407	Well Water Supply Lines
	2408	Boiler House
	2409	Steam Lines and Heating
	2410	Electrical Substations
	2411	Pole Lines
	2412	Underground Conduit and Cable
	2413	Time Recording Equipment
	2414	Compressed Air Service
	2415	Vacuum Service—Spinning
	2416	Machine Shop
	2417	Carpenter Shop
	2418	Electrical Shop
	2419	General Stores
	2420	Miscellaneous and General
	2421	First Aid
	2422	Main Office
	2423	Transportation and Traffic Vehicles
	2424	Employees Badges
	2425	Furniture and Fixtures
	2426	Small Tools and Equipment
	2427	Fire Fighting Equipment
	2428	Spinning and Textile Bobbins
	2429	Bobbin Carriers and Trucks

Machinery and Equipment (Continued)

	2430	Cone Carriers
	2431	Cranes
	2432	Yard
	2433	General Plant Lighting
	2434	Tractor and Trailer Equipment
	2435	Telephone System
	2436	Fire Alarm System
	2437	Passageways between Spinning and Textile
	2438	Yard Office Equipment
	2439	Equipment for Gileshire Farmhouse and Outbuildings
	2440	Office Equipment
	2441	Cafeteria Equipment
	2442	Pipe Shop
	2443	Instrument Shop
	2444	Cellulose Acetate Workshops
	2445	Bobbins Returnable
	2446	Power Plant Equipment
	2447	Cellulose Acetate Refrigeration Equipment
	2448	Machinery House Equipment
	2449	Sales Room for Celanese Fabrics
2 PL	2450	Oil Storage Shed Equipment
	2451	Locomotive
	2452	Bobbins Returnable (1) 4″ Fiber (2) Bakelite Flange Bobbins (3) 3⅛″ x 3⅝″ Steaming Bobbins
	2453	Blacksmith Shop
	2454	Paint Shop
	2455	Welding Shop
	2456	Tin Shop
	2457	Air Conditioning No. 19 Twisting
	2458	Gas Mains
	2459	Dismantled Machinery and Equipment
	2460	Rag Washing Equipment
	2461	Chemical Stores
	2501	Acetate Plant General
	2505	Cellulose Acetate Laboratory Equipment
	2511	Cotton Treatment and Storage—Department 8-A
	2521	Department 39
	2531	Precipitation—Department 9
	2541	Acetylating—Department 8
	2551	Glacial Acetic Acid—Department 7
	2561	Department 10
	2571	Stabilizing and Washing—Department 2
	2581	Drying, Grinding and Blending—Department 1
	2591	Acid Storage Equipment—Department 6

Site Improvements

3 PL	3001	Sewers and Drains
	3002	Dams
	3003	Sidewalks and Roadways
	3004	Railway Sidings
	3005	Fences
	3006	Auto Parking Grounds
	3007	Pump House Intake—River
	3008	Deep Wells
	3009	Site Improvements General

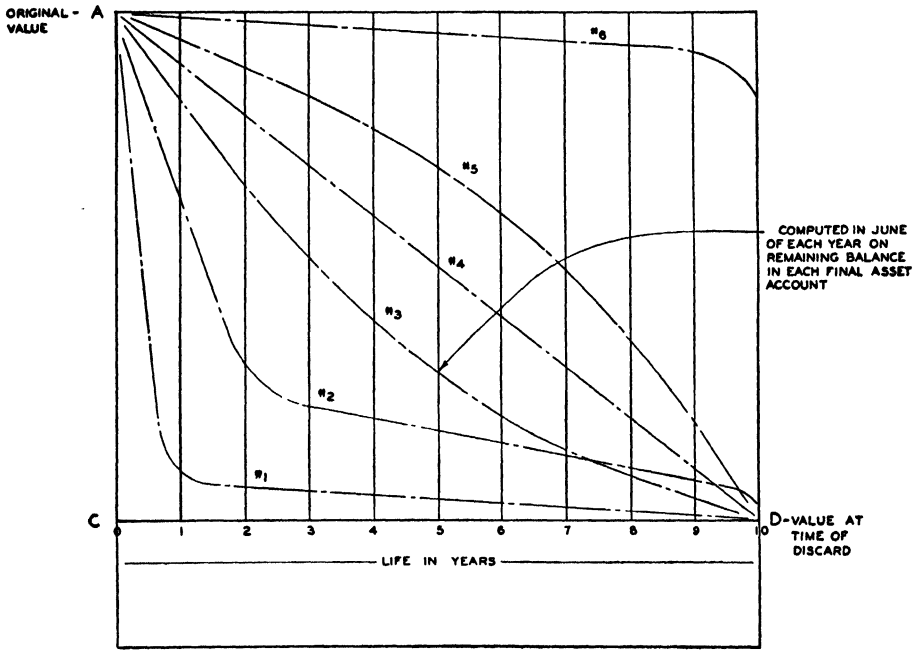


Exhibit 4. Curves 1 and 2 represent actual depreciation from the standpoint of salability, whereas Curve 6 represents actual depreciation from the standpoint of serviceability, assuming that maintenance has kept the asset almost 100% efficient. Curves 3, 4, and 5 are illustrations of theoretical depreciation and represent the different methods of calculating the annual amount of the decrease in value of an asset from an accounting standpoint.

Production Department

Production starts with acetic anhydride distillation, and the reaction takes place in a huge mixer. The resulting slurry is dropped through a pipe from the mixer into the still below where the anhydride is removed from the solids by vacuum distillation. The vapor is then drawn off through a vertical pipe and passes into a vertical cylindrical condenser. The liquid acetic anhydride drops from the condenser into glass-lined tanks, the crude acetic anhydride then being forced by air pressure to another still for final purification. There it is again distilled under

WORKS ORDER NUMBER MUST BE NOTED ON TIME CARDS AND STORES REQUISITIONS.

DATE_____ ENGINEER IN CHARGE_____ COMPLETED_____

BUILDING_____ APPROVED— REFERENCE NO._____

DEPARTMENT_____ PLANT ENGINEER_____ J. V. NO._____

AUTHORIZED BY_____ PLANT MANAGER_____ ACCOUNT NO._____

TO:

TITLE:

OBJECT:

DESCRIPTION OF WORK.

THIS IS A ROUTINE REPAIR_____ REPLACEMENT_____

PLANT RETIREMENTS

DISPOSITION OF RETIREMENTS:

BREAKDOWN OF WORK AND MATERIALS BY TRADES	CAPITAL		EXPENSE	
	MATERIAL	LABOR	MATERIAL	LABOR
BLACKSMITH SHOP				
CARPENTER SHOP				
ELECTRIC SHOP				
FIELD ENGINEERING				
INSTRUMENT SHOP				
MACHINE SHOP				
PAINT SHOP				
PIPE SHOP				
TIN SHOP				
WELDING SHOP				
C. A., SPINNING, OR TEXTILE ENGINEERING				
DRAFTING OFFICE				
SPECIAL ITEMS				

COMPLETION AND COST

APPROVED – PLANT ENGINEER

APPROVED – PLANT MANAGER

TOTAL ESTIMATED COST

TOTAL ACTUAL COST

OVER ESTIMATED

UNDER ESTIMATED

Exhibit 4a.

vacuum and condensed, whence it goes into large receiving tanks. At this point the liquid is pure acetic anhydride ready to be combined with cellulose. Cotton fiber or wood pulp preparation is the next step and special machines loosen the fiber and prepare it for steeping. Kneading machines then mix the pulp mass with acetic acid and the mixture is dropped down a chute into the machine. After the chemical reactions are completed in the kneading machines the entire machine is tilted and the dope or viscous liquid is dropped through a pipe into movable storage tanks, where the glutinous mass is aged. The acid dope from the storage tank is then forced into precipitating tanks and cellulose acetate is precipitated from the acid

dope. The cellulose acetate is washed in these tanks until it is free from acetic acid and dilute acetic acid is then drawn off and finally recovered as glacial acetic acid or acetic anhydride. From these tanks the cellulose acetate is conveyed to dryers whence it emerges in granular form resembling clean white powder or rice.

Process and Functions

The next step is the preparation of the spinning dope. After the cellulose leaves the dryers in granular form each batch is carefully analyzed and a number of batches are blended together to produce a cellulose acetate of uniformity. This blended material is then dropped down a chute into pebble mills or tanks where it is dissolved into acetone, the resulting solution being called spinning dope. From this pebble mill or blender it goes to the filters. The dope is then forced through these high-pressure filters where all impurities are removed by a very dense filter pack of cellulose material. From these filter presses the dope is forced through pipes to the spinning machines. Each spinning machine is made up of a number of units designed to produce one thread, and each unit is composed of a measuring pump, jet, hollow tube for evaporation, and a motor driven spindle carrying a bobbin for the yarn. Tall white boxes enclose the tubes down which the filament yarn passes and up which a current of warm air passes. On top of the boxes are cylinders, with windows in the side, which contain the jets through which the spinning dope is forced. As the filaments emerge from the minute holes in the jets they pass down the cylinder to the spindle at the bottom, a current of warm air evaporating the acetone from the filament, carrying the evaporation back to the acetone recovery department. By the time the filament reaches the spindle at the bottom of the cylinder, it is dry and solid and forms a finished yarn. From the spinning department the yarn goes to the coning department where it is transferred from spinning bobbins to shipping spools. From here the yarn goes to the warehouse if it is to be shipped out as thread, or to the textile department if it is to be chopped up into staple yarn and baled. Thus it can be seen that rayon requires quite a voluminous process in its various steps of manufacture.

Cost Methods Applied

In order to properly account for materials and labor in the above process, actual physical inventory of materials to start with, plus materials and labor used or debited, less actual closing inventory, is the basis for unit cost computation. The following items enter into the process:

Raw Materials Consumed (analyzed in process ledger)
Operating Supplies Consumed (operating stores records)
Coal Consumed
Packing Materials Consumed
Operating Wages
Nonoperating Wages
Nonoperating Wages—Engineering
Salaries—Foremen and Supervisors
Salaries—Superintendent and Factory Clerical
Salaries—Engineering
Electricity
Insurance

EXHIBIT 5

COMPARATIVE SUMMARY

PRINCIPAL COSTS AND PRODUCTION

For 13 Months Ending August 29, 1942

ACTUAL PRODUCT COST OBTAINED FROM PROCESS LEDGER NO. 3

Month	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Number of Weeks	4	4	5	4	4	5	4	4	5	4	4	5	4
Acetic Anhydride													
Production in 1000 lbs.												593	1,130
Cost per lb. ¢												10.7	10.3
Spun													
Production in 1000 lbs.	1,759	1,855	2,519	2,220	2,048	2,756	2,152	2,161	2,758	2,243	2,170	2,694	2,227
Cost per lb. ¢	21.9	22.0	23.6	23.4	23.5	22.5	22.0	22.5	23.2	23.0	23.1	23.7	24.5
Cheese-Twisting													
Production in 1000 lbs.	224	205	262	231	210	261	220	228	275	235	228	301	281
Cost per lb. ¢	27.2	27.7	29.4	29.9	29.5	28.9	28.7	28.2	28.7	28.1	28.4	28.7	29.5
Twisting													
Production in 1000 lbs.	967	1,051	1,539	1,267	1,260	1,728	1,368	1,277	1,462	1,160	1,133	1,436	1,175
Cost per lb. ¢	26.6	26.4	27.8	28.3	28.2	27.4	27.7	27.7	28.4	28.3	29.2	29.5	30.2
Coning													
Production in 1000 lbs.	1,009	1,038	1,573	1,377	1,267	1,756	1,375	1,274	1,454	1,167	1,130	1,495	1,172
Cost per lb. ¢	30.7	30.1	31.6	31.9	32.0	31.2	31.6	31.8	32.6	32.2	33.2	33.3	34.2
Lanese													
Production in 1000 lbs.	395	437	591	539	429	611	522	594	817	813	711	774	613
Cost per lb. ¢	24.5	24.3	26.4	26.1	27.0	24.0	23.9	23.9	24.4	24.4	23.9	24.6	25.4

Form M-67 2000 7-42

PRODUCT RECOVERED ACETONE No. 16

Account No. 501 Period August, 1942 No. of Weeks 4

PRODUCTION:	Curr. Month		Prev. Month	
	Actual 100%	5,620,600	Actual 100%	6,960,950

Items of Cost	Quantity	Rate	Cost	Quantity Per Unit	COST PER UNIT Curr. Mo.	COST PER UNIT Prev. Mo.
MANUFACTURING CHARGES						
Wages—Operative			2,675		.001	.001
" —Non-Operative			85		-	-
" — " " —Eng.			1,373		-	-
Supervision—Foreman & Chargehands			181		-	-
" —Suptds. & Clerical			105		-	-
" —Engineers.						
Routine Repairs			364		-	-
Maintenance			608		-	-
Consumable Stores			18		-	-
Other Direct Charges			202		-	-
Power			4,020		.001	.001
Water			804		-	-
Steam			6,269		.001	.001
Air						
Refrigeration						
Vacuum						
Soc. Sec: Comp. Inc: Vacation			320		-	
——————General						
Trades General Charges			170		-	-
Factory General Charges						
TOTAL			17,194		.003	.003
Distribution of Total—Materials—semi-finished						
—Materials—Raw						
—Manufacturing Charges			17,194		.003	.003

	Quantity	Rate	Amount
Opening Inventory	1,247,708	.070	87,740
Production for Period	5,620,600	.003	17,194
Acetone Rec'd less Cost of Rec'y			394,756
Total	6,868,308		499,690
Charged	5,627,292	.073	412,528
Closing Inventory	1,241,016	.070	87,162

Exhibit 6.

Form M-67 2500 7-42

PRODUCT WASTE WASHING No. 17

Account No. 516 Period August, 1942 No. of Weeks 4

PRODUCTION:	Curr. Month	Prev. Month
	Actual 100% 173,529	Actual 100% 171,435

Items of Cost	Quantity	Rate	Cost	Quantity Per Unit	COST PER UNIT Curr. Mo.	COST PER UNIT Prev. Mo.
Waste	177,465	.128	22,717	1.023	.131	.133
MANUFACTURING CHARGES						
Wages—Operative			646		.004	.004
" —Non-Operative			75		-	.001
" — " " —Eng.			837		.005	.005
Supervision—Foreman & Chargehands			250		.001	.001
" —Suptds. & Clerical			12		-	-
" —Engineers						
Routine Repairs			368		.002	.002
Maintenance			1,645		.010	.005
Consumable Stores			11		-	-
Other Direct Charges			617		.004	.003
Power			71		-	.001
Water			29		-	-
Steam			151		.001	.001
Air						
Refrigeration						
Vacuum						
Soc. Sec: Comp. Inc: Vacation			159		.001	.001
——General						
Trades General Charges			156		.001	.001
Factory General Charges						
TOTAL			27,744		.160	.158
Distribution of Total—Materials—semi-finished			22,717		.131	.133
—Materials—Raw						
—Manufacturing Charges			5,027		.029	.025

	Quantity	Rate	Amount
Opening Inventory	62,447	.155	9,658
Production for Period	173,529	.160	27,744
Total	235,976		37,402
Charged	148,028	.159	23,462
Closing Inventory	87,948	.159	13,940

Exhibit 7.

Form M-87 2500 7-41

PRODUCT LANESE No. 28

Account No. 700-702 Period August, 1942 No. of Weeks 4

PRODUCTION:	Curr. Month	Prev. Month
	Actual 612,666	Actual 774,283
	100%	100%

Items of Cost	Quantity	Rate	Cost	Quantity Per Unit	COST PER UNIT Curr. Mo.	COST PER UNIT Prev. Mo.
Celanese Spun	631,861	.232	146,556	1.031	.239	.231
Waste*	14,837*	.128*	1,894)*	.024*	.003*	.003*
Waste*(Black)	220*	.128*	28)*			
"204" Finish	12,476	.167	1,790	.017	.003	.002
Packing Mtls.			1,119		.002	.002
MANUFACTURING CHARGES						
Wages—Operative			2,744		.005	.005
" —Non-Operative			645		.001	.001
" — " " —Eng.			1,441		.002	.002
Supervision—Foreman & Chargehands			867		.001	.001
" —Suptds. & Clerical			113		-	-
" —Engineers						
Routine Repairs			390		.001	.001
Maintenance			250		-	-
Consumable Stores			104		-	-
Other Direct Charges			13		-	-
Power			754		.001	.001
Water						
Steam			133		-	.001
Air						
Refrigeration						
Vacuum						
Soc. Sec: Comp. Inc: Vacation			387		.001	.001
——————General						
Trades General Charges			413		.001	.001
Factory General Charges						
TOTAL			155,797		.254	.246
Distribution of Total—Materials—semi-finished			144,634		.236	.228
—Materials—Raw			2,909		.005	.004
—Manufacturing Charges			8,254		.013	.014

	Quantity	Rate	Amount
Opening Inventory	2,196	.242	531
Production for Period	612,666	.254	155,797
Total	614,862		156,328
Charged	610,695	.254	155,282
Closing Inventory	4,167	.251	1,046

* in red

Exhibit 8.

Form M-57 2500 7-42

PRODUCT WAREHOUSE & SHIPPING No. 58

Account No. 622 Period August, 1942 No. of Weeks 4

PRODUCTION:	Curr. Month	Prev. Month
	Actual 2,157,393	Actual 2,645,388
	100%	100%

Items of Cost	Quantity	Rate	Cost	Quantity Per Unit	COST PER UNIT Curr. Mo.	Prev. Mo.
Celanese Various	2,157,393	.323	697,490	1.000	.323	.316
Packing Materials			11,786		.005	.006
Repairing & Reclaiming			3,616		.002	.002
MANUFACTURING CHARGES						
Wages—Operative			2,276		.001	.001
" —Non-Operative			83		-	-
" — " " —Eng.			315		-	-
Supervision—Foreman & Chargehands			776		-	-
" —Suptds. & Clerical			364		-	-
" —Engineers						
Routine Repairs			109		-	-
Maintenance						
Consumable Stores			40		-	-
Other Direct Charges			203		-	-
Power			544		-	-
Water						
Steam						
Air						
Refrigeration						
Vacuum						
Soc. Sec: Comp. Inc: Vacation			252		-	-
——————General						
Trades General Charges						
Factory General Charges						
TOTAL			717,854		.331	.325
Distribution of Total—Materials—semi-finished			697,490		.323	.316
—Materials—Raw			11,786		.005	.006
—Manufacturing Charges			8,578		.003	.003

	Quantity	Rate	Amount
Factory General			37,248
Opening Inventory	461,419	.324	149,623
Production for Period	2,157,393	.332	717,854
Receipts & Returns	308	.422	130
Total	2,619,120		904,855
Charged	41,534	.298	12,370
Cost of Sales	1,991,242	.350	696,760
Closing Inventory	586,344	.334	195,725

Exhibit 9.

Expense Operating—Other
Maintenance and Repairs
Consumable Stores
Vacation Wages
Bobbin Provision
Cheese Tube Provision
Deferred Maintenance

Payroll expenditures for salaries and wages are accounted for through a system of production time cards in which most minute costs were analyzed in Exhibit 2.

Consumable stores expenditures are derived from a recapitulation of stores requisitions issued by each department receiving materials and are in turn spread in the cost ledger in the above-mentioned departmental expense accounts.

Utilities, including steam, well water, river water, coal, gas, etc., are accounted for by the services department through various mediums, such as scales, meters, and registering valves and charts, in order to properly record consumption.

II. Special Features About the System

The cost system used in this industry must be so designed by following the account charts as to yield maximum managerial actual costs with a minimum expenditure. It is highly essential to determine the following:

(a) The cost and efficiency of each operation, such as cost of the dope, acetone recovery costs, water and steam costs, and finally spinning, textile or coning costs, all as recapitulated in the cost ledger accounts shown in the foregoing charts and comments.

(b) The cost of each product and the income-cost relationship of each product and class of production as hereafter shown on schedules numbers 3, 16, 17, 28, and 58 which were excerpted from the monthly cost report furnished the management (Exhibits 5-9).

(c) The data for proper and intelligent preparation of analytical operating reports and finally the consolidated report of all major classifications.

In considering the designing of a system in this industry, only actual costs are used as same is designed primarily to formulate price policies for individual products based on known costs and not standard costs.

The cost system itself uses forms and methods well known and generally used in various industries. Those presented here are those more or less specialized to the needs of the industry, and are as follows:

DEPARTMENTAL EXPENSE REPORT

Department_____ Week Period of_____

Production: Budget_____ Capacity Operated: Prod. Hours

Actual_____

Hours: Budget_____

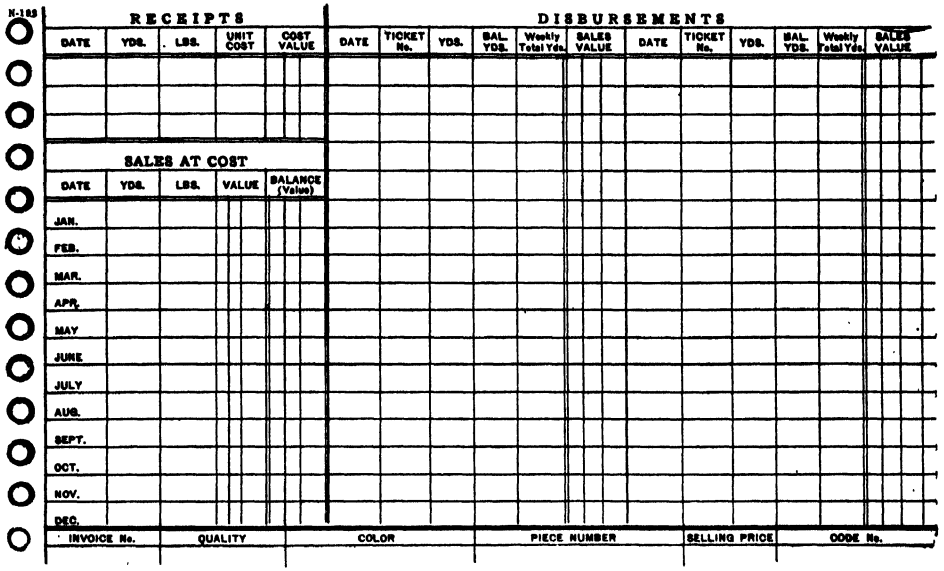
Actual_____

	Budget		Actual			Adjustment of Budget To Capacity Operated	Spending Level Ratio	
	Units	Cost	Units	Cost	Cost Per			
Wages—Operative								
" Learners								
" Non-Operative								
" Non-Operative Engineering								
Supervision—Foremen								
" Suptds. and Clerical								
" Engineers								
Routine Repairs—Labor								
" " Material								
Maintenance—Labor								
" Material								
Consumable Stores								
Other Direct Charges								
Power								
Water—Well								
" River								
Steam								
Compressed Air								
Refrigeration								
Air Conditioning								
Textile General								
Trades General								
Soc. Sec., Comp Ins., Vacations								
TOTAL								

Production_____ CUMULATIVE FOR_____WEEKS Capacity Operated_____

Wages—Operative								
" Learners								
" Non-Operative								
" Non-Operative Engineering								
Supervision—Foremen								
" Suptds. and Clerical								
" Engineers								
Routine Repairs—Labor								
" " Material								
Maintenance—Labor								
" Material								
Consumable Stores								
Other Direct Charges								
Power								
Water—Well								
" River								
Steam								
Compressed Air								
Refrigeration								
Air Conditioning								
Textile General								
Trades General								
Soc. Sec., Comp. Ins., Vacations								
TOTAL								

Form I—Typical Departmental Expense Report



Form II—Perpetual Inventory Record of Finished Goods

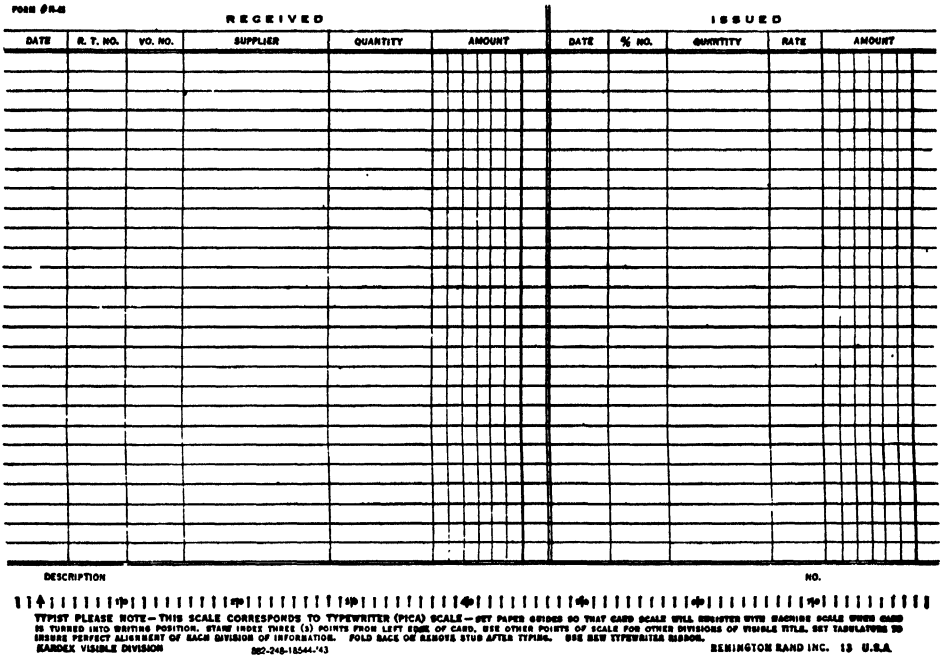
DEPARTMENT 10 - INVENTORY

Date_____

	Net	%	100%
GLACIAL ACETIC ACID:			
Closing Stock			
Transferred: Dept. 6			
Dept. 39			
Total			
Opening Stock			
Produced			
DILUTE ACETIC ACID:			
Opening Stock			
Receipt: Dept. 9			
Dept. 39			
Total			
Closing Stock			
Consumed			
LOSS:			
Consumed			
Produced			
Loss			

	Butol	Carbol	Caustic Soda	Sodium Acetate	Soda Ash
Opening Stock					
Receipts:					
Closing Stock					
Consumed					
%					

Form III—Department 10—Inventory



Form IV—Raw Materials Inventory Record

COST ACCOUNTING IN RUBBER MANUFACTURING

By
C. W. HALLIGAN *

The rubber manufacturing industry acquires its name from one of its principal raw materials—rubber—although its products vary widely in method of manufacture, distribution, and end use. The importance that this comparatively new industry has assumed in the economy of the world, and of this nation in particular, was dramatically illustrated on December 7, 1941 when we were cut off suddenly from the then existing source of 92% of our supply of raw material. One of the miracles of our age was the creation of new raw materials which filled the vacuum of our lost natural rubber supply, saved our highway transportation system from stagnation, put our Army on wheels, and enabled us to manufacture countless articles indispensable in our present-day economy.

Classification of Products

The public naturally associates the industry with its most popular product—tires. However, there were many thousands of other products manufactured prior to World War II and hundreds of additional products now are being made as a result of the development of new plastic materials having properties that are not present in natural rubber.

The products of the rubber manufacturing industry can be classified into several general groups:

1. Tire Products
   - Pneumatic Tire Casings
   - Pneumatic Tire Inner Tubes
   - Solid Tires
   - Camelback (Tire Recapping Material)
   - Tire Repair Materials
2. Mechanical Rubber Goods
   - Belting (Transmission, Conveyor, V Belts, Fan Belts)
   - Hose
   - Packing
   - Rubber-lined Tanks and Fittings
   - Rubber-covered Rolls
   - Molded, Extruded, and Lathe-cut Goods
   - Friction and Rubber Tape
   - Sponge Rubber
3. Heels and Soles
4. Footwear
   - Canvas (Tennis Shoes)
   - Waterproof (Rubbers, Overshoes, Boots, etc.)

* Assistant Secretary, The Rubber Manufacturers Association, New York, N. Y.

5. Hard Rubber Goods (Battery Boxes. Combs, Pipe Bits, Pipe Fittings, Knife Handles)
6. Coated Materials (Raincoats, Upholstery, Shoe Fabrics, Hospital Sheeting)
7. Drug Sundries (Hot Water Bottles, Catheters, Surgeon's Gloves, Syringes, Invalid Cushions, Baby Bottle Nipples)
8. Bathing Apparel (Bathing Caps, Suits and Shoes)
9. Stationer's Rubber Goods (Rubber Bands, Erasers, Pencil Plugs)
10. Toys and Balloons (Dolls and Other Children's Playthings)
11. Sporting Goods (Tennis Balls, Golf Balls, Beach Balls)
12. Insulated Wire and Cable

There are many other special rubber products which do not fit into any of the general categories listed, such as de-icers and bullet-proof gasoline tanks for airplanes, rubber life rafts, and many others too numerous to mention.

A few large companies in the industry manufacture products listed in all groups. However, most companies specialize in one or two groups or subgroups only.

Raw Materials

The chief raw material common to all products of the industry is rubber. Prior to World War II, 97% of the world's supply was grown in Malaya, the Netherlands East Indies, French Indo China, Siam, India, Burma, Ceylon, British North Borneo, and Sarawak. With the chief source of supply located at such a great distance and in the hands of a foreign cartel for various periods of time, the industry has suffered violently fluctuating changes in the price of this material, varying from $1.75 per pound in 1925 to under 3¢ per pound in 1933 for the Rib Smoked sheet grade usually quoted on world markets.

This unstable price situation has resulted in enormous raw material and finished goods inventory losses and has created many problems for the purchasing agent in determining when to buy and how much, as well as posing critical problems for the cost accountant in costing and pricing the finished product. The development of manufactured rubber in this country is likely to make natural rubber prices more stable in the future.

There are numerous grades of plantation natural rubber each priced at differentials above, as well as under, the base price grade previously mentioned. Some rubber products can be produced in the better quality only when made from premium grades of natural rubber whereas other products can be produced satisfactorily from the cheapest grades, although most products are made from blends of more than one grade.

These conditions make it necessary to segregate rubber grades in storage and maintain careful stock records on each. The chief grades utilized by the industry in normal times are as follows:

Thin Pale Latex Crepe	(Produced from cultivated trees principally in Malaya, Netherlands East Indies, Siam, French Indo China, India, Burma, Ceylon, British North Borneo and Sarawak)
Thick Pale Latex Crepe	
No. 1X Rib Smoked Sheets	
No. 1 Rib Smoked Sheets	
No. 2 Rib Smoked Sheets	
No. 3 Rib Smoked Sheets	
No. 1X Thick Brown Crepe	
No. 1X Thin Brown Crepe	

No. 1 Thick Remilled Blankets Roll Brown Sole Crepe	
Guayule	(Produced in limited quantities in Mexico and United States from both wild and cultivated Guayule shrub)
Wild Rubbers Uncut Fines Cut Fines Upriver Coarse Caucho Ball Cameroons	(This is the original form of rubber placed on the market; gathered chiefly from wild trees in the Amazon River Valley in South America)
Natural Liquid Latex	(The natural liquid rubber as it is tapped from the trees)

Rubber itself being a plastic, it was only natural that the industry's equipment should be adapted to the use of the numerous new manufactured rubbers and plastic materials that have recently been developed. The use of these plastics has caused the development of many new products not hitherto made by the rubber industry.

The new manufactured rubbers, sometimes erroneously called "synthetic rubbers," are not true syntheses of rubber but are truly new plastic materials with rubber-like qualities. The principal types are as follows:

GRS	The principal general-purpose manufactured rubber used during the war and now in place of natural rubber. It is similar but superior to the Buna S type manufactured in Germany.
Neoprene	A special-purpose type superior to natural rubber because of its oil-resistant qualities.
Butyl	A special-purpose type superior to natural rubber because of its air impermeability for the manufacture of inner tubes.
GRS Latex	(GRS in liquid form.)
Polyvinal Chlorides	A special type of plastic used in the manufacture of waterproof materials and for uses where its appearance and serviceability make it superior to other materials for many purposes.

Textiles represent the second most important raw material for several branches of the rubber industry. Vast quantities of cotton, rayon and nylon cord, as well as a lesser quantity of square-woven fabrics, are used in the manufacture of tire casings. Square-woven textiles are used in large quantities in the manufacture of coated fabrics, belting, hose, packing, footwear, and drug sundries. Yarns are used in making the woven type of hose, such as fire hose, garden hose, etc.

Reclaimed rubber, as well as being used as the principal ingredient in many rubber articles, is an important raw material imparting special qualities to certain rubber products when used in the proper proportions in the ingredient mix.

Approximately four hundred different pigments and chemicals are used by the industry for mixture with the rubber ingredient, each performing a special function in each product. Various other materials purchased are wire for tire beads and hose reinforcement, steel for metal inserts in molded goods, automobile running boards and roll shafts, nails and washers for heels, hose fittings and metal accessories for drug sundries, etc.

Some large manufacturers have expanded vertically and have established their own rubber plantations, cotton mills, reclaimed rubber plants, and chemical plants for the production of a large part of their major raw material requirements. However, even these companies are not completely independent of outside sources for their raw materials.

Manufacturing Processes

Most rubber products generally pass through the same stages of manufacture, although each class may be made on completely different types of equipment. These stages are as follows:

1. Compounding
2. Mixing
3. Sheeting, Frictioning, Coating, or Extruding
4. Cutting Parts to Shape
5. Assembling or Making
6. Vulcanizing or Curing
7. Finishing and Inspection

However, to illustrate better the actual processes and tie them in with the cost accounting procedures, a plant making only one product group (molded and extruded goods) is used in the following illustration:

Production Cost Centers	*Description of Operation*
Compounding	Each ingredient is carefully weighed and assembled according to laboratory formula for each batch. Very little equipment used except weighing and measuring devices.
Mixing	Each batch is mixed on the prescribed type of mixing equipment for a predetermined time with certain ingredients added when batch has been mixed for a stated time. This process utilizes a heavy expensive type of equipment called roll-mills and Banbury mixers.
Calendering	Mixed gum stock for some products is warmed on a warming mill, then sheeted out to a desired thickness or gauge on a heavy expensive machine unit called a "calender."
Extruding	The mixed stock for parts or products is warmed up on a warming mill and then forced through a die in an extruder or tube machine to the desired shape in continuous lengths or cut to length after extrusion.

Stock Preparation	The calendered or extruded stock is cut to fit mold cavities to specified size and weight either by machine or by hand, whichever method is adaptable to the product. Component parts are also assembled here where more than one is involved in a product. Special tooling or shaping equipment may be necessary for some products.
Curing	The prepared parts or slugs are loaded into mold cavities. Molds are inserted in a hydraulic press and subjected to heat for a specified time. Molds are unloaded and cleaned for next heat.
Finishing and Inspection	Operations will vary according to each product. Some may be machine trimmed or buffed, others hand trimmed, then inspected and packed in shipping containers.

In larger plants or those manufacturing a wider variety of items, additional processes would be recognized and the listed processes would be subdivided further for production control and for more accurate product costing.

In the rubber industry there are special preliminary handling and processing operations of an expensive nature on some raw materials that require special treatment.

Rubber Receiving, Handling, and Storage

Natural rubber, other than latex, is received in bales or cases. The operations connected with receiving, storing, handling, and opening the packages and cutting the contents on a heavy-duty cutter are considered a separate production center for which direct labor and overhead are segregated and added to the costs of all rubbers so processed on a poundage basis.

Washing and Drying

In addition, some natural rubbers cannot be used as received and must be washed and dried or screened on heavy equipment using much power.

These operations are treated as production centers and the costs are added to the cost of the particular rubbers so processed on a poundage basis in making charges to Direct Material in Process.

Non-Productive Service Cost Centers

Purchasing Department
Raw Material Stores Department
Production, Planning and Scheduling Department
Personnel Department
Time Study Department
Payroll Department
Steam Plant and Power Department
Maintenance Department
Mold Department
Laboratory
Factory and Cost Accounting Department
Factory Management Department

(These departments perform functions similar to those in other industries. In large plants many additional service departments or subdivisions of those listed are used; conversely in smaller plants some functions are combined.)

Distribution and Pricing Methods

Rubber goods fall into two main categories insofar as distribution is concerned. Products such as rubber footwear, drug sundries, bathing apparel, sporting goods, etc., are distributed directly or through jobbers and retailers to the consuming public. Other products such as tires, certain type mechanical rubber goods, heels and soles, and hard rubber goods are sold to manufacturers of other products as original equipment component parts of the customer's product. The rubber company then sells the same product to the general public as a replacement part.

Original equipment sales are desired by some producers of rubber goods for their advertising worth and for the volume involved. For example, if a substantial number of shoe manufacturers produce shoes equipped with a certain manufacturer's heel which is backed by national advertising, it is expected that the wearer of the shoe will be influenced to replace with the same brand. The same is true of automobile tires, fan belts, automobile radiator hose, etc.

Other types of products which are sold as original equipment, such as molded and extruded parts for motor mountings, washing machines, vacuum cleaner and refrigerator parts, are not usually branded with the rubber manufacturer's name and, therefore, no advertising prestige attaches to the sale of this material. However, the customer specifications must be rigidly met if repeat business is to be expected, but there is no expectation of continued consumer acceptance of such goods in the repair or replacement field.

The rubber manufacturing industry observes certain customer classifications for price-making purposes and, therefore, classifies distribution expense under the same customer classifications so that the cost of servicing each customer class can be obtained and controlled. Such customer classes are as follows:

Original Equipment—for Manufacturers of Other Products
Dealers—branch service
Dealers—factory service
Dealers—special service
Jobbers—branch service
Jobbers—factory service
Jobbers—special service
National Accounts
Commercial Accounts
Mail Order Accounts
Chain Stores
Department Stores
Retailers
Consumer Cooperatives
Government
Bus Mileage Accounts

Only the largest companies manufacturing and selling all types of rubber goods would use all the above customer classes. Smaller companies engaged in one product line would use only those customer classes with which they would be involved in the distribution of their own products, but in order to compete in the market, it is necessary that the cost of distribution be isolated for each customer class. It is necessary to analyze sales, and cost of sales, and the cost of distribution by product group and by customer classes because:

1. Terms of sale vary between product groups or customer classes;
2. Some product groups are sold through branches, whereas others are sold and shipped direct to a consuming customer;
3. Special salesmen may sell a product group or sub-group, or he may sell one or more products to one class of customer;
4. One sub-group of a product group may be advertised, whereas all other products in the same group may not be advertised;
5. The cost of distribution can vary widely as between product groups or customer classes.

Many rubber products such as tires, footwear, certain mechanical rubber goods, bathing apparel, drug sundries, rubber flooring, and heels and soles are usually price book items subject to trade discounts according to the product class involved.

A vast number of molded and extruded rubber goods specialties, hard rubber goods, and many articles of a special nature are manufactured to customer specifications, and prices are determined in competition by each competitor's ability to meet customer specifications at a cost that is competitive with other manufacturers. In this class of product, an adequate cost system is a vital necessity if intelligent prices are to be made and losses avoided.

In the rubber manufacturing industry certain costs of distribution are treated in a fashion at variance with that employed in other industries in general. Outbound transportation, where terms include delivery to the customer, is treated as a deduction from sale rather than as distribution cost in the profit-and-loss statement.

In the tire business and also in certain other product lines, the adjustment loss resulting from the replacement of product found defective after reaching a customer is of sufficient importance to be treated as a separate element of expense. The practice in the rubber manufacturing industry is to dramatize this loss for the purposes of control. The difference between the regular billing price of the merchandise and the adjusted price at which a replacement is made to the customer is considered the adjustment loss. This actually represents a loss of profit, as well as a true loss due to defects that have developed after the goods left the manufacturer's plant. The sale of the replaced item at a reduced price to allow for loss of service on the original purchase appearing in the profit-and-loss statement at its full sales price in gross sales is brought back to the true net sales figure by the adjustment loss appearing as a deduction from sale.

The same practice is extensively used as a means of controlling the overstocking of finished goods where obsolescence may become a factor resulting in a reduced return on the sale of such obsolete merchandise. In order to dramatize and control this factor when obsolete goods are sold at a sacrifice, the original selling price is used in computing the gross sales. The difference between the regular billing price and the actual sale price is classified as an Obsolete Finished Goods Loss under Deductions from Sales. The net sales figures on the profit-and-loss statement are thereby correctly stated.

In the actual distribution of goods, after the point of manufacture, the following functions are observed in the rubber manufacturing industry:

1. Factory Warehousing and Shipping
2. Selling
3. Administrative

It is the goal of the rubber industry to cost the distribution functions by the same technique as is used for costing the manufacturing functions, in order that expenses may be properly controlled and the cost of distribution more accurately determined.

II. How to Design the Cost System

Objectives

The needs of the particular company in which the system is to be installed must be the first consideration in the design of the cost system. Managerial control with particular respect to expense control is a foremost requisite—the extent of this control will depend upon the type of management, the size of the company and any restrictions on the cost of operating the system. When products are made to customer specifications, then major consideration must be given to the price-making function of the cost system.

In designing a cost system for a rubber manufacturing company, there are certain objectives that must be borne in mind in order that it will serve as an efficient tool of management:

1. The system must provide effective and efficient control of material, manpower, and plant facilities in all operations of the business.
2. It must provide yardsticks for measuring current cost of each operation against predetermined standards of efficiency.
3. It must provide, at minimum cost, the mechanism for the computation of actual historical unit costs.
4. It must also provide the means for computing the anticipated unit costs of products for the establishment of selling prices.
5. It must also furnish the basis for the preparation of operating reports, profit-and-loss statements, and balance sheets.

Standard Costs

In most branches of the rubber industry the so-called standard type of cost system is generally used because the vast number of products manufactured makes it impractical and too costly to operate an actual or job order cost system.

As in other industries, the standard cost system provides an efficient management tool at a modest cost for expense and production control and the means for quickly computing costs for selling price purposes before the product is made.

The rubber industry is a mass production industry and fluctuations in volume seriously affect unit costs; therefore, the volume variance produced by the standard cost system provides an instrument for management to evaluate properly its effect in the computation of costs for price-making purposes.

Preliminary Steps in Design of the System

Whether or not the system is being designed for a going concern, previously operating on another system or a new project, the same preliminary steps are involved before the system can be placed in operation. These steps are usually as follows:

1. Determine the cost centers for which it will be necessary to segregate expenses for cost control and for which separate overhead rates should be set up. Where all products manufactured pass through every operation in the plant, it is not particularly

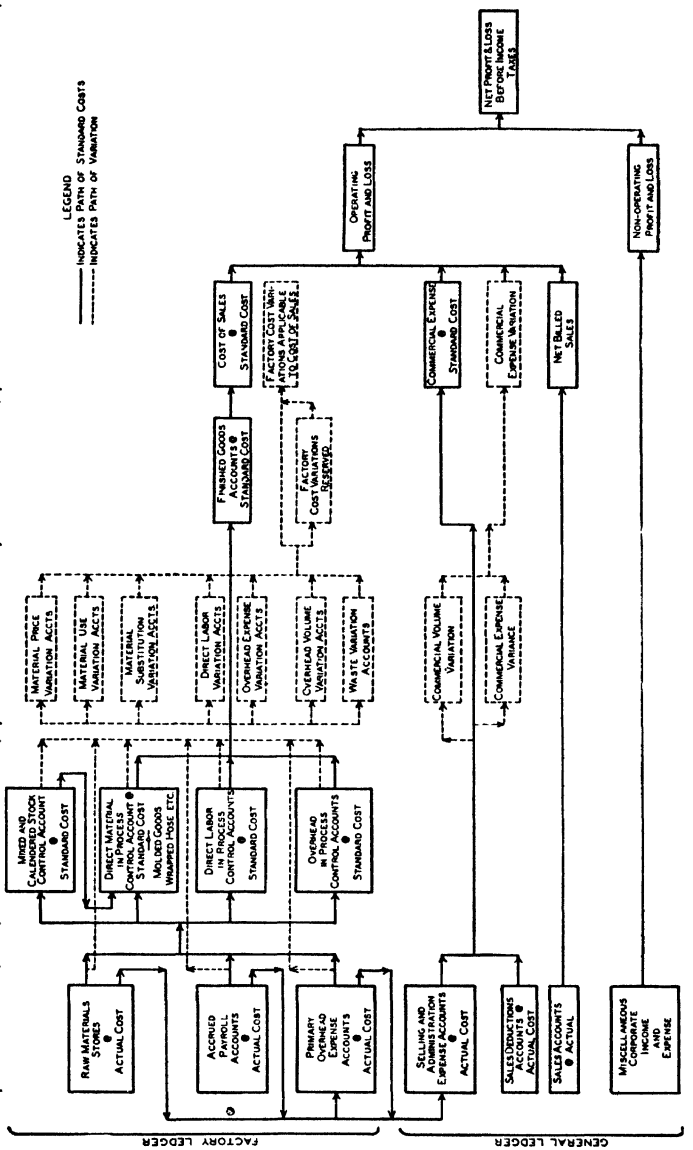

FLOW OF EXPENSE CHART
PRIMARY ACCOUNTS
WORK IN PROCESS ACCOUNTS
VARIATION ACCOUNTS
FINISHED GOODS ACCOUNTS
PROFIT AND LOSS ACCOUNTS
LEGEND
INDICATES PATH OF STANDARD COSTS
INDICATES PATH OF VARIATION
RAW MATERIALS STORES ● ACTUAL COST
ACCRUED PAYROLL ACCOUNTS ● ACTUAL COST
PRIMARY OVERHEAD EXPENSE ACCOUNTS ● ACTUAL COST
SELLING AND ADMINISTRATION EXPENSE ACCOUNTS ● ACTUAL COST
SALES DEDUCTIONS ACCOUNTS ● ACTUAL COST
SALES ACCOUNTS ● ACTUAL
MISCELLANEOUS CORPORATE INCOME AND EXPENSE
MIXED AND CALENDERED STOCK CONTROL ACCOUNT ● STANDARD COST
DIRECT MATERIAL IN PROCESS CONTROL ACCOUNT ● STANDARD COST
MOLDED GOODS WRAPPED HOSE ETC.
DIRECT LABOR IN PROCESS CONTROL ACCOUNTS ● STANDARD COST
OVERHEAD IN PROCESS CONTROL ACCOUNTS ● STANDARD COST
MATERIAL PRICE VARIATION ACCTS.
MATERIAL USE VARIATION ACCTS
MATERIAL SUBSTITUTION VARIATION ACCTS.
DIRECT LABOR VARIATION ACCTS.
OVERHEAD EXPENSE VARIATION ACCTS
OVERHEAD VOLUME VARIATION ACCTS.
WASTE VARIATION ACCOUNTS
COMMERCIAL VOLUME VARIATION
COMMERCIAL EXPENSE VARIANCE
FINISHED GOODS ACCOUNTS ● STANDARD COST
FACTORY COST VARIATIONS RESERVED
COST OF SALES ● STANDARD COST
FACTORY COST VARIANCES APPLICABLE TO COST OF SALES
COMMERCIAL EXPENSE ● STANDARD COST
COMMERCIAL EXPENSE VARIATION
NET BILLED SALES
OPERATING PROFIT AND LOSS
NON-OPERATING PROFIT AND LOSS
NET PROFIT & LOSS BEFORE INCOME TAXES
FACTORY LEDGER
GENERAL LEDGER

Exhibit 1.

necessary for unit cost accuracy to have more than one overhead center for the entire plant. However, for expense control, it is generally considered desirable to break down the manufacturing cycle into operations or overhead centers. Where various types of product pass through different operations in the plant, it is then necessary to set up separate overhead centers for each operation, if accurate unit costs are to be determined.

2. Determine the practical attainable capacity of each production center in terms of output per hour.

3. Ascertain the direct labor dollars or hours and service function requirements for each production center at the above-mentioned capacity.

4. Obtain a forecast of the expected sales volume as detailed as possible for the ensuing year.

5. Stations in the production cycle should be established where production volume may be measured and reported regularly, in conjunction with material usage, quality and labor controls.

6. Estimate the average expected prices for each direct raw material for the ensuing year.

Budgets should then be prepared for factory overhead, classified by production centers and service functions, and for commercial expense classified by administrative and distributive functions. In the preparation of these budgets, expenses should be further classified as between:

a. Fixed expense, or those expenses which remain constant regardless of volume of production.
b. Variable expenses, or those which fluctuate in proportion to the volume of production.

In determining the rate of expenditure for variable expenses, consideration must be given to the volume of production to be budgeted. If the company desires to use an ideal standard, then such variable expenses should be fixed in the budgets for production at capacity. Most companies, however, set their budget on the basis of the actual expected volume of business. The management and the accountant must have a complete understanding of the basis on which the budgets are prepared.

Expenses may be wholly or partially variable or fixed. When the expense is partially variable, the amount that would still be incurred under shutdown conditions should be classified as the fixed portion of this expense, and the balance classified as variable. This distinction between fixed and variable expense is highly important as there are departments in the plant which have a highly fluctuating percentage of capacity operation.

Power, steam, and other such service charges should be assigned to each production center for the budgeted volume of output, broken down as between fixed and variable expense.

For example, the demand charge for electric power should be apportioned as the fixed electric power cost to the various productive cost centers for which the demand charge is estimated. Likewise, the fixed part of steam costs should be assigned to the departments in proportion to the percentage that each is expected to absorb at the budgeted rate of operation. When any department fails to operate at a level of production equal to the budgeted rate, the failure to absorb the fixed charges of the service departments is then reflected in the volume variation for each production center.

In the rubber industry, if the company is to be competitive, there are many

special-purpose machines not regularly used that must be available for the production of certain types of products. The company cannot expect to absorb the full cost of these operations in the cost of goods manufactured during any period, particularly when some competitor might be specializing in the particular type of goods using the special-purpose equipment and operating to capacity in a similar department. Therefore, standard overhead rates on such equipment should be computed on a full usage basis.

Generally the forecast of expected sales volume is used as a basis for budgeting the plant production after taking finished goods inventories into consideration. The budgeted output for the plant as a whole should then be worked back through all production centers and a budgeted production established for each, as a base for calculating total budgeted direct labor and subsequently overhead rates for each production center. Where a machine-hour overhead application is to be used, the budgeted machine-hours necessary to produce the budgeted production should be computed.

A budgeted direct labor cost should be computed for each production center based on the production budgeted for each.

Overhead rates should then be computed for each production center. Where the employee-hours and the machine-hours remain constant on any given operation regardless of the type of product manufactured, and the base labor rates are the same regardless of product, it is usually considered simpler to compute an overhead rate in relation to the dollars of direct labor. However, when the employee-time and the machine-time vary in a production center, as between products that pass through, then it is essential that a machine-hour rate be established for that operation so that the overhead cost can be applied to each product passing through, in direct proportion to the time that product makes use of the facilities provided by the production center.

In some instances, for greater cost accuracy, where required, two or more overhead rates are used in the same department, that is, a portion of the overhead is applied as a percentage of direct labor for expenses which do not have any connection with the machines, and a machine-hour rate utilized for the same department for those expenses which are directly concerned with the machine.

Standard Material Cost

Standard prices should be determined, in collaboration with the purchasing department, for all raw materials to be used in the computation of standard unit costs as well as for the purpose of computing the variation between such standard material price and the price actually paid for the materials during each accounting period. The standard material prices at which raw materials are charged to Direct Material in Process should include inbound transportation and the cost of purchasing, receiving, handling, and storing on all major raw materials.

Standard Labor Cost

In most rubber manufacturing plants, some form of wage incentive plan is employed which provides the cost accountant with standards which can be used in computing the standard labor cost for each product and for measuring the efficiency of each operation.

Where incentive systems are not used and the employees are paid on an hourly

basis, it is then necessary that time studies be made to determine the standard rate of output for each operation for the computation of standard unit direct labor costs.

It is highly important that all labor be correctly classified as between direct labor and indirect labor, particularly if direct labor is used as the time measurement for the application of overheads.

Production Scheduling and Production Control

Production scheduling is an important function for the efficient operation of the factory and is highly essential for cost control. The scheduling system should provide the proper amount of raw material and semi-manufactured material for the right equipment at the right time, as well as facilitate the filling of customers' orders on time and in the right quantity.

The preparation of schedules alone will not perform these functions. A comparison of performance against the schedule must be readily available at all times; therefore, actual production information must be recorded at key points in order to effectively control the flow of output, labor and materials (see Exhibit 2). The reporting of this production information should be designed to serve the cost accountant in expense control. Weights of material and piece counts made at strategic points in the production cycle can be used to control piece work payments, material usage, and waste losses from minute to minute during each day and at the same time provide the cost accountant with the basic information for the periodic determination of variations from standard, in dollars and cents.

III. Description of the Cost System

Compound Costs

Each compound or formula cost is set up according to laboratory specifications as to quantity of each ingredient at standard prices for each (see Exhibit 3). The compounding and mixing direct labor is added, based on time study or piece work rates together with the attendant overhead for each of these operations.

Calendered Stock Costs

When compounded stocks are sheeted to gauge on a calender, the cost of the calendering operation is added to the compound cost. When fabric is combined with a rubber compound on a calender, it is important to compute the cost per square yard of the calendered stock to serve as a basis for computing the direct material cost of specific products (see Exhibit 4).

Standard Unit Cost

The standard unit cost forms (see Exhibit 5) should be designed to furnish the maximum information for the use of the cost accountant, and styled to facilitate computations of actual historical costs, costs for the calculation of selling prices and revised standard costs, and at the same time provide the standard unit cost summaries for costing production, costing sales, and pricing inventories.

A standard unit cost form is usually made up for each item manufactured. In rubber footwear, and rubber heel and sole manufacture, however, a cost form is compiled only for the weighted average size in each style instead of for each size.

The direct material cost per unit is computed at the standard direct material

ORDER | DAILY CAPACITY | SPEC. NO.

COMPOUND NO | PART NO. | MOLD NO.

RAW MATERIALS ORDERING WEIGHT PER M | CUSTOMER

PRODUCTION RECORD

DATE	CALENDER			TUBE			PREPARATION			CURE			FINISH			DEFECTIVE		INSPECT AND PACK			SHIPPED	
	SCHED.	DELVD.	CUM.	SCHED.	DELVD.	CUM.	SCHED.	DELVD.	CUM.	SCHED.	DELVD	CUM.	SCHED	DELVD.	CUM	PCS.	CUM.	SCHED.	DELVD.	CUM.	PCS.	CUM.

EXHIBIT 3

COMPOUND STANDARD COST

Compound No. 1024

Batch Wt. 147 lbs.
Mixing Time 10 Min.
Specific Gr. 125

Ingredients	Quantity	Standard Price	Extension
No. 1 Rib Smoked Sheets	10 lbs.	$.235	$ 2.35
GRS	50	.20	10.00
Stearic Acid	4	.15	.60
Sulphur	1	.02	.02
Pine Tar	2	.03	.06
Subtotal	67 lbs.		$13.03
Master Batch No. 206X	80	$.175	14.00
TOTAL	147 lbs.		$27.03

Compound Standard Cost Per 100 lbs.

Ingredients	Direct Material Cost	Direct Labor Cost	Factory Overhead Cost	Total Cost
Master Batch No. 206X	$ 9.52	$2.00	$3.50	$15.02
Ingredients Cost	8.86	—	—	8.86
Compounding	—	.60	.90	1.50
Mill Mix	—	1.20	1.80	3.00
Banbury Mix	—	—	—	—
MIXED COMPOUND COST	$18.38	$3.80	$6.20	$28.38

cost per pound for the net quantity of each material to be contained in the finished unit. The difference between the gross quantity necessary to manufacture and the net will appear as a waste loss as hereafter described.

Standard waste losses should be based on experience as to the minimum possible losses and should be determined for *each* product subdivided as follows:

1. *Rind or trim losses* represent a loss of direct labor and overhead for the preceding operations as well as the actual material loss. Standard trim losses should be set at the minimum possible except when excess rind may hasten stripping of molds and the resultant labor saving offsets the extra material loss. When computing the material value in waste, the expected salvage value should be deducted.

2. *Defective losses* represent the cost of product found defective before final finishing and should be computed at the full manufacturing cost per unit less any salvage sales value.

3. *Reoperation losses* represent the loss of direct labor and overhead when it is necessary to reprocess materials. A certain amount of reoperation is often unavoidable in rubber manufacturing and should be allowed for in standard cost as a waste loss on

EXHIBIT 4

CALENDERED STOCK

Stock No. 622B

Gauge_____
Width 36″
Weight Per Sq. Yd. .935 lbs.

Ingredients	Weight	Standard Cost per 100 lbs. Direct Material Cost	Direct Labor Cost	Factory Overhead Cost	Total Cost
Textile (2.35 yd. Osnaburg)	41 lbs.	$22.64			$22.64
Compound No. 1024	49	13.91			13.91
Compound No. 602	10	4.10			4.10
Calendering					
Skim Coat			$1.10	$2.20	3.30
Friction			2.00	4.00	6.00
TOTAL	100 lbs.	$40.65	$3.10	$6.20	$49.95

certain operations, such as tubing and cutting raw stocks while adjusting or setting up machines for a run.

The standard direct labor and overhead, for each production center used in the production of the article, is then added, based on piece work rates or time studies.

Commercial expense is applied to the factory cost on each standard unit cost sheet in the following manner:

Factory warehousing and shipping—on a unit or weight basis.

Selling and administrative expense—as a percentage of total factory cost. Differing percentages are used for each method of sale or class of trade by type of product for which separate distribution costs are computed.

There are exceptions from this procedure when a component part of the product can be furnished by the customer, that is, couplings for hose, metal tanks and parts to which rubber is to be applied and cloth to be coated. In such cases no mark-up for administrative and selling expense, sales deductions or profit can be made, otherwise the customer would always furnish such material.

Special mark-up percentages should be calculated for such products based on the relationship of standard administrative and selling expense totals to a standard total factory cost excluding such extra material values. These special percentages should be applied to the total unit factory cost less the value of the special extra materials for the products affected.

Deductions from sales, which must be recaptured from the customer in the price, are also applied on each standard unit cost sheet for special order products:

MOLD .....
SPEC. GRAV. .....
CUSTOMER .....
WEIGHT 11.67 # PER "C"

Standard Cost Per "C" Pieces

PART NAME .....

	DATE — JANUARY 1, 1937		DATE — FEBRUARY 20, 1938		DATE — JUNE 25, 1938	
	STANDARD COST		RATIO ACTUAL TO STANDARD	ACTUAL COST	REVISED STANDARD	
STOCK COST:						
RUBBER		$.90	91.84	.826		.90
RECLAIM		.54	96.73	.522		.54
OTHER INGREDIENTS		.23	107.56	.247		.23
EXTRA MATERIAL						
TOTAL DIRECT MATERIAL		1.67		1.595		1.67
DIRECT LABOR:						
COMPOUNDING		.03	97.4	.029		.03
MIXING-MILL BANBURY		.10	96 8	.097		.10
TUBING						
CALENDERING						
STOCK PREP		1.14	104.2	1.188		1.16
CURE		1.58	99.6	1.574		1.58
FINISH						
TRIM		.62		.624		.62
REAM		.46	100.7	.463		.46
INSPECT		.44		.443		.44
TOTAL DIRECT LABOR		4.37		4.418		4.39
OVERHEAD:						
COMPOUNDING	85%	.026	93.6	.024	83%	.025
MIXING	165%	.165	98.6	.163	160%	.16
TUBING						
CALENDERING						
STOCK PREP	95%	1.08	101.7	1.098	94%	1.09
CURE (2½ HRS.)	$.267 PER P.P.H.	.67	97.1	.651	26¢ P.P.H.	.65
FINISH	100%	1.58	97.1	1.534	97.5%	1.54
TRIM		.56		.533		.54
REAM	90%	.41	95.2	.390	87.5%	.40
		.40		.380		.39
TOTAL OVERHEAD		4.89		4.773		4.795
WASTE LOSSES:						
REOPERATION LOSS	1%	.11	145.5	.16	1%	.11
CURED SCRAP & TRIM LOSS	2%	.22	145.5	.32	2%	.22
REJECTION LOSS	12.4% OF TOTAL	1.36	119.1	1.62	12.4%	1.35
TOTAL WASTE LOSSES		1.69		2.10		1.68
TOTAL FACTORY COST		12.62		12.886		12.535
COMMERCIAL COST:						
FACTORY WAREHOUSE & SHIPPING	$.50 PER CWT.	.06	100.0	.06		.06
TRANSPORTATION	$1.25 PER CWT.	.15	100.0	.15		.15
SALES DEDUCTIONS ADMIN. & SELLING	16.12% OF FACTORY COST	2.03	114.3	2.32		2.02
TOTAL COMMERCIAL EXPENSE		2.24		2.53		2.23
TOTAL COST		14.86		15.416		14.765
PROFIT						
SELLING PRICE						

UNIFORM ACCOUNTING MANUAL—THE RUBBER MANUFACTURERS ASSOCIATION

Exhibit 5.

Transportation (factory to customer) is applied to each product on an actual basis. Outbound transportation costs are applied to each unit cost at an average rate per pound for each type of product.

Replacement or adjustment losses, representing the difference between the price at which a defective product is replaced and the original selling price less salvage value, are applied to each type of product in the same relation that the budgeted total of these losses bear to the budgeted total cost of sales of the same type.

Cash discount is treated as a deduction from sales, rather than as a financial transaction, and applied to product costs as a percentage of total factory costs based on the experience of each manufacturer for each class of trade by type of product.

Volume rebates are granted in the tire division at the year end, when customers qualify by purchasing a volume predetermined by contract. In computing an all-in cost, it is, therefore, necessary to make a provision for the average rebate expected to be made, based on past experience.

Direct Materials Price Variation

In this industry it is customary to carry raw material inventories at actual cost and determine the price variation as the materials are put into process. Most materials are tested for quality as received and handled through stores in a fashion similar to other industries. Shrinkage allowances are determined from experience on certain materials, where moisture evaporation or spillage of powdered ingredients are unavoidable. The invoice price is increased to cover such shrinkages and inbound transportation charges in determining the actual value of issues from stores. At the month end, a summary of stores issues is then extended at actual and at standard prices—the differences representing the price variation for the period. The standard cost of purchasing, receiving, handling, and storing should be added to the charges made to Direct Materials in Process. Separate rates should be used for each major raw material requiring special handling, such as rubber and textiles. The book entries would be:

Dr. Direct Materials in Process (at standard value)
Cr. Raw Materials Inventory (at actual cost)
Cr. Purchasing, Receiving, Handling and Storage Control (at standard cost)
Dr. or Cr. Direct Materials Price Variance (with difference)

The price variance should be prepared with subtotals for major material classes such as rubbers, textiles, and chemicals to facilitate the application of the variation to product groups on the profit-and-loss statement.

Direct Material Usage Variation

A specification is prepared for each product in a specification department. The specification should contain a complete bill of materials giving the quantities, weights, gauges and other dimensions of each component part together with operating tolerances. The scheduling department issues production orders to the various production centers combining runs of the same stocks in the mixing and calendering operations. These production orders should include the standard weights, gauges, and other dimensions mentioned in the specifications. Each production center's performance record should show the actual results which, when

summarized at the month end, will provide the information for computing the material usage variation.

In the manufacture of small molded or extruded rubber products, it is customary to weigh-count pieces to determine finished quantities for billing purposes. This same weigh-count record on finished pieces can be used to determine the variation in weight between standard and actual. The difference can be priced at the standard material cost of the compound to calculate the Material Usage Variation on each product of this type. Careful and regular observation of weight records by management aid in detecting and correcting material usage variations soon after they occur.

In the calendering or spreading operation, it is important for quality control as well as cost control to record the weight of gum stock applied to fabrics. Each roll of fabric should be weighed before and after calendering together with its shell and liner. The difference between the weights will represent the actual gum stock applied. The difference between the actual and the standard quantity predetermined by the scheduling department will be a material usage variation which can be valued at the standard cost of the milled stock used.

When calendered stock is cut up for further processing, another usage variation may occur in any divergence from the standard width of the pieces cut. This variation can be controlled by proper supervision but it is not customary to calculate the value of the variation at this point as the cut pieces are usually spliced into a continuous roll for use in the assembly of a product where the width variation may be compensated for by using greater than standard length in the product.

When products are made by assembling several component parts, as in the manufacture of tires, hose, and belting, it is difficult to determine which part has been used at a rate varying from standard. Many companies have their cost men make regular tests of the weight of each component used by the assembler, and then weigh the finished unit. An average of these tests is used for evaluating the material usage variation at this point. Other companies follow the practice of recording the deliveries of each component material to the assembly operation and taking periodical inventories for the determination of the usage variation by comparing the actual usage with the standard, computed by multiplying the actual number produced by the standard quantity of each component required.

Where it is impractical to measure a usage variation, due allowance must be made in the standard cost to compensate for it.

This variation is recorded at the end of the accounting period as follows if excess material is used:

Dr. Direct Material Usage Variation	(at standard
Cr. Direct Material in Process	values)

Direct Labor Variations are determined according to the method of wage payment. Where piece work rates or similar wage incentive plans are used, the variations are generally the allowances made at base hourly rates for waiting time, overtime premium, etc. These allowances are accumulated and summarized for production centers by the payroll department. When wages are paid on an hourly basis, the standard direct labor cost in each production center is computed by multiplying the unit production of each product by the standard unit direct labor cost for comparison with the actual payroll. The difference represents the Direct Labor Variation.

Overhead Variations

Separate overhead analyses are prepared for each cost center comparing detailed actual expenses with the budget, adjusted for the volume actually processed. The difference between the two represents the Overhead Expense Variance. The standard overhead rate applied to the actual production furnishes the earned overhead and the difference between this figure and the adjusted overhead budget represents the Volume Variation.

Work in Process Accounts

Some rubber manufacturers charge the following work in process accounts with materials from stores, and with labor and overhead costs, and credit these accounts with the cost of goods finished:

Direct Material in Process
Direct Labor in Process
Factory Overhead in Process

Other companies claim to secure better control and more accurate unit costs by setting up intermediate process controls as listed above for the preparatory operations—compounding, milling, calendering, and tubing. The semiprocessed materials issued from milled and calendered stores during the month are credited to these preparatory in-process accounts and charged to Direct Material in Process accounts for each product class for which controls are considered necessary. Under this method Direct Material Cost includes direct labor and factory overhead for the preparatory operations.

Many companies favor separate work in process accounts for each major product group, whereas others use a single set of such accounts regardless of the number of product groups manufactured.

At the close of each month the units finished are extended at the standard manufacturing cost to determine the credits to the in-process accounts and the charge to Finished Goods Inventory Account.

Cost of Sales

At the close of each accounting period the cost of sales must be determined for the profit-and-loss statement. Two methods are employed in the rubber industry:

1. Summarize unit sales by size and type and multiply by the standard manufacturing cost for each.
2. Insert the standard cost on each invoice and summarize the cost and sales values at the same time.

The first method is used where many shipments of the same sizes and types are made each period. The second method is employed where there is comparatively little duplication. Many companies employ both methods where confronted with both situations in different product groups.

Profit-and-Loss Statement

The final results of the operations for an accounting period as to profitability are displayed to the management in the form of a profit-and-loss statement. This statement should show the profit or loss on sales by product and by method of sale

EXHIBIT 6

PROFIT-AND-LOSS STATEMENT

For Period Ended_____

Classified By Types of Products and Classes of Customers

	Grand Total	PRODUCT A				PRODUCT B				
		Total	Original Equipment	Replacement	Export	Total	Chain Store	Jobbers	Dealers	Export
Gross Sales										
Less Returns										
Net Billings										
Sales Deductions:										
Allowances										
Cash Discounts Allowed										
Transportation Out										
Adjustment Losses										
Obsolete Finished Goods Loss										
Volume Rebates										
All Other										
Total Sales Deductions										
Net Sales										
Standard Cost of Sales										
*Variations:										
Material Price										
Material Usage										
Direct Labor										
Overhead Expense										
Overhead Volume										
Actual Cost of Sales										
Gross Profit										
Commercial Expense:										
Factory Warehousing and Shipping										
Selling:										
Advertising										
Branch Selling and Operating										
Home Office Selling and Operating										
Administrative Expense										
Total Standard Commercial Expense										
Variations:										
Expense										
Volume										
Actual Commercial Expense										
Net Operating Profit										
Income Taxes and Corporate Charges										
Net Income										

* Analyzed by responsibilities in cost and production center operating statements.

Exhibit 6.

for each product. It should also furnish an analysis of variations from standard cost to account for the difference between the budgeted rate of profit and the actual profit or loss (see Exhibit 6).

Most companies in the industry attempt to apply all variations as accurately as possible to each profit-and-loss classification. Some companies, however, display the profit-and-loss breakdown based on standard cost of sales only without attempting the distribution of variations to products and methods of sale.

The methods used in applying variations to product classes vary, but every company attempts to apply them as specifically as possible using the most equitable bases for prorating those which cannot be applied directly.

Direct Material Price Variation is prorated in proportion to the quantities of each material used in each product group.

Direct Material Usage Variations and Waste Variations can usually be applied specifically to each product group.

Direct Labor and Factory Overhead Expense Variations are applied specifically to product groups as far as possible and, where more than one product group is processed by a production center, a proration is made based on the direct labor dollars or machine-hours operated on each group.

Factory Overhead Volume Variations should be assigned to the product group or groups to reflect the success or failure to operate at the budgeted rate of production. This is largely the sales department's responsibility.

When a production center processes more than one product group, the volume variation should be apportioned specifically to groups, according to the actual difference between the earned overhead and the adjusted budgeted overhead for each group.

The profit-and-loss statement is usually supplemented by monthly operating statements for each cost and production center. These statements analyze and compare actual cost with the standard cost of production by cost elements and display variations by causes and responsibilities, as an aid to cost control and more efficient management.

COST ACCOUNTING FOR SHIPBUILDING, SHIP REPAIR AND CONVERSION

By

ADOLPH SCHOEN *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products and Services

Shipbuilding is the construction of large sea-going vessels. Ship repair is the restoration of ships to sound operating condition. Ship conversion is the process of effecting substantial functional changes in a ship's structure or installations, e.g., those necessary to make aircraft carriers of merchant vessels.

The beginnings of shipbuilding antedate recorded history. Through the centuries, the industry has played a vital role in national economy and security. Ever responsive to the demands of war and commerce, it has developed steadily in size, complexity, and essentiality.

Usual peacetime productive activities of privately owned shipyards are the construction and repair of passenger liners, freighters, tankers, trawlers, tugs, barges, colliers, floating cranes, etc. These products and services are contracted for by shipping lines, railroads, governments, and large industrial concerns in general. Some large yards with specialized facilities and organizations also participate in the country's naval program.

During national emergencies, shipbuilding capacity has expanded rapidly and tremendously. Established yards have augmented their facilities, new yards were built—many were government-financed and others were recruited from the ranks of small boat builders and related industries. Battleships, carriers, cruisers, destroyers, transports, cargo carriers, landing craft, mine layers, submarines, and other war craft, as well as merchant vessels, have been built in great numbers at such times. Repair and conversion of vessels are also substantial activities.

Yards vary in size, facilities, organization, production methods, products, and services. Individual yards have employed as few as 100 and as many as 30,000. Some yards build tugs and small vessels only; some specialize in repair work; others can build battleships and nearly every type of war craft and commercial vessel. A few large shipyards operate steel mills, foundries, and extensive equipment for a complete range of construction and service activities. Many others with limited facilities purchase steel and subcontract much of their requirements.

Ships are generally built to order in accordance with individual plans and drawings. During normal times, specifications usually vary with each contract. Repair and conversion projects rarely are exactly alike. Contract performance periods may range from a few days required for a single repair to several years for the construction of a large vessel.

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Origin of the Products

Commercial ship design is usually initiated by the special requirements of the prospective owner and operator. Independent design agencies translate these requirements into preliminary plans which are made the basis for contract bidding. These agencies are generally headed by naval architects of broad technical knowledge and long experience.

The design of ships built for the Navy is largely the responsibility of the U. S. Bureau of Ships. This agency has extensive facilities for research, survey and development of naval requirements. To its experimental stations come a variety of problems arising from military need, battle hazards, exchange of information with other governments, etc. Model ships are tested in water under controlled conditions in one of the world's largest model basins. These research centers facilitate solution of problems of structural design, powering, speed, stability, strength, maneuverability, resistance to weather and explosion, etc.

Merchant vessels built for the U. S. Maritime Commission are generally designed by its Technical Division. As a prerequisite to registry under the flag of the United States, merchant vessels must be built to conform to the requirements of the law governing such registry and the regulations of the various enforcement agencies.

Most merchant vessels are built to class. Before construction begins, structural plans are approved by the American Bureau of Shipping, an independent, nonprofit organization, known as a classification society. The society's representatives also inspect structural materials and important items of ship machinery and equipment prior to installation, and periodically examine the vessel during construction to insure maintenance of society standards and regulations. Upon completion of the vessel, the society issues a Certificate of Classsification which sets forth the ship's structural adequacy, seaworthiness, etc. This certification is generally required for insurance of ship or cargo.

Sources of Materials

Many modern ships are built largely of steel. It is the choice of structural materials because of its great strength, workability, and uniformity. It is available in many forms such as plates, shapes, forgings, and rivets. When destined for ship use it is also inspected and tested at the steel mill by the American Bureau of Shipping. Its chief disadvantage, susceptibility to corrosion and rust, can be controlled by painting.

Non-structural materials used aboardship are numerous. A few of these and their uses are listed as follows:

Asbestos, cork, and felt for insulation against heat and noise.
Brass, bronze, copper, lead, and zinc for piping and fittings.
Glass for windows, airports, etc.
Linoleum for deck coverings, etc.
Paint for preservation, sanitation, and decoration of surfaces.
Rubber for waterproofing joints, hatches, airports, doors, etc.
Tiling for galleys, pantries, etc.
Wood for weather decks, gratings, sparring, etc.

A variety of machinery and equipment is installed in shipbuilding. The following general classifications and component items are illustrations:

Anchor gear: Anchors, capstan or windlass, chain, engine, hawse pipe.
Boats and boat handling gear: Life boats, life rafts, davits.
Cargo handling gear: Booms, fitting, masts, nets, riggings, winches.
Communication equipment: Telephones, telegraphs, call bells.
Compasses and other navigational equipment.
Fire protection system: Sprinklers, hydrants, smoke detectors.
Mooring, warping and towing gear.
Oil system: Centrifugal cargo pumps.
Propulsion equipment: Engines, propellers, etc.
Steering gear: Control gear, engine, mechanism, rudder.
Ventilation and air-conditioning equipment: Fans, etc.
Water system: Mains, coolers, water closets, etc.

A few large shipyards manufacture their steel requirements and also much of the vessel's equipment from basic raw materials. Most yards, however, purchase steel and much of the ship's installations from numerous supply sources.

Organization of Plant

This description of shipyard cost accounting is particularly applicable to the yard of moderate size with approximately 2500 employees, engaged in the construction, repair, and conversion of steel passenger and cargo vessels, and which purchases its steel, machinery, and equipment requirements.

Shipyard organization is similar in some respects to the organization of manufacturing plants in general. These have, in common, departments for purchasing, storekeeping, maintenance, personnel, accounting, etc.; and general executives, managers, superintendents, and foremen. Principal differences are to be found in the engineering and production departments.

Engineering Department. This department is of prime importance as shipbuilding is fundamentally a matter of engineering. Shipyard work generally begins here. Departmental functions may be classified as follows:

1. *Marine Engineering.* This section is headed by a naval architect and marine engineer. It is responsible for the following activities:
   a. Research; origination and development of ideas.
   b. Preparation of sketches and plans for contemplated projects.
   c. Drafting of completed blueprints and drawings.
   d. Scheduling specifications and bills of materials.

2. *Planning.* A production engineer is the divisional chief. Duties of this section consist of the following:
   a. Preparation of cost estimates.
   b. Planning of production schedules.
   c. Preparation of production orders.
   d. Production control.
   e. Time and motion study and rate setting.

3. *Facilities.* A plant engineer is in charge. Sectional functions are:
   a. Providing structures and equipment essential to production schedules.
   b. Designing additional structures and equipment as required.
   c. Inspection of facilities to determine load capacity, need for repair, etc.

Production Departments. These may number twenty or more in the average shipyard. Inasmuch as hull construction and installation of machinery and equipment are exacting procedures, it is essential to coordinate plans, materials, and manpower among these departments.

Principal differences between shipyard work and other kinds of manufacturing or construction are outlined briefly so that production procedure and organization may be better understood:

1. Work order specifications usually vary materially with each job of construction, repair or conversion. Periods of contract performance differ likewise. Consequently, work is performed largely on a job order basis with limited application of mass production technique.

2. The curved lines of the average ship and numerous variations in compartment installations are in direct contrast to the straight lines of the average building and its rooms of comparatively uniform design. These differences limit the opportunity of repeating operations exactly space after space. Ship-building has many other unique technical problems and requires skills not employed elsewhere.

3. In shipyard work, much of the productive labor cost is incurred aboard or about the vessel. Although many operations are performed in yard shops or on assembly platforms, the direct labor expenditure at these points is usually less than half of the total. Because of limited working space in ship compartments, and for other reasons of efficiency, craftsmen move in specialized trade gangs from space to space and perform their work in predetermined sequence. Materials, on the other hand, remain relatively stationary after being routed to proper location aboard ship.

Production departments are usually headed by a general superintendent. These departments may be classified according to their principal contributions to the three major phases of construction procedure.

1. *Structural.* Hull construction or steel work is the responsibility of the hull superintendent. This phase may be subdivided as follows:

a. *Mold Loft Work.* Mold loft functions consist of fairing or correcting preliminary lines plans prepared by the drafting room; drawing the ship's body plan to full size on the mold loft floor; and making full-size templates or patterns of wood or paper of nearly every structural part of the ship. Mold loft craftsmen include template makers, loftsmen, etc.

b. *Fabrication.* In the fabricating shop, steel is cut, shaped, bent, punched, and drilled to template specifications. The plate section works on cold steel, cutting with machine shears, planers, torches, and acetylene cutting machines; punching with punch presses; and bending and straightening with heavy rolls and presses. Hot steel is shaped and worked with sledge hammers and other tools in the anglesmith shop. Shop personnel consists of shearers, punchers, drillers, welders, riveters, anglesmiths, etc.

c. *Preassembly.* Some of the fabricated parts are fitted together and joined to make large preassembled units or sections such as bulkheads, web frames, stern assemblies, and rudders. This work is done in the fabricating shop or on assembly platforms by shipfitters, erectors, welders, riveters, burners, chippers, reamers, drillers, etc.

d. *Erection.* In this final structural stage, the fabricated parts and assemblies are brought together, hoisted into position, fitted, and secured on the ways. Operations include laying the keel, erecting the framework, and plating the framework, and are performed by erectors, shipfitters, reamers, drillers, riveters, chippers, calkers,

burners, welders, etc. On completion of this stage, a watertight structure has been created, with decks, bulkheads, superstructure, and foundations for machinery and equipment. The vessel is now ready for launching and the next major phase of construction.

2. *Machinery Installation.* This phase is also known as the engineering phase and is headed by the machinery superintendent. The numerous jobs performed in this classification include the installation of propulsion and auxiliary machinery and equipment, steering apparatus, piping systems, etc., as well as the manufacture of some of these items. The following departments may be grouped here:

a. Blacksmith Shop	Manufacturing anchor gear, chains, etc.
b. Boiler Shop	Boiler construction.
c. Foundry	Manufacturing metal castings.
d. Machine Shop	Manufacturing valves, etc.
e. Pattern Shop	Making forms for molds for metal castings.
f. Pipefitting and Plumbing Shop	Making piping and plumbing installations.
g. Rigging Loft	Making and fitting rigging for masts, spars, etc.

Among the craftsmen in these departments are engine fitters, pipefitters, steamfitters, coppersmiths, blacksmiths, machinists, molders, coremakers, riggers, etc.

3. *Outfitting and Finishing.* This phase consists principally of installing in the vessel's living quarters, berths, dressers, lights, insulation, ventilation equipment, etc. Among the departments charged with these operations are the following:

a. Electrical Shop. This department installs wiring for lighting, power, communication, fire control, etc.
b. Sheet Metal Shop. Work consists of installing insulation, ventilation ducts, sheathing, etc.
c. Carpentry and Joinery Shop. This department builds wood decks, furniture, fixtures, and equipment. During the structural stage this shop builds the staging, shoring and launch ways for the vessel.
d. Paint Shop. All painting and varnishing aboard ship and about the yard are done by this shop.

Trades employed in these shops include electricians, tinsmiths, carpenters, riggers, painters, cleaners, etc.

Much of the second and third major shipbuilding phases is performed after the vessel is launched in order to make the ways quickly available for the next ship.

Cranes of various types play an important part in handling materials during all phases.

Production Order System

Production orders logically originate in the planning section of the engineering department where contract specifications, drawings, bills of material, production schedules, inventory records, and related data are conveniently centralized for production control purposes.

The work authorization sets forth order number, job number, contract number, hull number, departmental routing, drawing reference, description of work to be performed, material group number, size, quantity and description of materials, required completion date, etc.

A copy to the stores department serves to reserve materials which are later forwarded to the designated production departments in accordance with scheduled dates. Purchase requests are initiated for materials not on hand. Expediters follow

up the resulting purchase orders so that all materials listed on a production order are on hand when work is scheduled to begin on that order.

Production department copies are accompanied by blueprints and identification tags. These are issued well in advance of scheduled starting dates to enable supervisory executives and foremen to plan intelligently and efficiently, particularly with respect to manpower requirements.

II. How to Design the Cost System

What Information Is Required

The cost system should be designed to furnish management with adequate, accurate, and timely control data at minimum cost. It is usually essential to secure:

1. The cost of each job of ship construction, repair, and conversion, and the income-cost relationship of each class of productive activity.
2. The cost and efficiency of each major phase of production, each important cost group or classification, and of each principal labor operation.
3. The segregation of applicable performance costs into the general categories of direct labor, direct material, other direct costs, manufacturing overhead, and general and administrative expense.
4. The accumulation of statistical data such as direct labor man-hours and structural steel tonnage consumed.
5. Data for the determination of efficiency in the use of manpower, materials, and facilities.
6. Data in general for the preparation of balance sheet, profit-and-loss statement, and various analytical operating reports.

Reports to general executive management are broadest in scope and should be prepared in clear and condensed form. Reports to supervisory executives are in greater detail and should emphasize cost control in every day operations.

Considerations in Designing the System

Good plant organization is essential to the satisfactory operation of the shipyard cost system.

Essential preliminaries to cost system design therefore include development and standardization of organization plans and manuals which detail functions, responsibilities, and relationships of departments and personnel; collection of data relating to products, services, and production procedure; and organization of efficient production control methods.

Coordination of the cost system with production control is of prime importance.

The cost system must be an integral part of the general accounting system.

Cost data must be accurate and timely for prompt comparison with estimates and for progress and cost-plus billings.

Government is an important customer of the shipbuilder. Hence its accounting requirements should be considered. Observance of the following general principles is generally called for:

1. Complete and separate accounting and explanation on the books of account of the profit or loss on each government contract or subcontract.
2. Complete and comprehensive disclosure of nature and amount of different items of cost of government contract performance.

3. Control of cost accounts by the general accounts.
4. Accuracy of cost calculations and consistency with generally accepted and sound accounting principles.

Government contracts frequently refer to the following official publications concerning the subject of contract performance cost:

1. "Regulations Prescribing Method of Determining Profit," U.S. Maritime Commission.
2. "Treasury Decision 5000," promulgated under the Vinson-Trammell Act.
3. "Explanation of Principles for Determination of Costs under Government Contracts," War and Navy Departments.
4. "Purposes, Principles, Policies and Interpretations under Section 403 of the Sixth Supplemental National Defense Appropriation Act," War, Navy and Treasury Departments and the Maritime Commission.
5. "Joint Termination Regulation," War and Navy Departments.

Notwithstanding the official interpretations contained in these documents, government contracts may accord special treatment to specific items of expense.

The Job Order Cost System Is Favored

Most shipyards use the job order cost system. This form of actual or historical costkeeping is preferred by shipbuilders for the following reasons:

1. Profit or loss on each job is determinable.
2. Actual job costs can be used for estimating similar work in the future.
3. The efficiency of operations can be controlled by comparison of actual with estimated costs.
4. Shipyard job costing is essential for government contracts and many industrial contracts. Actual cost determines the selling price for cost-plus jobs. On fixed price contracts, actual costs are desirable in renegotiation, repricing, and termination procedure.
5. The job order cost system furnishes accurate work-in-progress inventory values at any point. These are necessary for the preparation of progress billings and financial reports.

III. Description of the Cost System

Following development and standardization of organization plans and compilation of detailed analyses of products, services, production procedure, and production control system, the next important steps in establishing the shipyard job order cost system are as follows:

1. Design the statement of income from operations for executive management (Exhibit 1).
2. Design the cost of contract performance reports for executive and top supervisory management. Examples are:
    a. Cost summary of completed shipbuilding contract (Exhibit 2).
    b. Cost of hull structure—completed shipbuilding contract (Exhibit 3).
    c. Cost of machinery installations—completed shipbuilding contract (Exhibit 4).
    d. Cost of outfitting and finishing—completed shipbuilding contract (Exhibit 5).
    e. Work-in-progress contract cost reports for extensive contracts requiring prolonged performance. (Described under Costing Contract Performance.)

PERIOD _____

JOB	CONTRACT	HULL	DESCRIPTION	DATE STARTED	DATE COMPLETED	CONTRACT PRICE	ACTUAL PERFORMANCE COST	OPERATING PROFIT	ESTIMATED PERFORMANCE COST	VARIANCE
			SHIP CONSTRUCTION							
			TOTALS							
			SHIP REPAIR							
			TOTALS							
			SHIP CONVERSION							
			TOTALS							
			GRAND TOTALS							

Exhibit 1. Statement of Income from Operations, Completed Contracts.

CONTRACT	HULL	JOB					
DESCRIPTION							
KEEL LAID	LAUNCHED	COMPLETED					
COST GROUP		DIRECT LABOR MAN-HOURS	DIRECT LABOR COST	DIRECT MATERIAL COST	OTHER DIRECT COSTS	MANUFACTURING OVERHEAD	TOTAL PRODUCTION COST
ACTUAL COST							
1. Plans and Drawings.							
2. Performance Bond.							
3. Builder's Risk Insurance							
4. Classification Fee.							
5. Professional Services.							
6. Mold Loft Work.							
7. Hull Structure.	(Steel Tonnage..... .....)						
8. Launching.							
9. Machinery Installations.							
10. Outfitting and Finishing.							
11. Towing, Mooring, and Shifting.							
12. Drydocking.							
13. Testing and Inspection.							
14. Trials and Delivery.							
15 Sundry.							
TOTALS							
General Administrative Expense							
ACTUAL CONTRACT PERFORMANCE COST							
ESTIMATE							
Accounts as above							
VARIANCE							
Accounts as above.							

Exhibit 2. Cost Summary of Completed Contract, Ship Construction.

CONTRACT	HULL	JOB					
DESCRIPTION							
KEEL LAID	LAUNCHED	COMPLETED					
COST GROUP		DIRECT LABOR MAN-HOURS	TONS OF STEEL	DIRECT LABOR COST	DIRECT MATERIAL COST	OTHER DIRECT COSTS	MANUFACTURING OVERHEAD	TOTAL PRODUCTION COST
ACTUAL COST								
7.01	Shell plating and bilge keel.							
7.02	Inner bottom weldments.							
7.03	Side frames and stringers.							
7.04	Bulkheads, shaft alley, deep floors, settling tanks.							
7.05	Stanchions and pillars.							
7.06	Deck assemblies.							
7.07	Hatch covers and supports, manholes, cargo ports.							
7.08	Casing.							
7.09	Foundations, ladders, gratings, floors.							
7.10	King posts and booms.							
7.11	Welding rod.							
7.12	Testing hull structure.							
7.13	Bow and stern assemblies, chain lockers.							
7.14	Hatch assemblies, brow plates.							
7.15	Decks above main deck.							
7.16	Partitions above main deck.							
7.17	Uptakes and stacks							
7.18	Sundry							
	TOTALS							
ESTIMATE								
Accounts as above.								
VARIANCE								
Accounts as above.								

Exhibit 3. Cost of Hull Structure, Completed Contract, Ship Construction.

CONTRACT	HULL	JOB				
DESCRIPTION						
KEEL LAID	LAUNCHED	COMPLETED				
COST GROUP		DIRECT LABOR MAN-HOURS	DIRECT LABOR COST	DIRECT MATERIAL COST	OTHER DIRECT COSTS	MANUFACTURING OVERHEAD	TOTAL PRODUCTION COST
ACTUAL COST							
9.01	Main engines, turbines, condensers, generators.						
9.02	Propellers, shafting, bearings.						
9.03	Anchor gear: Anchors, capstan, windlass, engine, hawse pipe.						
9.04	Bilge and ballast system: Piping, sounding tubes, pumps, etc.						
9.05	Cargo handling gear: Winches, controls.						
9.06	Circulating water system: Piping, pumps, equipment.						
9.07	Communication system: Telephones, telegraphs, call bells, etc.						
9.08	Compressed air system: Compressors, piping, receivers.						
9.09	Feed and condensate system: Piping, equipment, tanks.						
9.10	Fire protection system: Chemical system, smoke detector, etc.						
9.11	Forced draft system: Blowers, ducts.						
9.12	Fresh and salt water system: Drains, scuppers, tanks, plumbing.						
9.13	Fuel oil system: Piping, pumps, tanks, equipment.						
9.14	Lubricating oil system: Piping, tanks, equipment.						
9.15	Refrigerating system.						
9.16	Steam and exhaust system: Boilers, piping, fittings, equipment.						
9.17	Steering gear: Rudder, engine, gyro-pilot, wheel, etc.						
9.18	Sundry						
	TOTALS						
ESTIMATE							
Accounts as above.							
VARIANCE							
Accounts as above.							

Exhibit 4. Cost of Machinery Installations, Completed Contract, Ship Construction.

CONTRACT	HULL	JOB				
DESCRIPTION						
KEEL LAID	LAUNCHED	COMPLETED				
COST GROUP		DIRECT LABOR MAN-HOURS	DIRECT LABOR COST	DIRECT MATERIAL COST	OTHER DIRECT COSTS	MANUFACTURING OVERHEAD	TOTAL PRODUCTION COST
ACTUAL COST							
10.01	Carpentry and joinery.						
10.02	Furniture and fixtures.						
10.03	Handrails, stanchions, awnings.						
10.04	Hatches, cargo ports, scuttles, doors.						
10.05	Installation of purchaser's equipment						
10.06	Insulation.						
10.07	Life Saving Equipment: Boats, rafts, davits.						
10.08	Lighting and ventilation: Airports, skylights, ducts, vents, etc.						
10.09	Masts, decks and rigging.						
10.10	Navigating equipment.						
10.11	Outfits for master, steward, boatswain, etc.						
10.12	Painting, varnishing and cementing.						
10.13	Sundry.						
TOTALS							
ESTIMATE							
Accounts as above.							
VARIANCE							
Accounts as above.							

Exhibit 5. Cost of Outfitting and Finishing, Completed Contract, Ship Construction.

3. Design reports for supervisory operating executives, examples of which are:
   a. Worker's daily job time and production card (Exhibit 6).
   b. Labor operation efficiency report (Exhibit 7).
   c. Departmental labor efficiency report (Exhibit 8).
   d. Departmental overhead report.
   e. Defective work report.
   f. Departmental scrap report.
4. Establish cost standards for labor, material, and overhead.
5. Establish cost accounting procedure for accumulating the desired data.
6. Charting the necessary accounts.

Job Clock Time	Hours	Tenth		Rate	Straight Time Cost	Production Units	OPERATION	Job No.
			OFF					
			ON					
			OFF					
			ON					
			OFF					
			ON					
			OFF					
			ON					
TOTALS							Employee's Signature	Foreman's O.K.

Name

No. Dept. Date

Exhibit 6. Daily Job Time and Production Card.

Statement of Income from Operations

This important control report secures in summary form:

1. Separate profit-and-loss analyses for each class of product and service and for each principal contract and job within classes.
2. Comparisons of actual and estimated cost data of significance.
3. Variances between actual and estimated costs and profits.

From this information, management can readily determine which activities and contracts are profitable or otherwise, and then proceed to the detailed subsidiary reports for variance explanations.

Costing Contract Performance

A summary form for assembling costs on completed shipbuilding contracts is illustrated by Exhibit 2. Reference will indicate the various cost groups and factors to be scheduled, which include important man-hour and structural steel tonnage data.

Hull structure costs, a major category of shipbuilding costs, are analyzed in Exhibit 3.

Machinery installation costs, another important construction group, are set forth in Exhibit 4.

A third significant group, outfitting and finishing costs, is scheduled in Exhibit 5.

Cost groups shown in Exhibits 3, 4, and 5 may require modification in accord-

LABOR OPERATION EFFICIENCY REPORT

Department	Foreman	Period
Operation	Symbol	Production Unit
Standard Hourly Production	Standard Labor Rate	Standard Unit Cost

EMPLOYEE	Job No.	Units Completed	Hours Worked	Rate	TOTAL COST		VARIANCES			Remarks
					Actual	Standard	Rate	Efficiency	Total	
TOTALS										
UNIT AVERAGE										

Exhibit 7.

DEPARTMENTAL LABOR EFFICIENCY REPORT

Dept. _____ Foreman _____ Period _____

	Amount	Percentage
ACTUAL DIRECT PAYROLL		
VARIANCES FROM STANDARD:		
Rate Variances		
Idle or Lost Time:		
Weather		
Job Travel		
Waiting for Materials		
Waiting for Orders		
Machinery Breakdown		
Slow Workers		
New Workers		
TOTAL DIRECT PAYROLL VARIANCES		
STANDARD DIRECT PAYROLL		100.0
ACTUAL INDIRECT PAYROLL		
STANDARD INDIRECT PAYROLL (% of Stand. Direct)		100.0
INDIRECT PAYROLL VARIANCE		
TOTAL PAYROLL VARIANCE		

Exhibit 8.

ance with contract specifications. Estimated cost data for Exhibits 2, 3, 4, and 5 are obtained from contract bid estimates prepared by the engineering department.

Work-in-progress contract cost reports are essential for extensive contracts requiring performance over a prolonged period. Carefully prepared reports of this type will reveal unfavorable trends so that efforts towards correction may be initiated before contract completion. Such reports should set forth applicable costs for the current period and to date by cost group and major labor operation, in comparison with total estimated costs and estimated percentages of completion fur-

nished by the engineering department. Man-hour and steel tonnage data may be incorporated in these reports.

The cost factors for these reports, such as direct labor cost and man-hours, direct material costs, other direct costs, and steel tonnage used, are accumulated on job-cost records through the media of posting summaries of material requisitions from central stores, job-time-labor distribution, etc.

Direct labor is generally productive labor identifiable with a particular job. Overtime pay, special premiums, and bonuses paid to employees performing such productive labor, may be treated as part of direct labor cost provided these extra payments are equitably distributed among applicable jobs. However, these additional labor costs must be separately accounted for so as to facilitate overhead distribution, determination of workmen's compensation insurance expense, etc.

Direct materials are substances, articles, parts, machinery, equipment, etc., identifiable with a particular job as components of the product or service contracted for, or as having been consumed during contract performance. Direct material cost is the net cost of direct materials required for a specific job. Applicable incoming transportation charges may be included in this cost. Excess materials returned to stores and vendors and the salvage value of scrap materials should be credited. Direct material costs are accumulated on job-cost records from summaries of materials withdrawn from stores against approved requisitions. Perpetual inventory records for direct and indirect materials are essential to effective production control and are a valuable adjunct to the shipyard cost system.

Other direct costs are expenses—neither labor nor material—which are directly and entirely attributable to a specific contract or group of contracts, and which do not benefit over-all production. Examples of such direct charges are usually found in the following expense classifications:

Builder's Risk Insurance
Classification Fees
Engineering Fees
Launching Expense
Performance Bonds
Royalty and License Fees
Testing and Inspection Fees
Towing, Mooring, and Shifting Fees
Trials and Delivery Expense

Manufacturing overhead consists of items of production cost other than direct labor, direct material, and other direct costs, which cannot be charged directly to particular contracts accurately or conveniently. This cost category is identified with the manufacturing process and does not include general administrative expense.

Indirect payroll is an important element of manufacturing overhead and usually includes salaries and wages for supervisors, repair and maintenance men, watchmen, crane operators, stores keepers, etc. Vacation pay to employees in both direct and indirect payroll classifications is considered indirect payroll.

Indirect material is also classified in manufacturing overhead. Indirect materials are essential to manufacturing operations and may become components of the product contracted for or be consumed in its production. They are not classified as direct materials, however, because of their general nature and use in over-all

production, the difficulties involved in determining accurate allocations to specific contracts, and the relative costliness of the record keeping required to do so.

Remaining shipyard manufacturing expense classifications are quite similar to those of other manufacturing or construction industries and require no special comment here.

Manufacturing overhead is frequently distributed to contract costs on the basis of direct labor cost in the following manner:

1. All overtime pay, special premiums, and bonuses paid are eliminated from the direct labor distribution base.
2. Manufacturing expenses are "screened" and segregated according to applicability to productive activities and contracts.
3. Manufacturing expenses of limited allocability are then distributed on the basis of adjusted direct labor costs of the contracts involved.
4. Remaining manufacturing burden which is applicable to over-all production is then distributed on the basis of adjusted direct labor costs of all contracts.

Production cost, as used here, is the sum of direct labor cost, direct material cost, other direct costs, and manufacturing overhead.

General administrative expenses are not unusual in this industry and require no special comment as to classification. Distribution to contract costs is frequently made on the basis of total production cost after "screening" the expenses for applicability to productive activities. Expenses which are attributable to individual activities rather than over-all production are then distributed on the basis of production cost of the contracts involved. Remaining general administrative expenses which are created by all productive activities are then prorated on the basis of production cost of all contracts.

Contract performance cost, as used here, is the sum of production cost and general administrative expenses.

Daily Job Time and Production Card

The form shown in Exhibit 6 furnishes the basic information relative to direct labor cost, man-hours, overtime, completed production units, job and operation distribution, and labor efficiency.

The illustration may be conformed to the keysort or punched-card system to facilitate sorting and tabulating.

Cards are then sorted in various ways and tabulated to yield data on labor cost, man-hours, production units, etc. by job, operation, department, worker, etc.

Labor Efficiency Reports

This important category of daily, weekly, or monthly reports may be prepared for both supervisory operating executives and top management.

The labor operation efficiency report, Exhibit 7, schedules comparison between actual and standard labor operation costs by individual worker and provides an excellent index to his productivity and efficiency.

The departmental labor efficiency report, Exhibit 8, is a summarized analysis of labor variances and is valuable in determining departmental and supervisory efficiency with respect to manpower utilization. This report is also indicative of the success of production planning and control procedure.

Labor operation cost comparisons for completed contracts and for prolonged contracts in progress will furnish valuable information concerning the efficiency of specific labor operations as a whole. These should schedule actual and estimated direct labor costs, man-hours, and production units for each principal labor operation.

Overhead Reports

These are comparisons of budgeted and actual departmental expenses for a current period and to date, and are intended for executive and supervisory use. Expenses which are controllable by department supervisors are preferably segregated and analyzed in sufficient detail to permit intelligent planning. Examples of controllable items are superintendence, maintenance salaries, idle and lost time, indirect labor in general, maintenance supplies, light, heat, power, etc. Fixed charges and expenses not subject to any degree of control within the department may be shown in summary form on the report to the department supervisor and need be detailed only on the report to management.

Defective Work Report

This departmental report is prepared as required and affords a complete account of individual work spoilages. The information scheduled should include a detailed description of the defective work, the nature of the defect, responsibility for same, contract number, job number, and costs incurred. Disposition is also indicated—whether by repair, scrapping, or otherwise.

Scrap Report

This departmental report is also filled out as required and should describe the scrapped materials, their source, reason for scrapping, quantities and weights, contract number, job number, salvage value, etc. and indicate transfer to stores.

Standards

The establishment of adequate standards for labor, material, and overhead costs is essential for effective production and cost control in the shipyard. The setting of these standards is logically an engineering job.

Labor Standards. All crafts employed are classified in detail and scheduled according to standard ratings and standard wage rates for such ratings. Each labor operation is then scheduled as to type of craftsman and rating required for performance. Operations are time studied and standards set for production units completed within an hour.

Material Standards. These are largely quantitative and relate principally to raw materials such as structural steel. Requirements are computed from specifications and drawings and comparisons with actual cost data on similar completed jobs. Data on finished jobs are often classified and scheduled for convenient reference.

Overhead Standards. The setting of these requires an analysis of overhead expenses by department and segregation into fixed and variable costs. Departmental overhead budgets may then be computed on the basis of average capacity for single-shift operation during a 40-hour week. For this purpose, average capacity may be considered as approximately 80% of practical capacity for one shift.

COST ACCOUNTING IN SHOE MANUFACTURING

By

MAURICE SHAPIRO *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Shoe manufacturing includes the fabrication of varied types of footwear such as sandals, slippers, playshoes, boots, and moccasins, each having its own method of manufacture and use. The key operation, that of attaching the sole to the upper, is performed by one of several processes, each resulting in a shoe having its distinctive appearance, use, or wearing advantages. The more widely used of these processes are the McKay, Welt, Stitchdown, Turn, Littleway, Cement, and California. Shoes are further classified into men's, women's, misses', children's, etc.

Few plants make more than one kind of shoe such as women's cement process, children's stitchdowns, men's welts. The larger manufacturers who produce two or more types often confine each to a separate plant. This increases factory efficiency and the quality of the product and, incidentally, simplifies the determination of costs. Another advantage in making only one type of shoe is the ease of distribution.

Manufacturers usually serve one group of outlets such as jobbers, chains, specialty and department stores, or their own affiliated retail stores. The class of outlet affects the manufacturing costs. For instance, retailers want more styles in smaller quantities whereas jobbers permit mass production.

Origin of the Product

The creation of a new style is the first step in manufacture. The designer must be gifted with imagination yet be practical lest he originate something too expensive to make or unable to stand up under the strains of wear. He gets his ideas from many sources besides his own fertile brain, such as the sketches and dummy shoes of free-lance artists and model makers. New processes and materials bring about new styles. The perfection of the cement process permitted manufacture of the open toe, open back shoes which our women took to with such avidity. New fabrics and plastics were worked up into many new patterns. Changes in the shapes of lasts and heels also play a part in creating new shoes.

The designer's sketch is converted into a paper pattern from which a sample is made. Difficulties in manufacture are corrected, and specifications as to materials and construction are set down. A cost sheet is completed to determine the total expected cost and the selling price. All possible economies in construction are considered to bring the costs within the allowances for materials and labor. Then a line of samples is made in different materials and color combinations.

* Certified Public Accountant, New York.

Sources of Raw Materials

Leather is by far the most important material used. It is almost waterproof yet permits the foot to "breathe" and it is highly resistant to the strains a shoe must withstand while being worn. The hides and skins come from many parts of the world. The shoe manufacturer gets his leather from the tanner who has treated the skins so that they are now ready to be cut into shoes. Fabrics are used extensively for uppers, whereas plastics and other synthetics are growing in use for soles as well as for uppers. Heels are often of rubber, although women's high heels are usually of wood.

The production of rubber footwear entails a different process of manufacture which is not suited to the cost method described here.

Organization of Plant

The proper arrangement for a plant is to have the productive departments in the sequence in which the processes are performed starting with the cutting room on the top floor or at one end. Upper material stores, sole stock, last bins and other supply centers should be placed so as to facilitate the natural flow of production. Such a sequence in a cement process plant follows:

Productive Dept.	*Process*
Cutting	Cutting the parts of the outside and linings by hand or clicker.
Fitting	Stitching together the parts of the upper by means of plain and special sewing machines, skivers, etc.
Stock Fitting	Cutting and preparing the soles by use of clickers, rounders, roughers and other special machinery.
Lasting	Pulling the upper over the last by hand and machinery.
Cementing	Attaching outsole to upper by pressure machines.
Heeling	Attaching heel to shoe.
Finishing	Burnishing and staining the bottom.
Packing	Cleaning, repairing, inspecting, and packing.

Service Dept.	*Function*
Designing	Originates new shoes, makes patterns, responsible for proper fit.
Plant Management	Supervision. Includes superintendent and foremen.
Production	Responsible for production and quality.
Planning and Control	Decides order in which shoes are put into work. Traces movement of work and sees to it that supplies and lasts are available.

Departments for shipping, maintenance, purchasing, stores, payroll and cost finding have their normal duties.

Production Order System

The customer's order is transcribed to production tickets on which are put all the specifications for making the shoes. It is made in sufficient copies to supply those departments that start work simultaneously and to the purchasing, stores, payroll, and cost departments. One copy becomes the cost sheet on which is assembled the standard cost of the order.

The planning department arranges the tickets with regard to the availability of lasts and materials and in the order of their shipping dates. It separates them into groups containing the number of pairs that the factory can produce in one day. The tickets are then numbered serially and each group is listed on a Day Sheet. These Day Sheets are numbered consecutively and copies given to each department which is required to perform its work in the order of the Day Sheet numbers and to complete a sheet each day. The planning department uses one copy as a master sheet on which to record the movement of the work through the plant.

Almost all labor is paid for by the piece and is controlled by a checking system or by coupons for each operation.

II. How to Design the Cost System

Considerations in Designing the System

The cost system should give management the information necessary to control costs and efficiency. This is done by means of daily, weekly, and monthly reports on the consumption of materials and on the expenditures for labor and expense, culminating in the monthly profit-and-loss statement. These must not only show the amounts involved but must point out exactly where the trouble lies and what action is needed.

The system should provide data for estimating costs and setting selling prices and for computing the actual cost of each shoe produced.

The Standard Cost System Is in Use

The shoe manufacturing industry has always used some form of the standard cost system because shoes are sold at prices set before production begins. It is then necessary to know whether actual costs keep within those estimated when setting the selling prices.

These estimated or "standard" costs provide a yardstick for measuring actual costs. Variances are segregated according to their causes and so tell what and where action is needed. The use of standard costs require less clerical work and simpler procedures than other cost systems and it saves time of management and clerks because intensive analysis and action are required only on those costs which vary more than a reasonable degree from the standards.

Steps In Designing the System

Proceed as follows:

1. Design a profit-and-loss statement to be used as a monthly report to top management.
2. Design a cost sheet on which the standard costs of each style may be assembled.
3. Design cost cards for departmental and subsidiary cost data to support the summary.
4. Design reports for executives, such as:

"Outside Materials—Usage"
"Productive Time Work"
"Manufacturing Expense"

5. Set up standards for material, labor, and overhead for all styles in works.

6. Design forms and start procedures for collecting the information and making reports.
7. Set up chart of accounts and monthly journal entries.

III. Description of the Cost System

Profit-and-Loss Statement

This report is prepared monthly for the top executives. As shown in Exhibit 1, the reason for any gain or loss due to differences between actual costs and those set by the standards are clearly indicated by the variances listed in the statement.

EXHIBIT 1

PROFIT-AND-LOSS STATEMENT

For the Month of_____

	GAIN	LOSS	
Sales			$.....
Cost of Goods Sold at Standard			$.....
Gross Profit at Standard			$.....
Gain or Loss on Manufacturing Variations			
Materials—Price	$.....		
Materials—Usage		$.....	
Labor—Rate	$.....		
Labor—Efficiency	$.....		
Manufacturing Expense—Budget	$		
Manufacturing Expense—Capacity		$.....	
Total Variations	$	$	
Net Gain on Manufacturing Variations			$.....
Actual Gross Profit			$ .....
Standard Selling and Administrative Expenses		$	
Gain or Loss on Selling and Administrative Variations			
	GAIN	LOSS	
Selling Expenses	$		
Loss on Returns and Allowances		$	
Administrative Expenses	$.....		
Inventory Adjustments	$.....		
Total Variations	$	$.....	
Net Gain on Selling and Administrative Variations		$	
Actual Selling and Administrative Expenses			$.....
Net Income on Operations			$.....
Other Income			
Discount on Purchases			$.....
Net Profit for the Month			$.....

The materials variances are further broken down in supporting schedules which show the cost variations in the different parts of the shoe.

Variances Used

General ledger accounts are opened to take care of the following variances:

Variance	*Represents Difference Between*
Outside Materials—Price Linings and Trim—Price Soles Heels Findings—General Findings—Special	Standard and actual cost of materials used.
Outside Materials—Usage Linings and Trim—Usage	Standard and actual quantities of materials used.
Labor—Rate	Standard and actual rates of pay.
Labor—Efficiency	Standard and actual cost of productive time work.
Overhead—Budget	Budgeted overhead and the actual expenses.
Overhead—Capacity	Budgeted overhead and the amount applied to actual production at standard rates.
Inventory Adjustments	Ledger and actual values of inventories.

The findings, labor, and overhead variances are broken down by departments for better control.

How the Variances Are Allocated

The variances are set up on the ledger monthly. At the end of the period they are transferred to the profit-and-loss account or to Inventory Reserve as follows:

To Profit-and-Loss:
- Materials-Usage
- Labor-Efficiency
- Overhead-Capacity
- Inventory Adjustments

To Inventory Reserve to the extent required to bring inventory valuation up to market and the balance to Profit-and-Loss:
- Materials-Price
- Labor-Rate
- Overhead-Budget

This procedure conforms with the "cost or market" requirement of the income tax regulations as the ledger will now show the inventory at the lower of the two and any variances due to waste, inefficiency, or lack of volume will be reflected in the profit-and-loss accounts and will not affect the value of work in process or of finished goods.

Costing a Shoe

Exhibit 2 illustrates one form of cost sheet used in assembling the estimated or standard costs of any particular style. One of these is made up for each shoe that

EXHIBIT 2

COST SHEET

Description: Pattern No.

Item				Item			
UPPER MATERIAL				LABOR			
Outside				Cutting			
Linings				Fitting			
Trim				Stock Fitting			
				Lasting			
BOTTOM MATERIAL				Cementing			
Outsole				Heeling			
Insole				Finishing			
Counter				Packing			
Box Toe							
Shank				TOTAL LABOR			
Heel							
				LASTS, DIES, AND PATTERNS			
FINDINGS—GENERAL				ROYALTIES			
				MANUFACTURING EXPENSE			
FINDINGS—SPECIAL							
Binding (French)				TOTAL COST TO MAKE			
Eyelets							
Piping				SELLING EXPENSE			
Stripping				LOSS ON RETURNS AND ALLOWANCES			
Insole Binding				ADMINISTRATIVE EXPENSE			
Laces				COMMISSION			
Gore				DISCOUNT			
Ornaments							
				PROFIT			
				SELLING PRICE			
CARTONS, CASES, ETC.							
TOTAL MATERIAL							

the salesmen will take out to the trade. This sheet is the basis for setting the selling price. It also is used as the source of the standard cost figures for determining the variances and for computing the cost entries in the journal.

Supporting this summary are sheets for collecting the costs making up some of the items listed. An example is Exhibit 3 which summarizes all the details of Fitting Room Labor.

EXHIBIT 3

FITTING LABOR

Pattern No.

Operation				Operation			
Skiving Shoes				Fancy Stitch—2 need.			
Skiving Sock Linings				Space Stitch			
Skive Shank Pcs.				Stitch Foxes			
Paste Fleece				Stitch Tips			
Lacing				Stitch Straps			
Closing				Stitch Cutouts			
				Stitch Collar			
Fold Vamp				Stitch Saddles			
Flat Folding				Stitch Stripping			
Fold Tongue				Stitch Welting			
Fold Qtrs.							
Fold Sock Lining				Fancy Pasting			
Fold Stays				Stitch Marking			
Pinked Piping				Seam Pressing			
Piping				Tape Tops			
Pipe Cutouts				Paste for Perf.			
Pipe Qtrs.				Paste Tuffstay			
				Marking			
First Perf.				Paste Straps			
2nd Perf.				Paste Underlays			
Perf. Bkle. Straps				Paste Tongues			
Eyeletting				Backing Shanks			
Vamping				Stitch Labels			
Stitch Blu. Lin.							
Stitch. Binding							
Cementing							
Fold Binding							
Zig Zag Lining							
Stitch Qtr. Lining							
Stitch Vp. Lining							
Stitch Open Shank				TOTAL PIECE WORK			
Stitch Tongue							
Edge Tongue				Estimate of Time Work			
Fancy Stitch							
Fancy Stitch on Qtr.				TOTAL COST			
Fancy Stitch on Vp.							
Fancy Stitch on Tip							
Fancy Stitch on Fox							
Edge Stitch.							
				O.K.			

Revision of Standard Costs

The standards are revised at least twice a year, before the Spring and Fall seasons, also whenever there is a radical change in costs such as a new union contract calling for changes in wage rates. The cost sheets have several columns to permit the revisions to be listed on the original sheets.

Analyses for Supervisory Executives

Daily, weekly, and monthly reports are prepared for plant executives and for management which set forth summaries of the variations in costs. These give the standards for each department and show what degree of success is being attained in reaching them. They call attention promptly to the points where losses occur.

WEEKLY CUTTER'S REPORT

No._____ Name_____ Week Ending_____

Case	Leather	Pattern	Pairs	FOOTAGE		PRICE		COST		VARIANCES*		
				Standard	Actual	Standard	Actual	Standard	Actual	Total	Price	Usage

* Losses in red

Exhibit 4.

Reports of this type are: Exhibit 4, Weekly Cutter's Report, which is a summary of the individual slips shown in Exhibit 5, Outside Materials Requisition, and Exhibit 6, Time Work Report. There are also leather-cutting reports on each tanner's leather; monthly reports on the usage of soles, heels and findings and monthly reports of expense application and spending.

How the Standards Are Created

The standards set are the expected costs for the ensuing season arrived at as follows:

Materials-Price.—The prices which it is expected will be paid for materials are submitted by the purchasing department and become the standards for price.

OUTSIDE MATERIALS REQUISITION

Cutter No._____

Name_____ Date_____

Stock			
From			
Grade			
Lot			
Feet Given			
Feet Given			
Total Given			
Feet Returned			
Feet Used			
Price			

Case	Pattern	Last	Pairs	FOOTAGE			
							Total

COST			
Material			
Total Cost			
Standard			
Gain			
Loss			

Exhibit 5.

Materials-Usage.—The designing or pattern department list the specifications as to the materials required by each style and these are set as standard for quantities. The quantities required for outside materials, linings and trim are set by use of one of the patented systems available to the trade.

Labor-Rate.—Forms like Exhibit 3 are used to set the standard for labor in each department. The designing department checks off the operations required by each new style and these are priced. New operations are tested and timed to establish piecework rates. Others are set at the established prices with adjustment for any expected changes.

Labor-Efficiency.—Since almost all labor in shoe manufacturing is paid for by the piece, the efficiency variation is applicable only to time work, productive and non-productive. The standards for these are set on a per pair basis using past experience as the chief guide.

Overhead Rates.—Careful estimates must be made of production and payroll

TIME WORK ANALYSIS

WEEK ENDING_____

Department	Pairs	PER PAIR				TOTAL	
		Standard	Actual	Gain	Loss	Gain	Loss
PRODUCTIVE Cutting							
Fitting							
Stock Fitting							
Lasting							
Cementing							
Heeling							
Finishing							
Packing							
TOTAL PRODUCTIVE							
NON-PRODUCTIVE Cutting							
Fitting							
Stock Fitting							
Lasting							
Cementing							
Heeling							
Finishing							
Packing							
Shipping							
TOTAL NON-PRODUCTIVE							
GRAND TOTAL							

Exhibit 6.

for the ensuing season. The overhead expenses are classified and budgeted. Rates for applying these expenses are then set up on the basis of (1) pairs produced, (2) productive labor, or (3) selling price.

Basis for Overhead Application:

Pairs Produced

Rent
Electricity and Gas
Royalties
Patterns and Dies
Machinery Maintenance
Cripples
Freight and Express In
Office Salaries (Factory)

Insurance—Fire, etc.
Depreciation—Lasts
Depreciation—Machinery and Equipment
Administrative Expenses

Productive Labor
Supervision
Indirect Labor
Vacation Pay
Holiday Pay
Group Insurance
Christmas Bonus
Overtime Bonus
Factory Supplies and Expense
Taxes on Payroll
Compensation Insurance

Selling Price
Selling Expenses

How the Data for the Profit-and-Loss Statement Is Obtained

Finding the Standard Cost of Goods Sold. The number of pairs shipped of each style are tabulated from the sales invoices and the totals are multiplied by the standard cost of the styles to get the Standard Cost of Goods Sold.

Calculating the Materials Variances. The Materials-Price and the Materials-Usage variances are obtained by summarizing the reports of materials used such as the Weekly Cutter's Report shown in Exhibit 4. Soles, heels and findings have no usage variance unless the plant makes its own in which case there are reports similar to the cutter's report. Any losses due to theft, wastage, or the like are handled as explained below under Inventory Adjustments.

Calculating the Labor-Rate Variance. The amount of this variance is arrived at by a payroll analysis which totals the cost of labor resulting from differences in the rates of wage payments as compared to the standard rates on the cost sheets.

Calculating the Labor-Efficiency Variance. Most of the payroll is paid on a piece work basis which is not subject to efficiency rating as regard its labor cost. The cost of time work, however, does vary in relation to the efficiency with which it is put to use. From the weekly payroll there is extracted the productive and non-productive time work in each department. These amounts are divided by the department's production to get the actual cost per pair. The standard costs are set alongside the actual to arrive at the Labor-Efficiency variance (Exhibit 6).

Calculating the Manufacturing Expense Variances. These are found by comparing three totals with regard to each item of expense:

(1) The actual expenditure
(2) The budgeted expenditure
(3) The amount applied to production at the standard rate

Exhibit 7 illustrates a form used to accumulate these figures and report the variances to top management. For departmental executives these expenditures and variances are allocated to the different production centers and departmental expense

MANUFACTURING EXPENSE REPORT

For the Month of_____

Expense Item	Actual	Budgeted	Applied	BUDGET VARIANCES		CAPACITY VARIANCES	
				Gain	Loss	Gain	Loss
Supervision							
Indirect Labor							
Overtime Bonus							
Vacation Pay							
Holiday Pay							
Group Insurance							
Christmas Bonus							
Rent							
Electricity and Gas							
Royalties							
Patterns and Dies							
Machinery Maintenance							
Factory Supplies and Expense							
Cripples							
Taxes on Payroll							
Compensation Insurance							
Freight and Express In							
Office Salaries							
Insurance - Fire, etc.							
Depreciation - Lasts							
Depreciation - M. & E.							
TOTAL							

Exhibit 7.

reports are made up to show what results are being obtained, especially with those items that are controllable by the supervisory executives.

Calculating the Selling Expense Variance

Calculating the Administrative Expense Variance. These variances are obtained by the same procedure as is used for Manufacturing Expense: Compare the actual, budgeted and applied totals to arrive at the amount of the variances.

Calculating the Variance Due to Loss on Returns and Allowances. The totals of the general ledger accounts Sales Returns and Sales of Seconds are adjusted for the opening and closing inventories of returned shoes. To the resulting figure, which is the Loss on Returns, the total of the Sales Allowances account is added to give the actual loss on returns and allowances. This is compared with the amount applied to Loss on Returns and Allowances at the standard rate used on

the cost sheet to get the variation as shown in the profit-and-loss statement. The above calculation is made as follows:

Inventory of Returned Shoes at Beginning		$.....
Sales Returns		$ .....
Total		$ .....
Less: Sales of Seconds	$	
Inventory of Returned Shoes at End	$.....	$ ...
Loss on Returns		$ . ...
Sales Allowances		$ .. ....
Loss on Returns and Allowances		$ .....
Amount Applied to Production		$ .....
Loss on Returns and Allowances Variance		$.....

Inventory Adjustments. Here are shown losses in inventory valuation due to the reduction of market values below cost as well as variations between book and physical inventories.

Heels, soles, and special findings may be said to have no usage variance. Only one pair of heels or soles or a specified quantity of the findings can be used to make one pair of shoes. Physical inventories, however, will often show that more has been taken out of stock than was required by the number of pairs produced. Such excess is due to spoilage, waste, theft or similar cause, and the amount of the loss is charged to Inventory Adjustments.

COST ACCOUNTING IN THE SPRING INDUSTRY

By

FRANCIS L. HASKELL *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

The spring industry is composed of manufacturers of mechanical precision springs. Products are classified according to the type of springs manufactured. The three most common classifications are Flat, Flat Coil and Spiral. Other classifications may be added as the need occurs. If a particular class of product, such as hot wound springs, becomes a major portion of the plant output, it is advisable to add "Hot Wound" to the product classification. It is vital that the chart of accounts follow the classification of the product, at least in such accounts as Work in Process, Sales and Cost of Sales. Carrying the same classification into the manufacturing departments as well will make for better control.

Origin of the Product

Springs usually conform to a blueprint or to a sample. Repeat orders follow the usual pattern, but new products are usually the result of extensive engineering and laboratory procedures. Spring manufacturers maintain salesmen who are spring engineers, and many problems of spring design are answered by personal contact. For the new developments in industry which require complete and original design, the larger plants have special engineering departments and suitable research facilities with both chemical and physical laboratories available to satisfy the customers' needs.

Types of Raw Material

For the most part, carbon steel is used for precision spring products. Steel alloys, such as stainless steel, chrome vanadium, and molybdenum as well as the non-ferrous metals, brass, phosphor bronze, and beryllium copper, constitute the balance of raw material used in the manufacture of mechanical precision springs.

Organization of Plant

A spring plant may have its own cold rolling mill for flat material or a wire drawing department within its own organization. This article will describe only the activities involved in the manufacture of springs. The material used will be considered as purchased, whether from outside sources or from another department within the corporate group. The following departments will serve as a framework on which to build a workable departmental structure:

* Assistant Secretary and Assistant Treasurer, Bristol Divisions, Associated Spring Corporation, Bristol, Connecticut.

Indirect Departments

- Factory General Department
- Production Department
- Quality Department
- Purchasing Department
- Personnel Department
- Maintenance Department
- Estimating and Planning Department
- Laboratory
- Stock Room
- Timekeeping
- Shipping Room

Productive Departments

Starting Departments

- Foot Press Department
- Automatic Coiler Department
- Four Slide Department
- Power Press Department
- Small Order Department

Finishing Departments

- Bench Department
- Power Department

Service Departments

- Straight Hardening Department
- Pan Hardening Department
- Plating Department
- Stock Department
- Grinding Department
- Machine Tool Department

In the plant, separate bench and power departments should be established for each of the major departments, namely, flat, flat coil, and spiral. These major departments serve the purpose of allocating certain types of factory expense to the proper product classification. An example of this type of expense would be the cost of maintaining the Superintendent's Office—Flat Department.

The small order department is an integral part of any spring manufacturing concern. To give quick delivery on small orders a separate and complete manufacturing department should be established. This department should have its own finishing and servicing equipment. It should have a small order stock room adjacent to it and a simplified method of accounting for the material used. A special factory order form with fewer copies in the set will save hours of indirect labor and speed up the shipping and billing processes. Timekeeping and production control for small orders can be removed from the general procedures and made a part of the small order department. In fact, the more self-contained the small order department is, the more we reduce the time element between the receipt of the customer's order and the time of shipment. This speed up is always accompanied by a reduction of the cost of manufacturing small orders and also an appreciable reduction in the necessary paper work.

For accurate allocation of costs, the maintenance departments, such as elec-

tricians, millwrights, painters, etc., are often treated as productive departments. Hourly rates are established and the time changed to Plant Orders. All costs are then accumulated against these plant orders and the expense items are charged off monthly. Charges against capital accounts are charged to asset accounts when the plant orders have been completed and signed by the foreman concerned.

Production Order System

A production order should be entered for each customer's order received. Sufficient copies should be made available to the various departments, such as the following list suggests:

1. *Work Order Copy.* This copy should follow the work through the plant and be attached to the Shipping Copy when the Shipping Copy is sent to the office for billing.
2. *Acknowledgment of Order.* An acknowledgment in the regular order set will save the individual typing of acknowledgments to the customer.
3. *Salesman's Copy.* In a job plant, this copy is mailed to the salesman in the field each afternoon. It keeps the salesman up to date on the customers in his territory.
4. *Production Office Copy.* This is to maintain a numerical file in the production office.
5. *Production Office Copy.* This is to maintain an alphabetical file of all live orders in the production department.
6. *Office Record Copy.* This copy is maintained in a visible file near the sales correspondent's desk. These files are set up by territories.
7. *Shipping Room Copy.* The shipping room copy is filed in the shipping room and used to record shipments until the order is completed, at which time it travels to the office for billing.
8. *Progress Copy.* This copy is used for assembling the labor and burden by individual job orders and is usually handled by some means of mechanical posting.
9. *Cost Analysis Copy.* This is a duplicate of the progress copy and furnishes the information to the cost department for costing the order.
10. *Cost Summary.* This copy is used to assemble the final cost figures for each job order.

The expense of an extra copy in a set of order forms is more than offset by the many benefits gained by its addition. In any system when it becomes necessary for a department to make an extra copy of an order for its own use, it is more efficient to include a copy for that department in the original order setup. The inclusion of all copies in the original order set insures that the information on all copies of the production order is uniform. In plants doing a large volume of small order business, it is also advisable to install a separate order system to handle these small orders. In most cases, it is not necessary to have as many copies of the order as are included in the regular production order forms, and the timekeeping methods may also be simplified considerably with a view toward increasing efficiency as well as reducing costs and cutting down the time element before shipment is made.

With present-day office equipment and carbon aids, it is possible to design the lower half of the order form to present best the information needed by the particular department concerned. The top half of the production order should be the same on all copies of the order, but by designing the lower half to fulfill the requirements of the department in which it is to be used, many savings may be made.

II. How to Design the Cost System

What Information is Required

The cost system must be designed in any industry to yield the maximum of cost control information with a minimum cost. In most spring plants, the cost of individual customer's orders is important, and it is therefore equally important to be able to determine the following:

1. The efficiency by individual job orders as well as by operating departments should be checked.
2. Hours and money should be posted to each order since the efficiency attained on individual job orders is best controlled through quantities per hour rather than by money value.
3. The cost of each product classification showing net as well as gross profit must be obtained with the least clerical effort.
4. The details for proper reporting of all details leading up to and including the financial statements will be automatic.
5. Any information presented to management, whether at the supervisory level or to elected officers, must be presented in an interesting and understanding manner.

Considerations in Designing the System

It is important that the chart of accounts follow the physical pattern of the departments in the plant. The following chart of accounts is a typical one:

Chart of Accounts

1 Cash, bank
2 Cash, petty
3 Postage
4 Notes Receivable
5 Accounts Receivable
6 Investments
7 Stationery and Office Supplies
8 Accrued Interest and Rents Receivable
9 Out Freight and Express
10 Interest Received
11 Dividends Received
20 Sales
  20-1 Flat
  20-2 Flat Coil
  20-3 Spiral
30 Cost of Sales
  30-1 Flat
  30-2 Flat Coil
  30-3 Spiral
40 Discount Earned
41 Interest Received
42 Investment, Income and Expense
43 P. & L.—Sale of Plant Assets
44 Real Estate, Income and Expense
45 Reserve for Bad Debts
46 Discount Allowed

50 Land
51 Brick Buildings
52 Frame Buildings
53 Factory Equipment
54 Tools and Machinery
55 Furnaces and Equipment
56 Boilers and Heaters
57 Conduit and Yard Items
58 Office Furniture and Fixtures
59 Autos and Trucks
60 Factory Trucks
61 Real Estate Investments
70 Notes Payable
80 Accounts Payable
82 Accrued Payroll
85 Capital Stock
86 Capital Surplus
87 Earned Surplus
90 Scrap
1000 Material
- 1010 Flat
- 1030 Spiral

1090 Material Burden
- 1091 Receiving Room
- 1092 Stock Room
- 1093 Supply Room
- 1094 Purchasing Department

1095 Supply Burden
1100 Supplies
- 1110 General
- 1120 Barrels and Shooks
- 1130 Coal
- 1140 Fuel Oil
- 1150 Quenching Oil
- 1160 Gas

1200 Prepayments
- 1201 Fire Insurance
- 1202 Boiler Insurance
- 1203 Burglary and Elevator Insurance
- 1204 Auto Insurance
- 1205 Compensation Insurance
- 1206 Liability Insurance
- 1207 Group Life Insurance

1250 Deferred Charges
- 1251 Local Taxes
- 1252 Advertising

1300 Accrued Building Repairs
1310 Accrued Additional Compensation
1500 Work in Process
- 1501 Flat
- 1502 Flat Coil
- 1503 Spiral
- 1507 Plant Orders

1700 Power, Light and Heat
1800 Reserve for Depreciation
- 1801 Brick Buildings
- 1802 Frame Buildings
- 1803 Factory Equipment
- 1804 Tools and Machinery
- 1805 Furnaces and Equipment
- 1806 Boilers and Heaters
- 1807 Conduit and Yard Items
- 1808 Office Furniture and Fixtures
- 1809 Automobiles and Trucks
- 1810 Factory Trucks
- 1811 Rented Properties

1850 Reserve for Inventory Losses
1860 Reserve for Federal and State Taxes
- 1861 Reserve—State
- 1862 " —Local
- 1863 " —Old Age
- 1864 " —Unemployment
- 1865 " —Withholding

7000 Returned Goods and Allowances
Use 7000-1, 2, or 3 for sales class
- 7001 Material faulty
- 7002 Misinterpretation of order
- 7003 Poor Workmanship
- 7004 Overrun
- 7005 Shipped wrong
- 7006 Poor packing
- 7007 Poor plating
- 7008 Wrong instructions by customer
- 7009 Correction of price
- 7010 Shortage
- 7011 As a matter of policy
- 7012 Miscellaneous

11000 Selling Expense
- 1 Salaries
- 2 Supplies
- 3 Repairs
- 4 Travel and Entertainment
- 5 Exhibits and Conventions
- 6 Advertising
- 7 Telephone and Telegraph
- 8 Postage
- 9 Commissions
- 10 Extra compensation
- 11 Membership dues
- 12 Samples and Experimental
- 13 Social Security Taxes
- 14 Depreciation
- 15 Insurance
- 16
- 17
- 18

12000 Administrative Expense
- 1 Salaries
- 2 Supplies
- 3 Repairs
- 4 Travel and Entertainment
- 5 Conventions
- 6
- 7 Telephone and Telegraph
- 8 Postage
- 9
- 10 Extra compensation
- 11 Membership dues
- 12
- 13 Social Security Taxes
- 14 Depreciation
- 15 Insurance
- 16 Contributions
- 17 Trade Periodicals
- 18 Audit and Legal

19	Estimating Department
20	Order Department
21	Stenographic Department
22	
30	Miscellaneous

19	
20	
21	
22	Accounting and Credit Dept.
30	Miscellaneous

Operating Departments

20000	Plant Burden
100	Flat General
101	Bench
102	Power
103	Roll Feed
104	Fourslide
105	Slit, File, and Reel
107	Japan
200	Flat Coil General
201	Bench
202	Power
203	Furnaces
300	Spiral General
301	Bench
302	Power, Light
303	Power, Heavy
308	Single disc grind
398	Double disc grind
390	Small Order General
391	Bench
392	Power
600	Pan Harden General
603	Tumble
604	Color
605	and Temper
700	Straight Harden General
800	Machine and Die Room General
900	Spiral Automatic General
990	Shipping Room General

Classification of Charges

A	Direct Day Work Labor
B	Direct Piece Work Labor
*C	Indirect Labor
D	Supplies
E	Experimental
F	Repairs, Furniture, and Fixtures
G	Repairs, Machinery
H	Repairs, Tools
J	Power and Light
M	Heat
O	Compensation Insurance
P	Fixed Charges
R	Goods Spoiled in Process
T	Overtime
V	Share of Department Burden
S	Miscellaneous

* Subclassification of "C"

1	Superintendence
2	Instruction
3	Fire Drill
4	Power Off
5	Machines Out of Order
6	Taking Inventory
7	Sweep and Clean
8	Oil and Overhaul
9	Moving Stock
10	Personal Injury
11	Wait for Work
12	Wait for Stock
13	Estimating
14	Clerking
15	Miscellaneous

Indirect Departments

2100	Payroll
2200	Cost
2300	Employment
2400	First Aid
2500	Plant General
2600	Fire
2700	Experimental
2800	Timekeeping
2900	Welfare

Classification of Charges

1	Wages and Salaries
2	Supplies
3	Repairs
4	Heat
5	Power
6	Heat
7	Insurance
8	Fixed Charges
9	Overtime

3000	Safety	10	Compensation Insurance
3100	Yards and Grounds	11	Miscellaneous
3200	Engineering		
3300	Garage		
3400	Salvage		
3500	Production		
3600	Quality		
3700	Laboratory		

Operations may be given numbers between 1 and 100.
This will give ample room for future expansion.

Cost systems perform many varied functions in industry. One function for which the cost system is used in the spring industry is for the correct pricing of so-called "cost jobs." These cost jobs are usually small orders which are taken on a cost basis, the profit being added to the cost prior to billing. This procedure is followed particularly on small orders to facilitate the actual delivery of the springs. This method saves the time consumed in correspondence usually necessitated by the time needed to quote prices and await the return of a customer's order.

Standards are used in the setting of the combined labor and burden rates for the purpose of eliminating irregularities caused in the labor content by having different hourly rated employees perform the same function. As work in process inventories are maintained at standard rates, annual inventory adjustments are at a minimum.

A "Job Order" Cost System Is Favored

It is possible to use either standard or job costs in the industry, but the trend seems to be toward the individual job order cost system. A properly designed job order system *demands* the use of standards in the setting of the hourly rates. Thus it is possible to utilize the advantages of both systems. The labor and burden variances will appear as under or over absorbed balances in the operating departmental accounts in the factory ledger. Thus the labor variances and the burden variances may be isolated whether on the individual job or in any operating department. The use of an estimate or bogey on every job makes it possible to point out the variances on each customer's order caused by either the labor, the burden or the material content. The installation of a job order cost system implies that there is need for individual costs of each customer's order, and it also implies that *they will be used.* For example:

1. Every order is costed.
2. Every stuck job is stamped "stuck job" and analyzed in order to correct on future orders either the factory operations or the selling price so that it can be changed into a profitable order.
3. The analysis of stuck jobs presents the basis for discovering variances in labor, material, or productive hours consumed.
4. Real control of job costs helps to maintain good production control. The quantities posted on individual jobs while in process serve as the basic information used by the production department. Thus, overruns are prevented and delivery dates accurately determined without duplicating this work in the production department.

III. Description of the Cost System

Profit-and-Loss Statement

The profit-and-loss statement is top management's control report Exhibit 1. It is customary to show both Springs and Tools separately as far as the normal

PROFIT=AND=LOSS SUMMARY

Month:	Springs	%	Tools	%	Total	%
Gross Sales						
Less Ret. Goods and Allowances						
Total Net Sales						
Cost Of Sales						
Normal Gross Profit						
Plus Over Absorbed Labor						
" " " Burden						
Total Over Absorbed						
Actual Gross Profit						
Less Sales Engineering						
" Administrative						
Total S. E. and Admin.						
Operating Profit						
Plus Sundry Income						
Profit Brought Down						
Less Discount Allowed						
Miscellaneous						
Total Deductions						
Net Profit *						
* Before Federal Income Taxes						

Cumulative To:	Springs	%	Tools	%	Total	%
Gross Sales						
Less Ret. Goods and Allowances						
Total Net Sales						
Cost Of Sales						
Normal Gross Profit						
Plus Over Absorbed Labor						
" " " Burden						
Total Over Absorbed						
Actual Gross Profit						
Less Sales Engineering						
" Administrative						
Total S.E. and Admin.						
Operating Profit						
Plus Sundry Income						
Profit Brought Down						
Less Discount Allowed						
Miscellaneous						
Total Deductions						
Net Profit *						
* Before Federal Income Taxes						

Exhibit 1.

gross profit. This procedure permits the use of this statement to formulate general pricing policies on tool work. The current month and the accumulated figures are shown.

Balance Sheet

A sample balance sheet for a small spring concern is shown with the other forms (Exhibit 2). The increase or decrease since the first of the current year is reflected in the outside column for control purposes.

BALANCE SHEET

Date _____ Company _____

Assets	Current Year		Balance Jan. 1st	Increase Decrease
	Details	Totals		
Cash on Hand and in Banks				
Notes Receivable				
Accounts Receivable				
Total Receivables				
Reserve for Bad Debts				
Net Receivables				
Inventories - Work in Process				
Material				
Supplies				
Total Inventories				
Reserve for Inventory Losses				
Net Inventories				
Total Current Assets				
Investments				
Land				
Buildings				
Machinery & Tools				
Factory Equipment				
Furnaces and Ovens				
Boilers and Heaters				
Yard Improvements				
Office Furniture & Fixtures				
Automobiles				
Total Plant Assets and R.E.				
Less Depreciation Allowance				
Net Book Value - Plant & R.E.				
Prepaid Insurance & Taxes				
Deferred Charges				
Plant Orders in Process				
Total Miscellaneous				
Total Assets				
Liabilities				
Accounts Payable				
Accrued Salaries and Wages				
" Additional Compensation				
" State and Local Taxes				
" Social Security Taxes				
Total Current Liabilities				
Provision for Building Repairs				
Miscellaneous				
Total Liabilities				
Capital				
Capital Stock Issued & Outstanding				
Capital Surplus				
Earned Surplus				
Total Capital				
Total Liabilities & Capital				
Net Worth				

Exhibit 2.

DIVISION No.	Month of			Year to		
NET SALES	**Amount**		**%**	**Amount**		**%**
Normal Cost of Sales—Springs						
" " " " Material						
Normal Cost of Sales—Total						
Unabsorbed Burden						
Selling and Administrative Expenses						
Sundry Income and Expense						
Net Profit						
Net Sales—Total						
DIRECT LABOR HOURS	**Hours**		**Per Hour**	**Hours**		**Per Hour**
Male Production—Daywork						
" " Piecework						
Female " Daywork						
" " Piecework						
Plant Orders						
Total Direct						
INDIRECT LABOR HOURS						
Male Indirect						
Female "						
Total Indirect						
CHARGES TO WORK IN PROCESS—PRODUCTION	**Amount**		**%**	**Amount**		**%**
Male Production—Daywork						
" " Piecework						
Female " Daywork						
" " Piecework						
Total Production Wages						
Material and Direct Supplies						
Burden Applied to Production						
Direct Shipping Expense						
Outside Charges						
Total Charges						
BURDEN CHARGES	**Amount**		**Per Hour**	**Amount**		**Per Hour**
Indirect Salaries and Wages						
Overtime on Direct Labor						
Overtime on Indirect Labor						
Additional Compensation						
Total Indirect Salaries and Wages						
Traveling						
Power, Light, Heat and Water						
Tel. and Tel., and Postage						
Repairs						
Upkeep of Yard and Grounds						
Repairs to Product						
Samples and Experimental						
Depreciation and Amortization						
Insurance						
State Income and Franchise Taxes						
Social Security Taxes						
Property and Miscellaneous Taxes						
Laboratory Inspection—Materials						
Moving Stock and Equipment						
P. P.—Freight and Trucking						
Sweeping, Cleaning, Painting, Etc.						
Inventory Adjustments						
Employees Welfare						
Miscellaneous						
Total Burden Charges						

Exhibit 3.

Production Statement

A regular monthly statement for the control of production charges might include such items as sales and cost of sales—direct hours and money as well as indirect and overtime (Exhibit 3). All charges to work in process should be shown as well as a breakdown of burden charges. This report is of particular value where subsidiary plants are reporting to a parent company as it permits sight comparisons of the different units.

Analysis of Selling and Administrative Expenses

A glance at the sample form (Exhibit 4) will divulge the wealth of information that can be obtained from this report. As in the case of the production statement the current month and the year to date figures should be shown. This Selling and Administrative Expense statement also is indispensable where there are several operating divisions.

How the Burden Variances Are Allocated

The plant burden under or over absorption which is made up of the balances in each operating department is shown on the profit-and-loss statement as a separate item following the gross profit. This variance is made up of both labor and burden. Many companies provide for this distinction on the profit-and-loss statement.

Costing by Product Classification

It is necessary to assemble the cost of sales by product classification. As accounts are set up for these classifications it is only necessary to group the job costs in the same manner when transferring from work in process to the various cost of sales accounts.

Analyses for Supervisory Executives

There are many varied reports used in the industry for the guidance of supervisory employees. Some of the common ones are mentioned and the titles are self-explanatory:

Piece Work Reports for Each Individual Piece Worker
Production Reports for Each Individual Production Worker
Indirect Labor Breakdown for Each Department Foreman
The Return of Supply Requisitions to Department after Pricing
Idle Machinery Report to Foreman
Monthly Budget of Controllable Expenses
Stuck Job Report
Analysis of Estimates to Determine % of Orders Received from Estimates
Analysis of Estimated Jobs Costed
Monthly Report of Plant Repair Orders Costed
Returned Goods Report
Safety Reports for Each Foreman—Monthly

How the Standard Rates Are Created

To create combined hourly rates for labor and burden it is good practice to use normal capacity. The normal capacity may have to be tempered by sound judgment because of known conditions in certain operating departments. There are many

ANALYSIS OF EXPENSES

DIVISION No.			Month of		Year to	
	Code	SELLING EXPENSE	Amount	% Net Sales	Amount	% Net Sales
	1	Salesmen and Office Salaries				
	2	Order Department Salaries				
	3	Estimating Department Salaries				
	4	Commissions and Royalties				
	5	Accrued Additional Compensation				
		Total Salaries				
	7	Traveling				
	8	Exhibits and Conventions				
	9	Advertising				
	10	Telephone and Telegraph				
	11	Postage				
	12	Supplies Used				
	13	Repairs				
	14	Membership Dues				
	15	Samples and Experimental				
	16	Social Security Taxes				
	17	Depreciation				
	18	Insurance				
	19	Share of Taxes				
	20	Rental Charges				
	30	Miscellaneous				
		Total				
		Total Selling Expense				
		ADMINISTRATIVE EXPENSE				
	1	Salaries				
	5	Accrued Additional Compensation				
		Total Salaries				
	6	Pensions				
	7	Traveling				
	10	Telephone and Telegraph				
	11	Postage				
	12	Supplies Used				
	13	Repairs				
	14	Membership Dues				
	16	Social Security Taxes				
	17	Depreciation				
	18	Insurance				
	19	Share of Taxes				
	20	Rental Charges				
	21	Credits and Collections				
	22	Contributions				
	23	Trade Periodicals, Etc.				
	24	Audit and Legal				
	25	Share Home Office Expense				
	30	Miscellaneous				
		Total Administrative Expense				
		Net Pounds Shipped—Year to Date				
		Total Employees—Average For Month				
		Total Orders Received—Year to Date				
		Less Cancellations				
		Net Orders Received Year to Date				
		Unfilled Orders—End of Period				
		Additions to Plant Assets—Year to Date				
		Less Disposals and Adjustments				
		Net Increase in Plant Assets				

Exhibit 4.

ways to arrive at the normal annual hours. However, a method which has withstood the test of time is based on a 50-week year of 40-hour weeks. This plan assumes a 2-week vacation for all employees. An additional "down time" and holiday allowance of 5% is deducted from the 2000 hours to arrive at 1900 hours. This method further assumes that all setup will be classified as productive or direct labor.

Revision of Standard Labor and Burden Rates

All rates should be carefully checked annually. They should be *revised* only when a major increase or decrease is made. *Individual* rates should be revised as often as necessity demands. The following circumstances would indicate a revision of the individual rate concerned:

1. A substantial reduction in the supplies consumed.
2. A change in the number of machines operated by one employee.
3. The removal of a complete department to a new building.
4. The purchase of new and up-to-date machines for the department.
5. And, of course, any major change in direct labor.

All conditions within the department should be carefully scrutinized at the time the rate is revised. Attention should be given to the reasons which caused the under- or overabsorption. It is *important* to know *why* a department is underabsorbed because such items as lack of hours, improper spread of plant general expense, or unusual expense caused by moving a department will reflect a high burden rate for the annual period under consideration. If lack of hours is the cause of an underabsorption, the normal hours (1900) should be the base used for revising the rate.

Designing the Factory Ledger

Factory ledger accounting (Exhibit 5) should be maintained for each productive and non-productive department in the plant. These accounts should be grouped and controlled by one general departmental account. This general account for each group is used to collect salaries, supplies, and other items which must be allocated to the operating departments monthly by some method which reflects the activity of the departments. One method which satisfies this activity requirement is to spread this general expense on the basis of the labor and repairs for the *latest* six months. All burden accounts in the factory ledger should be controlled by a plant burden account in the general ledger.

It is often helpful to combine the factory ledger with an analysis ledger by adding detailed accounts for inventories, sales, cost of sales, selling expense, administrative expense, and depreciation accounts. Each of these accounts showing the detail in the factory ledger will be controlled by a corresponding account in the general ledger.

To make an analysis of selling expenses for a particular period, it is then possible to copy the figures from the detail account in the factory ledger. All accounts should be set up to produce automatically the figures desired for use on monthly reports.

500-6-46

FACTORY LEDGER

ACCOUNT.....

Red Ink For All Credit Entries Adjusting Debits—In Debit Columns. Credit Column Is For Transfers Only.

DATE	MEMO.	Machine Hours	DAY WORK		PIECE WORK		Total Indirect Charges	TOTAL DEBITS	TOTAL CREDITS	BALANCE
			Hours	Amount	Hours	Amount				
	Forward									

Exhibit 5.

Simplified Payroll Accounting

The plant payroll is kept in one or more payroll books made up of individual sheets containing all payroll information concerning one employee for a calendar year (Exhibit 6). In a large plant the numbering system should be so set up that an employee's number reflects the following information: It should divulge whether the employee is male or female and the department in which he or she is working. The digit which tells the department, of course, physically locates the employee on a certain floor of a certain building and at the same time reveals the foreman and timekeeper. Payroll accounts should be grouped insofar as practical by departments for ease of locating and reporting. All social security reports, federal income tax deducted, as well as union dues, club dues, hospital plan and a host of other deductions, will appear on the payroll ledger sheet; this sheet also, at the year-end, becomes the annual earnings record of the employee without further copying. For those who desire a payroll register it is only necessary to group the employee records properly to reflect the departmental figures desired on a summary sheet at the end of each payroll book.

Labor Distribution

In the cost department, all labor is assembled and pasted on the peg-board sheets as shown in the form section (Exhibit 7). The top part of the peg-board sheets provide for the usual labor statistical information. The lower half of the sheet is used to record the credit for the departmental production at the standard hourly rate, which includes both labor and burden. The labor hours and money values on the top portion of the peg-board sheet represent the summary of the daily time tickets. The departmental credit which appears below the dark line is a summary made from a carbon copy of all the individual job order postings. At the end of the accounting period, the peg-board sheets are pegged and the outside column, which is the month to date, is transferred to one sheet which serves as the journal entry for all labor as well as the production credits for the entire plant. We develop from this monthly labor sheet the charge to the departments and the credit to accrued payroll for all labor. We also show below the dark line the charge to work in process and the credit to each of the productive departments for the month's production. The transfer may be made from the several peg-board sheets to the journal sheet by liquid duplicator or by photography.

Policies to be Followed in Miscellaneous Departments

A. Millwright, machinist, and electrical departments shall be treated as productive departments and rates established for them.

B. Separate departments (non-productive) shall be created for such activities as payroll, cost, timekeeping, production, first aid, engineering, laboratory, etc.

C. Accounts shall be established for purchasing, storing, and issuing supplies and materials. The cost of these departments is absorbed on a pound basis through the use of material burden application in contrast to the use of productive hours as used in the factory operating departments.

D. Shipping expense should be isolated in one account and the decision made whether to classify it as a productive or non-productive department depending on the individual plant conditions. If the decision is made to treat it as non-productive

EXHIBIT 7

Dept._____

	Total	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Total
Mch. Hrs.								
Male D. W. Hrs.								
Amt.								
Female D. W. Hrs.								
Amt.								
Male P. W. Hrs.								
Amt.								
Female P. W. Hrs.								
Amt.								
Overtime								
INDIRECT LABOR								
1. Superintendence								
2. Instruction								
3. Fire Drill								
4. Power Off								
5. Mch. Out of Order								
6. Inventory								
7. Sweep & Clean								
8. Oil & Overhaul								
9. Moving Stock								
10. Personal Injury								
11. Wait for Work								
12. Wait for Stock								
13. Wait for Tools								
14. Miscellaneous								
15. Clerking								
Male Ind. Hrs.								
Male Ind. Amt.								
Female Ind. Hrs.								
Female Ind. Amt.								
Indirect Hrs.								
Amt.								
Total Hours								
Total Amount								
CREDITS Springs Hrs.								
Amt.								
Plant Ord. Hrs.								
Amt.								
Total Cr. Hrs.								
Total Cr. Amt.								

Exhibit 7.

ESTIMATE NO. _____ DEPT. _____ **ESTIMATE AND COST SUMMARY** OUR NO. _____ W. B. CO. Form 18

ESTIMATE DATE | CUSTOMER | CUSTOMER'S NO.

ESTIMATE BY | ADDRESS | DATE ORDERED

DESCRIPTION | DATE SHIPPED

DATE COSTED | QUANTITY SHIPPED

PIECE OR B. P. NUMBER | STOCK SIZE | QUAN. ORDERED / QUAN. MADE | QUO. PER | COST PER | FUTURE QUOTATION

LABOR AND BURDEN ESTIMATE AND COST

ESTIMATED			OPERATION		ACTUAL COST			
Labor per M.	Bdn. per M.	Qty per Hr	DEPT	No	Qty. per Hr.	Total Hrs	LABOR	BURDEN

MATERIAL AND SUMMARY

MATERIAL	ESTIMATE LBS.	ESTIMATE PRICE	ESTIMATE AMT.	ACTUAL LBS.	ACTUAL PRICE	ACTUAL COST
RETURNED						
NET MAT'L COST						
Material Burden						
SUMMARY						
TOTAL MATERIAL AND BURDEN						
LABOR AND BURDEN						
PLATING						
TOOLS						
CONTAINERS and SHIPPING						
COST OF RETURN TO W. IN P.						
MISCELLANEOUS						
MANF'G COST						
SELL AND ADMIN FACTOR						
TOTAL COST						

Our Number

COST USED ON PARTIAL SHIPMENTS

Date	Quantity	S. P. Per-	Cost Per	Shipment Cost

Exhibit 8.

because of the amount of detail involved, a procedure should be established to price the shipping containers when the order is shipped and absorb the balance of the cost of shipping possibly on a percentage basis.

E. Power, light, and heat when they are made in the plant should be carefully analyzed and cost spread to the operating departments. The power cost should be spread monthly. The light and heat charges may become part of the regular monthly entries for fixed charges.

How the Data for the Individual Job Cost Are Obtained

Calculating the Price of the Material. Material prices are averaged and adjusted to the lower of cost or market when the annual inventories are taken. Invoices received are added to the pounds and money values in inventory and a new average price is determined. All material is applied to the individual job costs at this average price.

Calculating the Weight of the Material. All material used is weighed at the time of issue.

Calculating the Material Burden. The material burden account includes all the cost of the stock room which also includes the cost of bookkeeping machines used for the perpetual inventory cards. Material burden, in addition, includes a share of the purchasing and receiving departments and any incoming freight and express charges. It is customary in the industry to apply this material burden on a pound basis.

Calculating the Labor and Burden. The labor and burden charge against a particular order number is posted mechanically in a centralized posting department. The hours spent on the various job orders are extended in the plant at a combined rate which includes labor and burden. If there is piece work in the plant, the burden alone can be added to the actual labor expended on the order. To calculate the labor and burden applied to an order it is necessary to summarize the postings which appear on the posting copy.

Calculating the Selling and Administrative Expenses. These two accounts reflect the amount to be absorbed and many methods have been devised to take up this expense. The most practical method in use in the spring industry is to apply the selling and administrative expenses on the basis of "conversion cost," which is the amount of labor and burden expended.

COST ACCOUNTING IN SULPHUR MINING

By
JOHN Q. ADAMSON *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Basically there is but one class of product in the sulphur mining industry—elemental sulphur, or brimstone, designated in chemical formulas by the letter S. The Frasch process, used exclusively in the Gulf Coast region, often produces a product with organic discoloration. This is due to oil seepage since petroleum is usually present in the vicinity of sulphur deposits. The discoloration is not consistent or uniform but from a marketing standpoint it provides another grade of product. It is not uncommon for both bright and dark sulphur to be produced from different wells simultaneously at the same mine. Separation is controlled at the relay station. Occasionally it is found necessary to move a storage bin site and the bin bottom sulphur is salvaged. As this sulphur usually has a higher ash and moisture content it constitutes a different grade. It is infrequently available and only in limited quantities.

Marketwise, therefore, there are four classes or grades of product in the sulphur mining industry:

a. Bright sulphur
b. Dark sulphur
c. Boiler bottom sulphur
d. Bin bottom sulphur

Origin of the Product

Sulphur has been known from the earliest ages. It is found abundantly in a pure state in volcanic regions and is also freely distributed in combination with other substances, notably metals. Formerly Sicily was the chief source of the commercial supply of pure sulphur, but the United States now has the leading place in the trade. The production is from the Gulf Coast of Louisiana and Texas where mining is conducted by the Frasch process. The Gulf Coast sulphur deposits are found only in salt domes and, even there, occur very infrequently in commercially recoverable quantities.

Obtaining the Deposit

There are two ways of obtaining a sulphur deposit, first by discovery, and second by purchase after another has made the discovery. Even the first method is sure to require a purchase obligation in the form of a land fee or lease with bonus and eventual royalty should sulphur be produced. By the second method a double royalty is usually incurred. The first is in the form of a profit-sharing agreement or contingent royalty to the discoverer, and the second is the basic royalty to the fee owner or mineral rights holder.

* Certified Public Accountant, Louisiana.

Organization of Plant or Mine

This description of cost accounting for the sulphur mining industry is obviously applicable where the Frasch process is used and does not pertain to other methods such as surface operations.

A tabulation of the processes at a typical plant or mine and their grouping into departments follows:

Service Departments

Managerial Department Accounting Department Including budgets, cost control and statistics Purchasing Department Personnel Department Traffic Department Control Laboratory	(These have the usual duties and functions of industrial plants and present no problems peculiar to this industry.)
Service and Mechanical Department	(Much broader in scope than the usual maintenance department of a manufacturing plant. Includes complete machine, blacksmith, welding, sheet metal, paint, carpenter, electrical, automotive, and, occasionally, locomotive shops, boats, barges, buses, trucks, tractors, etc.)
Warehouse Department	(This refers to a warehouse for supplies of pipe, lumber, heavy hardware, other building materials, machinery repair parts, power plant, electrical, telephone, automotive, and oil field equipment. There are no raw materials and the finished product is stored in the open.)
Research and Development Department	(Laboratory and engineering work on new uses, new processes, improved methods, etc.)
Investigation and Exploration Department	(Geological studies, search for new sulphur deposits. prospecting of likely or prospective territory, such as new or undrilled (for sulphur) or partially drilled salt domes. Keeping abreast of developments in the industry. Observing and evaluating competitors activities.)

Productive Departments	*Processes*	*Equipment and Facilities*
Plant	Providing hot water, tempering water, steam, compressed air, and electricity. (In a manufacturing enterprise these would be considered as services but in sulphur mining they are too	Fresh water sources and storage facilities: wells, reservoirs, tanks. Water pumping plants, pipe lines, flumes, aqueducts, etc. Water treating plants for softening and other purification processes. Fuel facilities: oil tanks, tank cars, pumps, pipe lines, barges, tugs, unloading equipment. Natu-

Productive Departments	*Processes*	*Equipment and Facilities*
	essentially a part of the producing operations.)	ral gas pipe lines and metering equipment. The power plant proper with its battery of large Scotch marine type boilers, high pressure water heaters, pumps, air compressors, electric power generators. Heat exchangers.
Field	(a) Drilling, sampling, and equipping prospective wells for steaming. (b) Steaming the well, i.e., turning hot water into the well to melt the sulphur embedded in the porous caprock in the area adjacent to the bottom of the well. (c) Pumping the well by turning on the compressed air to lift the sulphur through the pipe provided and flow it over to the relay station for gathering into pans or sumps.	Trunk pipe lines from plant to sulphur relay station. Pipe lines from sulphur relay station to wells. The sulphur relay station with pumps and motors, meters, air separators, valves, pans, and piping. Electric power and telephone lines. Derricks, drill stem, drilling rigs, drilling tools. Trucks, tractors, trailors, ramps, bridges, roads. Auxiliary buildings for temporary shops, second hand warehouse, current supplies, superintendent's headquarters, and for housing automotive equipment. Docks, barges, boats, and tugs where canals are used for transportation. Vapor boiler plant or other sulphur cleaning equipment. Pipe lines from sulphur relay station to sulphur storage bins. Bin sites, bin sidings, sulphur spreaders to insure even cooling. Bleed water gathering equipment, bleed water purification equipment, mine water control equipment (mud dredge, mud lines, and mud wells).
Loading *	Breaking down the sulphur into lumps for loading. Hoisting the sulphur into cars or onto conveyor belt. Conveying the sulphur onto barges via the conveyor belt.	Blasting equipment, hoists, conveyors or railroad track sidings, box car loading equipment, bagging equipment, weighing equipment.
Shipping *	Conveying the sulphur by rail or truck directly to customer or to intermediate storage. Conveying the sulphur by rail, barge, or truck from mine to a port. Loading the sulphur aboard ship or barge for transportation to customer or intermediate storage point. Shipment from intermediate storage point to customer by rail or barge.	Gondola railroad cars, locomotives, railroad tracks, automotive trucks, barges, tugs, canals. Car unloading or barge unloading equipment. Conveyor equipment for loading vessels.

* Loading and Shipping are often one department.

Production Order System

Lacking the formality that can be exercised in a manufacturing industry, there is elaborate planning, nevertheless, behind every ordered change in production pace. The rate of production cannot be deliberately increased overnight because much preparation is required. Drilling of wells must be speeded up, requiring additional drilling crews; more wells must be equipped ahead of steaming. Additional boilers, if available, must be put back on the line in the power plant.

Lowering of production is an easier problem but has its limiting factors if it is to be done economically. Sometimes production involuntarily and disastrously drops. There are unexpected well failures due to various causes. Wells that sampled satisfactorily will fail to produce for no apparent cause. Any corrective measures take much time, effort, and extra cost.

Recognizing the foregoing possibilities, the managerial department sets the rate of production. Many factors govern the setting of this rate. Some are anticipated sales for a reasonable period ahead (say a year), storage facilities, the competitive situation, the balance between bright and dark sulphur production, transportation facilities, the general business outlook (both domestic and foreign), the capacity of the plant, the number of skilled operators available, and even the estimated productive capacity of the mine itself. Once the rate of production has been set by the managerial department, it is up to the production control department (or simply the production department) to maintain that level.

II. How to Design the Cost System

What Information Is Required

A thorough analysis of costs is required for managerial control purposes. It has been found necessary or beneficial to determine:

1. The total production, by leases wherever pooling agreements are lacking. This would be necessary for royalty purposes as well as statistical purposes, although cost by leases is not usually maintained.
2. Tonnage statistics of sulphur both loaded and shipped. This is according to storage bins. Each bin is numbered and an inventory is maintained for each one.
3. The over-all cost and the cost per ton of (a) sulphur produced, (b) sulphur loaded, (c) sulphur shipped.
4. A summarized breakdown of the over-all cost and the cost per ton for production, loading, and shipping.
5. The detail cost of individual jobs or activities as denoted by standing work orders and special work orders.
6. Information for preparation of analytical operating reports, available from detail costs provided under item No. 5 next above, supplemented by statistical data.
7. The foregoing will provide the essentials for Profit-and-Loss Statement and Balance Sheet preparation.

Sulphur is usually quoted on a price-delivered-to-customer basis since no actual deliveries are made at the mine. The basic market price, however, is f.o.b. mine; and for that reason and sometimes for royalty purposes, the distinction between loading and shipping is necessary.

Considerations in Designing the System

Results are not directly in proportion to the expenditure of materials, labor, and services. For there is the unknown factor of thermal efficiency: the ratio of gallons of hot water used to one ton of sulphur produced. If thermal efficiency is poor, the fuel cost per ton is unduly high. As this ratio increases the cost per ton of sulphur goes up. Then heavier expenditures are made to decrease this ratio. If the efforts are sufficiently successful, the cost per ton goes down as a result of increased production.

The "Actual" Cost System Is Favored

Because of this unknown factor of thermal efficiency, as well as the exhaustive characteristic of the mine itself, it is impractical to apply a "standard" cost system in the sulphur mining industry. The unit of product is large, being a long ton of 2240 pounds, and rapidity of turnover is lacking. A predetermined cost or budget for statistical comparison serves almost the same purpose as far as control is concerned. The flexible budget works very well in the sulphur mining industry but nothing would be gained in charging cost of goods sold at a standard cost figure rather than at actual cost.

The cost of production is on a cumulative basis throughout the fiscal year and the cost of goods sold follows accordingly. The total sulphur stock is carried at one moving average cost for each mine, there being no distinction between grades. It costs just as much to produce dark sulphur as bright. The cost of cleaning is extra on which careful statistical costs are kept. There is such an interplay of marketing economics between bright and dark sulphur, however, that separate costing is impractical if not impossible as well as meaningless.

III. Description of the Cost System

The most important steps in establishing a cost system in the sulphur mining industry are as follows:

1. Set up the required Chart of Accounts.
    a. Major accounts.
    b. Subaccounts.
    c. Work orders.
2. Set up the labor cost control procedure.
    a. Labor distribution system (Figure 1).
    b. Flexible labor budget (Figure 2).
3. Set up the material and supplies control procedure.
    a. Inventory control.
    b. Material and supplies distribution control (Figure 3).
4. Determine the miscellaneous expense procedure.
5. Design the monthly cost statement and schedule its preparation (Figures 4 and 5).
    a. Cost ledger (Figure 6).
6. Design the daily cost statement.
7. Design analytical supplemental cost statements.
    a. Sulphur vapor boiler plant.
    b. Bleed water reclamation.
    c. Heat exchanger system.

d. Casing pulling operation.
e. Hospital operation.
f. Hotel operation.

8. Design the flexible operating budget.

Chart of Accounts

In addition to the usual real and nominal accounts there are the accounts for production cost. There can be one control account on the general ledger or several major accounts as shown on the monthly cost statement summary.

Work Orders

Work orders are of two types—standing and special. A standing work order is open throughout the year, even from year to year, to receive current charges. There is no limiting amount other than through the budget. Special work orders are issued for specific jobs limited as to time and cost. These are usually for experimental work, for unusual maintenance jobs, or for fixed assets.

A work order is an authorization for expenditure. It is formalized and distributed to the executives concerned. The form provides for work order number, date, estimated cost and completion date (if a special work order), a description of the nature of the proposed expenditure, and the accounting charge. It is approved by the general manager and the chief accountant.

Labor Cost Control

The type of labor cost distribution system is influenced by the variety of work and the large number of work orders. When a manual system is used, forms are provided as follows:

(a) Daily time ticket.
(b) Daily foreman report.
(c) Monthly distribution sheet, for recapitulating foremen's reports by departments.

There are many machine or semi-machine applications that follow the basic pattern as set forth above.

The flexible labor budget is developed by departments, computing the number of men required for each job. Beginning with the size staff required at "norm" production rate, the number of employees needed is increased as the production rate is raised by stages. Likewise as the production rate is lowered on the scale below the "norm" the number of employees required is reduced. The standard number of employees allowed for any given production rate is not based on the actual rate of production but on the intended rate of production.

A roster of employees is issued monthly. In the interim the personnel department keeps a running record of employees added and dropped. At any time it is easy to obtain the number of employees on the roll.

Since there are standard approved rates for each job or station, and since the number of employees on the roll is under control, the only unknown factor pertaining to labor cost is overtime. Periodic overtime reports are issued by the payroll department showing what employees are involved, the amount, who authorized it, and the reason why it was necessary.

WEEKLY LABOR REPORT

Week Ended_____

DEPARTMENT	Number of Employees				Reasons for Variances
	On Roll	Standard	Over	Under	
Managerial					
Production Control					
Accounting					
Purchasing					
Personnel					
Traffic					
Control Laboratory					
Service and Mechanical					
Warehouse					
Research and Development					
Investigation and Exploration					
Plant					
Field					
Loading					
Shipping					
TOTAL					

Additional Remarks or Comments

Fig. 1. Illustrating the Periodic Labor Report Coordinated with the Flexible Labor Budget.

Material and Supplies Control

Inventory control begins with the perpetual inventory records. These are reinforced with dividing the record function, spot-check rotating audits, or supplementary machine control.

In the distribution of the supplies, their withdrawal from stock is by warehouse requisition properly authorized under departmental supervision. A monthly detail report of charges to each work order is typed and distributed to the responsible executives (see Figure 3). By the use of precarboned sets, typing throughout the month is practical and the bottleneck at the end of the month is minimized.

Miscellaneous or Other Expense

These are the charges that originate by special journal entry or by cash vouchers. The special journal entries are posted directly to the cost ledger by work order number. The cash vouchers are posted from the cash voucher journal which permits segregation and accumulation by work order number. If too many columns are encountered, a subsidiary journal should be used. If a combination cash voucher and journal voucher journal is used, then all the vouchers would be posted individually or through a subsidiary journal. These expenses are under the control of executives at the source when or before incurred.

STANDARD NUMBER OF EMPLOYEES REQUIRED AT VARIOUS RATES OF PRODUCTION

Revision Date:

Department	Rate of Production in Relation to "Norm" of 100										
	40	50	60	70	80	90	100	110	120	130	140
Managerial											
Production Control											
Accounting											
Purchasing											
Personnel											
Traffic											
Control Laboratory											
Service and Mechanical											
Warehouse											
Research and Development											
Investigation and Exploration											
Plant											
Field											
Loading											
Shipping											
TOTAL											

Fig. 2. Flexible Operating Labor Budget Summary.

Work Order No. _____ Definition: _____ Month of _____

DESCRIPTION AND QUANTITY	WAREHOUSE CHARGES	TRANSFERS	
		Debits	Credits

Fig. 3. Detail of Material and Supplies Charged to Work Orders.

The Monthly Cost Statement

In the absence of mechanical equipment, such as a punched card accounting machine, this statement is made up from the cost ledgers. Considerable time is saved at the end of the month by the advance preparation of skeleton forms on which the figures from the cost ledgers are quickly entered at the month's close. The assignment of a designating letter for each schedule facilitates the preparation of an index in advance. Figures for the summary are entered by the general ledger bookkeeper. The totals of the schedules are checked to the summary. Separate summaries and schedules are required for each mine (see Figure 4).

Schedules are not provided for the non-controllable costs. Production Taxes represent the state's assessment for the privilege of extracting a natural resource and is on a per ton basis. Property Taxes are accrued monthly and adjustments are made to correct the accrual through the current month so that the accumulated expense absorbed conforms with valuations and rates when determined from the taxing authorities. Royalty refers to base royalty that must be paid to the holders of the mineral rights, likewise on a per ton basis. For Depreciation, a composite rate is used because the value of the plant installation is limited by the life of the mine in addition to the usual factors which determine a depreciation rate. Depletion is the amortization of expenditures for land, leaseholds, and development. The sum of such expenditures is divided by the recoverable tonnage as estimated by the engineers to determine the per ton rate of depletion.

The Cost Ledger

Control sheets for work orders by subsidiary accounts and control sheets for subsidiary accounts by major accounts are provided in the cost ledger. The form

THE BRIMSTONE SULPHUR COMPANY
COST STATEMENT

Sch. A-1

For Month of _____ 19____

LAKE MINE
SUMMARY

PRODUCTION COSTS	Sch.	Month's Budget Total	Month's Budget Per Ton	Current Month Total	Current Month Per Ton	Year To Date Total	Year To Date Per Ton
Controllable Costs:							
Operating Expenses							
Plant	B	$	$	$	$	$	$
Field	C						
Svc. and Mech.	D						
General	E						
Total Oper. Exp.							
Maintenance							
Plant	BB						
Field	CC						
Svc. and Mech.	DD						
General	EE						
Total Maint.							
Total Controllable							
Non-Controllable Costs:							
Royalty							
Production Taxes							
Property Taxes							
Depreciation							
Depletion							
Total Non-Controllable							
Total Production Cost		$	$	$	$	$	$
Number of Tons Produced			----		----		----
LOADING AND SHIPPING COSTS							
Loading at Mine	L	$	$	$	$	$	$
Loading Equipt. Maint.	LL						
Property Taxes							
Depreciation							
Total Loading Cost							
Traffic Dept. Expense	S						
Freight and Handling	S						
Freight and Handling Eq. Maint.	SS						
Property Taxes							
Depreciation							
Total Frt. and Hdlg. Cost							
Total Loading and Shipping Costs		$	$	$	$	$	$
Number of Tons Loaded			----		----		----
Number of Tons Shipped			----		----		----

Fig. 4. First Page of Summary of Monthly Cost Statement.

PLANT PRODUCTION EXPENSE Sch. B-1

LAKE MINE

Month of_____19__

	Labor	Material	Expense	Total	Allowed Cost
Water Supply Operation					
LP1 Operators' Time and Supplies	$	$	$	$	$
2 Electric Power					
Water Treating Expense					
LP3 Operators' Time and Supplies					
4 Lime Used					
5 Other Chemicals					
Heat Exchangers Operation					
LP6 Operators' Time and Supplies					
7 Electric Power					
Fuel Equipment Operation					
LP8 Operators' Time and Supplies					
9 Electric Power					
10 Barge and Tugboat Rental					
Power Plant Operation					
LP11 Fuel Used—Gas					
12 Fuel Used—Oil					
13 Operators' Time and Supplies					
14 Electric Power Purchased					
15 Electric Power Distributed—Credit					
Total Plant Production Expense	$	$	$	$	$

Fig. 5. Example of a detailed schedule in the monthly cost statement illustrating the presentation of costs by subaccount and by work order with the several columnar classifications. Distribution of electric power is optional and might well remain a cost of power plant operation unless there are special reasons to rule otherwise. Under a dump-power contract the power plant will purchase power during occasional overloads.

of the sheet provides for a classification by labor, material, expense, and total. If a manual system is in use, the cost ledger is posted in detail and from it the monthly and annual cost statements are prepared. When a punched card accounting machine is available, the costs can be accumulated thereon for cost statement purposes. In this case the cost ledger is posted from the monthly cost statement and the monthly

COST LEDGER

Started_____ Finished_____ Estimated Cost $_____ Work Order No._____

Major Account_____ Subaccount_____

Description_____

Date	Reference	Labor	Material	Expense	Total		Date	Reference	Labor	Material	Expense	Total

Fig. 6. Cost Ledger Sheet.

postings are accumulated for a cost to date and for the preparation of an annual cost statement. On the monthly cost statement the cost to date is shown only in summary (see Figure 6).

The Daily Cost Statement

Warehouse requisitions for piping-in-wells and other supplies are sent in daily.

Daily fuel consumption is obtained from the power plant report. In the case of oil a predetermined average price can be computed. Gas is at a contract price per 1000 cubic feet with a possible adjustment for B.t.u. content.

Daily payroll figures can be furnished by the payroll department since for this purpose no distribution is required. Monthly salaries are totaled and divided by the number of days in the month.

Miscellaneous expense is picked up from memos for special journal entries and from the cash vouchers or voucher journal.

Fixed fees include rentals, retainers, etc. The amount of such fees are obtainable in advance. The total for the month is divided by the number of days in the month to obtain a day's charge.

General insurance for a month is calculable in advance from the insurance premium proration register.

Workmen's compensation insurance premium and social security taxes are a certain percentage of the payroll. If various classifications and rates are applicable in the case of W.C.I., past experience indicates the approximate amount of payroll that will fall under each class.

Royalty, depreciation, and depletion are each at a specified per ton rate which need only be applied to the tonnage produced.

Property taxes and depreciation are calculable in advance on a monthly basis which is divided by the number of days in the month.

Analytical Cost Statements

Analytical cost reports are required periodically: daily, weekly, or monthly. Some companies operate their own hospitals and medical associations and therefore special detailed reports with statistical data are needed.

The sulphur vapor boiler calls for an analytical report. Depreciation, insurance, and taxes are fixed. Labor and fuel can be standardized while other operating expenses are small. Maintenance is the big item of uncertainty, mostly due to the corrosion and heat fatigue in the boiler tubes. The best way to smoothe out the maintenance cost is to establish a fixed rate per ton of sulphur in-put and use a maintenance reserve account statistically as a footnote to the analytical report. The important statistical figures are:

a. Tons of sulphur in-put.
b. Tons of cleaned sulphur.
c. Tons of boiler bottom sulphur.
d. Days operating.
e. Days of outage time due to tube changes, other repairs, or other causes.

Casing pulling is profitable for an old mine provided that the casing in abandoned wells is sufficiently well preserved. Statistics are required on the size and

the footage of the pipe recovered. Usually an arbitrary value must be given to the pipe salvaged, such as 50% of the price of new pipe of the corresponding weight and diameter. The labor of the casing pulling crew, supplies used, along with maintenance, depreciation, insurance, and taxes on the casing pulling machine, make up the costs to be deducted from the gross value accorded the salvaged pipe to obtain the net realization. Totals-to-date are of as much interest as results for the current month.

The Flexible Operating Budget

The flexible operating budget provides the basis for the allowed cost as listed in the right hand column of the monthly cost statement. The allowed cost is the standard as taken from the flexible budget for the current schedule of operation, that is, the monthly tonnage desired, plus the special jobs scheduled for the particular month. Special jobs are obviously those not provided for in the standard flexible budget. They include those of a non-recurring type and those which reoccur less often than once a year. Special work orders for such jobs provide positive cost control.

The flexible standard budget is, therefore, built up from the usual annual costs, both operation and maintenance. Past experience, exemplified in the previous year's figures, is used as a guide. Modifications are made as dictated by future changes that can be anticipated.

COST SYSTEM FOR TEXTILE BAGS

By
IRVING D. DAWES *

I. DESCRIPTION OF THE INDUSTRY

Textile bags are usually made of burlap or cotton cloth and in various sizes for many industries. They are extensively used for packaging foodstuffs, such as grain, flour, feed, potatoes, peanuts, and sugar, and also fertilizers, chemicals, salt, and many other products. Bag sizes range from the very small "pockets" for pipe tobacco, etc., to those capable of carrying two hundred pounds or more. Because of the nature of the material, burlap bags are almost always of the larger sizes having capacity of fifty pounds and over. The very small textile bags are made from cotton cloth, which is also used for many of the larger types. The size and the contents of either burlap or cotton bags determine the weight and type of cloth used.

Practically all burlap used in this country comes from the single port of Calcutta in India, although certain special and higher-priced constructions come from Dundee, Scotland. Cotton cloth is entirely from domestic sources and principally from the Southern mills which specialize in the coarser types of cloth.

A very large percentage of textile bags manufactured are printed, frequently in several colors, with the printing presses designed to cut, fold, and print in one operation. An important exception is fertilizer bags, many of which cannot be printed until filled, since the fertilizer manufacturer will not know in advance what grade formulas must be printed on the bag or how many of each grade will be required. Hence, each fertilizer factory usually has a small press to use for printing the bags at the time of use.

One of the outstanding features of the textile bag industry is the very high proportion of the material (cloth) cost to the total cost of the bag. This varies with the price of burlap and cotton cloth and with the type of printing involved, but usually ranges from 80 to 90% of the total cost. Hence by far the most important factor in profitable operations is the economical and efficient purchase and use of cloth. A difference of only a fraction of a cent a yard in the price of the cloth can easily result in large losses, as can also its inefficient use either by waste and spoilage or cutting the cloth as little as an inch too much.

The selling price of a bag consists of two elements—the price of cloth (including a standard allowance for waste) and the Margin to cover manufacturing costs, general and administrative expenses, and profit. Commonly the cloth portion of the price is computed at what is known as the Basis Price, which is usually related to the market price for cotton or burlap cloth prevailing on the day the order is taken. Market prices are reported daily in the trade papers and thus are available to all buyers. The actual cost of the cloth to the manufacturer may be more or less, the difference representing the Trading profit or loss. Since the prices of cloth vary

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from day to day and week to week, total bag selling prices are bound to change in the same way. That portion of the price represented by the Margin, however, is usually fixed for a considerable period. It is divided into two sections: first, the price per thousand for plain bags, this being based on the number of sewing inches in the bag; and, second, that for printing, with differentials for quantity in both cases, and for one or more color jobs for printed bags.

II. How to Design the Cost System

In designing a cost system for textile bags the following considerations must be given special weight:

1. It is important to show the Trading profit or loss on cloth in bags sold as distinguished from Manufacturing profit or loss because of the high proportion of cloth values to the total amounts involved. The purchasing and manufacturing functions are greatly different and not usually carried on by the same persons; therefore, knowledge of their respective contributions to the business is of great value. This separation of earnings is one of the most vital items to the successful operation and control of a textile bag business.

2. The economical use of cloth—in other words, the control of waste—is another major factor. All selling prices carry an allowance (usually one-half per cent) for waste, and with such a low working margin very careful and accurate determination of actual waste is needed.

3. Because of the very small amount of the selling price covering manufacturing costs, selling, and general expense and profit, the product cannot stand the expense of an elaborate cost system. The many orders going through the factory at the same time, with varying quantities, sizes, styles of printing, etc.—but often using the same construction of cloth—make it impractical, without excessive detailed work and clerical expense, to keep track of the cloth and labor expended on individual lots. Thus a simple and general type of system must be installed which will provide both adequate cost information and control with a minimum of expense.

4. The wide variety in sizes and types of bags makes it desirable to design some uniform method for obtaining individual costs for each type. Average costs obtained by dividing the total manufacturing cost by the number of bags produced would be valueless and misleading for most plants because of the constantly changing kinds and proportions of bags being produced. Individual costs are of great value in revealing the profit or loss on the various types sold, in fixing sales prices, and for general control purposes.

III. Description of the Cost System

Since determination of Trading Profit or Loss and Manufacturing Profit or Loss is one of the most important objectives of a cost system for textile bags, it should be designed with these items chiefly in mind. The main instrument for this purpose is the *Sales Summary* (Exhibit 1). This form will be understood best by reference to the sample shown with illustrative entries thereon. Basically, it is for the purpose of daily listing and summarizing of shipment invoices and analyzing the amount received into its two elements of Cloth Price and Margin; also to show the actual cost of the cloth in bags against its selling price and the resulting Trading Profit or Loss. Likewise, it shows the manufacturing cost against the Margin and the Manufacturing Profit or Loss.

CLASS 200 FERTILIZER BAGS — MONTH OF _____ 19____

	DAY	CUSTOMER	INVOICE NO.	SALES AMOUNT GROSS	PREP. FR.	NET	BAGS AND CLOTH QUANT.	CUT	CLOTH	TOT YDS	CLOTH $ BASIS PRICE	TOTAL	CLOTH $ ACTUAL PRICE	TOTAL	CLOTH PROFIT	MFG. MARGIN	STANDARD MFG. COST UNIT VAL.	TOT. UNITS	TOT. COST	TWINE LBS.	TWINE TOT. COST	MFG. PROFIT
		BROUGHT FORWARD																				
	1	JOHN SMITH AND CO.	406	1772 50	25 00	1747 50	10000	54	40-10	15075	10 00	1507 50	8 60	1447 20	60 30	240 00	114	11,400	136 80	55	26 40	76 80
		ETC.																				
						(USE A SEPARATE SALES SUMMARY SHEET FOR EACH SALES CLASSIFICATION DESIRED.)																
		TOTALS FOR MONTH		80000 00	3000 00	77000 00	700000			105000		10000 00		10800 00	4000 00	19000 00		850,000	9000 00	2600	1700 00	8300 00

Exhibit 1. Sales Summary.

In Exhibit 1 there is recorded a sale of 10,000 burlap bags, cut 54 inches (i.e. one and a half yards to the bag), made of 40″-10 oz. burlap for which the Basis Price at the time the contract was taken was 10 cents per yard. The contract price, therefore, was determined as follows, per thousand bags:

1000 Bags @ 54 inches = 1500 Yards @ 10¢ =	$150.00
Standard Allowance for Waste (½ of 1%)	0.75
Total Basis Price for Cloth	150.75
Margin as per Price List	24.00
Freight	2.50
Total Billing Price Per M	$177.25

For this particular sale of 10,000 bags the price obtained for the burlap in the bags was $1507.50 out of the total net price of $1747.50 after deducting the freight. This entry represents the quoted price for 40″-10 oz. burlap prevailing at the time the order was taken, which was probably several weeks or months before the bags were actually made, although, of course, it may have been a spot sale. The manufacturer, however, had burlap on hand at 9.6 cents, so his actual cost for the cloth used (including one-half per cent for waste) was $1447.20. Subtracting this from the $1507.50 received for the burlap in the bags leaves the Trading Profit of $60.30 on the sale.

Deduction of the burlap cloth part of the selling price gave a margin of $240.00 on this sale. Against this the Standard Cost of Sewing Twine and Manufacture is applied in the respective columns. The figure for twine is easily determined as each type of bag has a specified number of stitches to the sewing inch and the price of the twine is usually quite constant. The number of pounds of twine per thousand bags for each kind of bag is generally available from a table, and with a reasonable allowance for waste there should be little difference between the standard and the actual cost for this item. The reasons for using a standard cost for Manufacturing Expense rather than a so-called "actual" one will be given later.

In this example the cost of the twine is found to be $26.40 and the cost of manufacture $136.80. Subtracting their sum of $163.20 from the margin of $240.00 leaves a Gross Manufacturing Profit of $76.80. Adding to this the Trading Profit of $60.30 the total gross profit amounts to $137.10 which is 7.84% of the net selling price and $13.71 per thousand bags. These computations are not made on the Sales Summary but are easily available if desired. Instead they are shown as group totals on the Detailed Profit-and-Loss Statement (Exhibit 6).

The above explains one item appearing on the Sales Summary and depicts how each sale can be analyzed into its components, cloth and manufacturing, and the profit or loss on each determined. There are, however, certain additional comments and explanations regarding the Sales Summary which should be given, such as the following:

1. A separate Sales Summary should be used for each sales classification which may be desired as, for example, by types of use such as:

Salt Bags—Cotton
Flour Bags—Cotton

Sugar Bags—Cotton
Fertilizer Bags—Cotton
Fertilizer Bags—Burlap
etc.

or by size, such as

Burlaps to 48 inches
Burlaps 48 inches and over
Small Cottons
Large Cottons
etc.

2. If the profit and loss on individual sales is not needed or desired, totals only for the month or other period can be used. In this case the total yards of each type of cloth for all sales concerned can be added from the Summary and one extension at the inventory price per yard made to arrive at the total actual cost of cloth for comparison with the total Basis Price. The same procedure can be followed for twine and manufacturing cost. This method will give accurate and valuable control totals for each Sales Summary Group and save a considerable amount of clerical work. In periods of keen competition and close pricing, however, it is frequently important and valuable to know the results of individual sales and if the Sales Summaries are posted and computed every day, the detailed computations are not too burdensome. A practical alternative is to use group totals for ordinary purposes and to make individual calculations only for those individual sales in which there is some special interest.

3. Since the machines which cut the bags are set very accurately, the quantity of cloth used for any shipment as computed on the Sales Summary is likewise bound to be very accurate. With cloth representing from 80 to 90% of the total cost, such accuracy in quantity used is not only most comforting but also rather unusual in a cost system.

4. The actual cost of the cloth is usually derived from stock inventory ledger cards or sheets of a standard nature. There will be a separate sheet or card for each type of cloth and average costs per yard computed. It is preferable to use the average cost at the first rather than the end of the month so that trading profits or losses can be determined from the Sales Summary daily or as frequently as desired without waiting until the end of the month when the stock record sheets are closed. This method, of course, assumes that all cloth of the same construction is to be averaged and used against all sales even though very often sales of bags are covered simultaneously and specifically by corresponding purchases of the equivalent cloth. In a bag factory having many orders going through at the same time it is usually not feasible to keep track of the specific lots of cloth used for each order. Likewise it may be that the cloth purchased for a particular sales contract has not yet arrived when the order is being processed and other lots must be substituted. Even if segregation to particular orders were practicable, the clerical expense involved would usually be out of proportion to the amount that can be afforded for a cost system in a business operating on such small margins.

Cloth and Miscellaneous Sales

Along with the sale of textile bags there is usually a certain amount of business in cloth sold as such, also certain miscellaneous items such as twine, ink, pieced and misprint cloth, bale covers, etc. These are likewise entered on the Sales Summary form, invoice by invoice, with a separate sheet for each group. By using the applicable columns the respective selling and cost amounts can be shown and totals taken for transfer to the Detailed Profit and Loss Statement.

Determination and Control of Waste

It has been stated that in showing the basis price and the actual cost of cloth on the Sales Summary a standard allowance of one half of one per cent for waste has been used. The value of cloth being so large, it is important to know whether this waste allowance is being exceeded or bettered since a serious variation either way can have a subtsantial effect on the profit-and-loss account.

The yardage of every bale or roll of cloth opened and put into process can easily be determined from the Daily Opening Report (Exhibit 2). These daily reports are summarized currently on a Cloth Used Summary (Exhibit 3) by the various cloth constructions. The quantities are deducted daily from the respective Stock Ledger Cards. At the end of the month the total yardages of each kind of

NO._____

_____ 19__

BURLAP										
BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.	BALE NOS.
			(EACH BALE IS 2000 YARDS, EXCEPT 14 OZ. CLOTH							
			OR HEAVIER WHICH HAS 1000 YARDS TO THE BALE)							
COTTON										
BALE NO.	YDS.	BALE NO.	YDS.	BALE NO.	YDS.	BALE NO.	YDS.	BALE NO.	YDS.	
			(USE A SEPARATE COLUMN FOR EACH TYPE OF							
			BURLAP OR COTTON CLOTH)							

Exhibit 2. Daily Opening Report.

_____CLOTH MONTH OF _____ 19____

DAY	OPENING REPORT NO.																
					(USE SEPARATE FORMS FOR BURLAP AND COTTON CLOTH;												
					ALSO USE ONE COLUMN FOR EACH TYPE OF CLOTH)												
TOTAL YARDS																	
PRICE PER YD.																	
TOTAL VALUE																	

Exhibit 3. Summary of Cloth Used (in Yards).

cloth are multiplied by their unit costs and the grand total charged to Work in Process and credited to Cloth Inventory Account. If there were no inventory of cloth or of finished and unfinished bags remaining in process at the end of the month, the differences between the total yardages of each type of cloth as drawn off from the Sales Summary and that shown by the Cloth Used Summary would represent the excess or deficiency of the one-half per cent waste allowance. Such is never the case, however, and the actual determination of the sufficiency of the waste allowance can be made only at such times as it is feasible to take physical inventories. This is desirable once a quarter or at least every six months to obtain the needed and important information as to the sufficiency of the waste allowance.

A more current check on waste can be obtained by having a daily report of all bags, unsewn sheets, remnants of cloth, etc. that are discarded into the waste pile. These can be converted into their equivalent yardage on a daily report and compared either daily, weekly, or monthly with the yardage in finished bags as given by the Sales Summary to determine their percentage and its relation to the standard one-half per cent allowance. This will provide a reasonably accurate and quick determination of waste that will be excellent for current control purposes. It will not, however, give any information as to whether bags are being cut longer or shorter than specified. Any difference between the total waste determined in this manner from that under the method first described can be presumed to be due chiefly to inaccurate cutting, provided that all other records have been kept correctly.

Determination of Manufacturing Costs

In the usual bag factory numerous production orders are going through at the same time. It has already been stated that neither the margin on which sold nor the physical manufacturing operations is such as to justify individual job costs. The bale openers, cutting machines, presses, sewing personnel, turners, clippers, and balers will be switching continuously from one order to another and it is simply not practicable to keep accurate labor records, amount of ink used, etc., for each separate order.

Because of this situation, the only feasible plan is to obtain first the *total* cost of *all* bags manufactured during the month and second, by some fair and reasonably approximate method, distribute it to the various lots of bags going through. Each of these two procedures is discussed below.

1. *Determination of Total Manufacturing Cost.* For this purpose two ledger accounts should be used, the first entitled "In Process and Completed Bags—Cloth" and the second "In Process and Completed Bags—Manufacturing Costs." It will be noted that no separate account is maintained for completed bags. Almost all bags are sold by specification and shipped promptly after manufacture, the stocking of bags being very rare. The keeping of such an account, therefore, would have very little purpose and much accounting work is avoided by not having it.

The charges to this first or cloth account are made, as already stated, from the Cloth Used Summary and the credits are from the Sales Summary column showing the cost of cloth in bags shipped. The other sides of these entries are respectively to Cloth Inventory and Cost of Sales. It is preferable to make regular journal entries based on these reports rather than to post direct from the latter.

The charges to the second of these two accounts, that for Manufacturing Cost,

cover all manufacturing costs incurred during the month for direct labor, indirect labor, supervision, repairs, depreciation, ink, manufacturing supplies, insurance, and all other items of manufacturing cost other than cloth or twine.

Since it is not feasible, as already shown, to allocate these costs to specific lots of bags going through the process account, some other method must be devised that will enable the proper amount of manufacturing cost to be removed from the in-process account and charged to the cost of bags shipped. A very simple and practical way to do this is by relating the manufacturing cost to the values of the cloth going in and out of the Cloth in Process Account—in other words, on the assumption that the *manufacturing cost follows the cloth.* This will be found quite true on the average. Perhaps this method will be made clearer by a specific example: Let it be assumed that Cloth in Process has a beginning inventory value of $50,000, that cloth put into process during the month amounted to $100,000, and the value of cloth credited to the account from the Sales Summary for bags shipped was $110,000, leaving $40,000 in the account at the end of the month. Thus the credits were 110% of the charges. Assume further that the starting inventory of the In-Process-Manufacturing Cost Account was $3,000 and the total manufacturing cost for the month was $10,000. The amount to be credited under this formula would then be 110% of the costs put into process, using the same ratio as for the cloth going out in the form of bags shipped. Thus the cloth would have to take with it some of the manufacturing costs previously accumulated against it in the in-process account. This would make $11,000 as the total manufacturing cost allocated to the bags shipped for the month, and the inventory of In-Process-Manufacturing Cost would be $2000 at the end of the month.

Many years of experience with this method have demonstrated its simplicity, usefulness, and general accuracy. Any great inaccuracy would be revealed rather quickly by an abnormal ratio of the inventory of manufacturing cost to that of cloth at the end of a month. In the example given, the ratio of expense to cloth at the beginning of the month was $3000 to $50,000 or 6% and at the end $2000 to $40,000 or 5%, a reasonable difference. If, however, the ratio had dropped to 1% or risen to 10% with no abnormal change noted in the physical situation, it would be apparent that either too much or too little cost had been applied to bags shipped. On the other hand, an unusually large proportion of finished bags to the total in-process account would explain a higher ratio of manufacturing cost remaining in the account. Correspondingly, an abnormal amount of opened but unprocessed cloth would be responsible for a lower ratio of manufacturing cost in the in-process inventory. In actual practice, however, it will usually be found that the ratio remains quite uniform from month to month as long as the relative stages of completion of the bags in process remain in about the same proportions.

2. *Application of Total Manufacturing Costs.* Since we cannot keep accurate costs of the various lots or types of bags as they go through the manufacturing process, it becomes necessary to allocate costs to them on some more or less arbitrary basis if it is desired to have cost figures for each different kind. This can be done in a reasonably satisfactory manner by the use of a unit system, whereby an assignment of a specific unit value to each type of bag is made. The unit assignment represents what may be called its "relative difficulty of manufacture" as compared with some standard type of bag to which the numerical unit value of 100 has been given. The determination of unit values is a matter involving considerable

study and judgment but one well worth the time and effort, particularly because they have other important uses aside from the costing feature. The number of sewing inches per bag (that is, labor cost for sewing), the amount of ink required for printing, and the type of cloth are major factors to be considered in assigning unit values. A table of such values is shown in Exhibit 4, but for example only, as they are neither applicable to any particular manufacturing plant nor intended to be in proper relationship.

EXHIBIT 4

TABLE OF UNIT VALUES

Standard Burlaps—3½ Stitches to the Inch

	Lights			Heavies		
Cut (")	36"	40"	45"	36"	40"	45"
32	—	—	—	—	—	—
34	107	—	—	96	—	—
36	108	112	—	98	103	—
38	109	114	—	99	104	—
40	110	115	123	100	105	112
42	112	117	124	101	107	113
44	113	118	126	103	108	114
46	114	121	127	104	109	115
48	115	122	128	105	110	117
50	117	123	129	107	112	118
52	118	124	130	108	113	119
54	121	126	132	109	114	121
56	122	127	135	110	115	122
58	—	128	136	112	117	123
60	—	129	137	113	118	124
62	126	130	138	114	119	126
64	—	—	—	115	—	127
66	—	—	140	—	—	128
68	129	—	—	—	—	—
70	—	—	—	—	—	—
72	133	—	—	121	—	147
74	—	—	—	—	—	—

Cotton and Bleached

Exports		Bleached Salts	
30" 7 oz. Osnaburg—Cut 49	107	1# to 8# Inclusive	44
30" 7 oz. Osnaburg—Cut 78	158	9# to 14# Inclusive	47
30" 7 oz. Osnaburg—Cut 84	187		
30"—2.50 Drill—Cut 51	132	Flours—Bleached	
		3# to 12# Inclusive	44
Small Sugars—Not Bleached		24#	49
2#	44	48#	54
5#	47		
10#	49	Flours—Brown	
25#	62	96# to 100# Inclusive	76

The method of determining the total manufacturing cost applicable to bags shipped has already been described. If each shipment on the Sales Summary is multiplied by its own assigned unit value and the extensions are added, the result is the total number of units represented by the bags shipped. Dividing the total cost by the total units gives the manufacturing cost per unit. The manufacturing cost applicable to each shipment can then be obtained by multiplying its own total units by this cost per unit. It is easier and preferable, however, to use instead a standard cost per unit.

The unit system provides an excellent medium for the development and use of standard costs. The experience of a few months with unit costs should enable the establishment of a representative or standard cost per unit from which the variations month by month can be determined. Such a standard will have a number of uses. It enables day-by-day computation of manufacturing costs on the Sales Summary against shipments made. It can be used as a "Selling Price" by the manufacturing department to the sales department, with the monthly differentials from actual costs acting as a measure of the efficiency of the manufacturing operations. Lastly, it serves as a measure of what the factory should do under normal conditions of operation.

The units themselves will also be found of great use and value. First, they can act as a common denominator of many diverse types of bags and thus make possible the measurement of production. The total number of bags produced in one month as compared with another is of little value if in a month there should be a disproportionate ratio of large bags to small ones, or vice versa. Converted into units, however, there is a common base or measure of production and these differences are overcome. The comparison of total units produced from month to month and their relationship to the various items of labor and manufacturing expense can be of immense statistical and control value as well as of absorbing interest. The unit system for the measurement of production and determination of costs will be found very satisfactory in use and inexpensive to operate. It will be obvious, however, that its successful operation must be premised on an accurate determination of the individual unit values for the various types of bags.

Profit-and-Loss Statements

The cost system described has provided one of the most essential elements for the successful operation of a textile bag manufacturing business, namely, the separate showing of profit or loss on the cloth in bags and on the manufacturing operation, as well as that on cloth sold as such and on other items. A simple and condensed form of a profit-and-loss statement showing the earnings from the various major sales classifications is presented in Exhibit 5, which provides for both the month and the fiscal year to date. The important statistical and control information, however, is given on the supporting schedule "Detailed Profit and Loss Statement" (Exhibit 6). Manufacturing and Trading Profit and Loss in total and per thousand bags, as well as much other useful data, appear here for each bag classification. This statement is in essence a recapitulation of the various Sales Summaries. Two such reports should be prepared, one for the month and the other for the fiscal year to date, as it is not feasible to combine both on one sheet.

A third financial statement "Manufacturing Costs" (Exhibit 7) gives valuable information as to manufacturing costs, both total and per unit, volume of produc-

EXHIBIT 5

CONDENSED STATEMENT OF PROFIT AND LOSS

Month of_____19__

Month Only					_____Months to Date			
Net Sales	Cost of Sales	Gross Profit		Item	Net Sales	Cost of Sales	Gross Profit	
		Amount	%				Amount	%
325,000.00	293,000.00	32,000.00	10.93	Bags				
13,400.00	12,700.00	700.00	5.22	Cloth as Such				
2,000.00	1,500.00	500.00	25.00	Miscellaneous				
340,400.00	307,200.00	33,200.00	9.75	Totals				
				Expenses				
		7,500.00	2.20	Selling				
		10,500.00	3.08	General and Administrative				
		18,000.00	5.28	Total Expenses				
		15,200.00	4.47	Net Operating Profit				

EXHIBIT

DETAILED STATEMENT

Classification	Quantity		Net Sales Value		Cloth Value	
	Bags	Units	Amount	Per M	Sales	Cost
Bags						
200# Fertilizer	700,000	850,000	132,000.00	188.60	113,000.00	109,000.00
etc.						
Std. Cost Diff.	—	—	—	—	—	—
Total Bags	2,000,00	2,400,000	325,000.00	—	280,000.00	265,000.00
Cloth	(Yds.)					
Burlap	100,000		12,000.00			11,450.00
Cotton	10,000		1,400.00			1,250.00
Total Cloth	110,000		13,400.00			12,700.00
Miscellaneous	—		2,000.00			1,500.00

tion expressed in units, standard cost differentials, etc. This will be found self-explanatory.

Conclusion

The cost system described will fulfill for the textile bag industry the requirements of every proper cost system, namely, suitability to the business, full statisti-

6

OF PROFIT AND LOSS Month Ended

Trading Profit	Per M	Sales Margin Total	Per M	Mfg. Cost Total	Per M	Mfg. Profit Total	Per M	Total Gross Profit Amount	Per M
4,000.00	5.71	19,000.00	27.14	10,700.00	15.28	8,300.00	11.86	12,300.00	17.57
—	—	—	—	(1,000.00)	—	1,000.00	—	1,000.00	
15,000.00	—	45,000.00	—	28,000.00	—	17,000.00	—	32,000.00	
550.00									
150.00									
700.00									
500.00									

Schedule No.

cal and financial information, data for effective control, and ease and economy of operation. Once functioning, the clerical expense will be found surprisingly small whereas the amount of available information will be very complete. The system is readily adjustable to the varying types of manufacturing operations in the textile bag industry and has been designed to fit that industry alone, thus increasing its utility and value.

EXHIBIT 7

MANUFACTURING EXPENSE — Month Ended

This Month	Last Month	Increase (or decrease)	Item	____Months This Year	____Months Last Year	Increase (or decrease)
			Salaries—Office			
			Salaries—Foremen			
			Factory Labor			
			Vacation Pay			
			Office Supplies and Expense			
			Telephone and Telegraph			
			Light and Power			
			Printing Ink			
			Printing Supplies			
			Baling Supplies			
			General Factory Supplies			
			Repairs—Buildings			
			Repairs—Equipment			
			Depreciation—Buildings			
			Depreciation—Equipment			
			Fire Insurance			
			Taxes—State and Local			
			Taxes—Social Security			
			etc.			
33,000.00			Total Manufacturing Expense			
28,000.00			Amount Applicable to Shipments			
29,000.00			Standard Cost Applicable to Shipments			
1,000.00			Standard Cost Differential—Saving—(or Excess)			
2,400,000			Total Units Shipped			
11.67			Cost Per M Units			
12.00			Standard Cost Per M Units			
0.33			Saving—(or Excess)			

Schedule No.

COST ACCOUNTING IN THE TOOL AND DIE INDUSTRY

By
FREDERICK CEZER *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

The products of the tool and die industry are essentially in the nature of services since materials make up a relatively small part of costs. While the main products are special tools and dies which are individually ordered according to special design and specification, the variety is so great as to make impossible any classification as to categorical groups. When orders are received for a quantity of a single design, however, the character of production changes and the effective economies are such as to create a perceptible difference in relative costs. It is only with respect to differentiating quantity orders from individual orders that the terms "production order" and "job order" are used.

Because of the variety of metal-working machinery employed in the industry, much of which is unusual in the precision of performance, many manufacturers find it economical to use the services of tool and die plants to fabricate certain parts of their products. These are commonly known as "assemblies" and are grouped with "production orders" since they are generally in quantity.

Most well-equipped tool and die plants perform highly technical services and consequently retain among their personnel highly trained engineers, who are commonly consulted by customers on problems relating to lay-out, process, metallurgical and other engineering problems. On such occasions, fees for consultations are sometimes charged.

Origin of the Products

Nearly all the products are the result of a manufacturing process, either established or initiated, requiring special tools, fixtures, dies, or molds. At times, a newly developed machine may result from the individual study of the problems of manufacturing processes, which are in some manner related to the fabrication of special tools, etc. It is obvious that in much of the work performed research and experimental costs will be important and may not always result in a successful product.

Organization of Plant

The tool and die plant is organized according to function. The two main groupings of personnel are non-productive and productive.

* Certified Public Accountant, New York and New Jersey; Partner, Flink, Cezer & Company, Certified Public Accountants, Newark, N. J.

Non-Productive

Plant Management
Estimating
Production Control
Purchasing
Personnel
Plant Maintenance and Tools
Engineering and Development
Stores.

Productive

Design
Machine Operation
Inspection
Shipping and Receiving

Many of the functions above delineated are often grouped and handled as a single department or even by a single individual depending upon the size of the plant and the extent of its operations. Thus, a single group of engineers may perform all the duties related to estimating, engineering, development, and design.

In plants of greater size, machine operations are further subdivided into separate departments for each major classification of equipment, such as screw machine department, milling machine department, etc.

II. How to Design the Cost System

What Information Is Required

In manufacturing products of highly individual character such as tools and dies, the cost system must be so designed as to make readily available accurate costs correlated to the original estimates for the job. To accomplish this, it is necessary to determine:

1. The cost per hour of operating each machine or type of machine.
2. The cost accumulations while in each stage of progress corresponding to original estimates for each stage.
3. The consequent data for the preparation of analytical production reports and for the profit-and-loss statement and balance sheet.

The information which is summarized is used primarily for the purpose of determining the accuracy of estimates (which are used as a basis for pricing) and discovering inefficiencies in plant-wide operations. In this connection, it should be borne in mind that cost estimates which are made before production commences constitute a highly skilled task, performed by individuals of more than ordinary experience in the field and in the plant, and therefore set the standard for the job. The cost accumulations during production reflect the variances from the standard or normal established by experts for the job. When, on the other hand, a job is a trial for a quantity "production job," the variances developed from the cost records are of prime consideration to management in formulating proper policy for quantity production.

II. Description of the Cost System

The cost system is so designed as to make readily available actual costs at each stage of production and comparisons with original estimates or standards. This objective is accomplished by the following steps:

1. Establish standard costs for overhead by direct allocation to each machine (Figure 1).
2. Design Time Card (Figure 2).
3. Design Job Cost Summary Card (Figure 3).
4. Design Machine Operation Card (Figure 4).
5. Design Production Report (Figure 5).
6. Design Completed Job Report (Figure 6).
7. Design Uncompleted Job Report (Figure 7).
8. Establish the necessary procedures for accomplishing the desired objectives.
9. Design all accessory forms such as requisition forms for materials, purchase orders, production order, etc.

Machine Hour Overhead Costs

Overhead expenses are divided into three main groupings:

1. Those expenses that apply directly to the machine only while operating.
2. Those which apply directly to the machine whether operating or idle.
3. Those which apply only indirectly to the machine and arise out of the operation of the plant as a whole.

Since the ultimate result desired is an average standard rate for each machine while in operation, it is obvious that the application of all overhead expenses to a machine will be predicated on the premise that, normally, a machine is idle only during the interval necessary to change from one job to another.

It is, therefore, necessary to determine what is the total normal average number of hours of operation of each machine during a given period. It is this average normal average number of hours of operation which is used as the factor in determining the hourly rate of overhead for each machine. This normal average has many other collateral applications such as determining excessive idleness, abnormal use, obsolescence, or lack of demand for the machine's products. These are indicated from the variances reflected in the actual hours of operation. Once it has been determined what the normal average operating time is for each machine, it should be only changed to conform with such conditions which can be regarded as of a permanent nature. For example, if a power press is converted to use in special broaching operations because of its size and power, its idle time may reasonably increase on account of the requirements of adjustment in changing over larger or more complicated dies from job to job.

Machine Hour Rate

By use of Figure 1, the machine-hour rate may be established for each of three main groupings of overhead expense. In general, the most common expenses for each group is as follows:

a. Directly applicable to machine while in operation.
   Power—(Based on kilowatt hour predetermined from horsepower)

MACHINE HOURLY RATES

Month of_____, 19____

Name of Machine	Machine No.	Average Operating Hours per Month	Horse Power	Power Rate per Hour	Depreciation		Repairs etc.		Plant Fixed Charges		Indirect Labor etc.		Total Rate per Hr.	Idle Rate per Hr.
					Amt.	Rate per Hour	Amt.	Rate per Hour	Amt.	Rate per Hour	Amt.	Rate per Hour		

Fig. 1.

b. Directly applicable to machine whether in operation or idle.

Depreciation
Repairs
Fixtures, accessories and abrasives

c. Indirectly applicable to machine arising out of plant or department operations as a whole.

Plant Fixed Charges—(Rent, Taxes, Heat, etc.)
Supervision and Indirect Labor
General Factory Supplies, such as lubricating and cooling oils, small parts and other items not practically chargeable to a machine or job

(Plant fixed charges are distributed to each machine in proportion to floor space area occupied whereas the other expenses in this group are chargeable to each machine in proportion to the normal operating hours)

The final result obtained may be separated to reflect an hourly operating rate and an hourly idle rate. The latter rate consists of all overhead items with the exception of power.

Direct Labor

The term "direct labor" is used to describe all forms of labor performed in the plant directly chargeable to that job and to no other. Because of the nature of operations, the distinction is clear enough for the worker himself to know. This

TIME CARD

Worker's Name_____ No._____

Date_____ Hourly Rate_____

Job No.	Machine No.	Description of Work	Started	Finished	Hours

Fig. 2.

includes labor peformed in making a machine ready for the operation, the actual operation of the machine, inspection, etc. Labor performed however, which may benefit more than one job is treated as indirect labor and is included in the general overhead grouping.

The device which is used to obtain this information is the Worker's Time Card, Figure 2, which each worker keeps for a day and on which he accounts for the manner in which he utilized his working day. From the information accumulated each day, the office personnel may make the necessary charges to each job cost card and to indirect labor or other appropriate overhead accounts. At the same time, the

form also furnishes the information necessary to accumulate the machine operating time and other pertinent data respecting indirect labor, repairs, etc. The total accumulated information from this source provides the necessary data for payroll distribution.

Materials

The basis for the charge for materials is the material requisition which is prepared in triplicate at the time the production order is completed. The latter accompanies the part or parts throughout the process of production and contains the main instruction and references to the blueprint or sketch. The materials requisition is approved by the storekeeper, receipted by the dispatcher, and two copies sent to the office for record. One copy is used as a posting medium to the stores inventory and after pricing and extension is entered on the Job Cost Summary Card. At the same time, proper journal entry may be made to reflect consumed materials in the general ledger accounts.

Sub-Contracts

Where some part of the job may be performed outside, a purchase order will evidence its dispatch. If it is a partially fabricated part which is sent out for some process (such as anodizing or plating), control must be kept of its absence from the plant. On the other hand, if the sub-contract provides for the manufacture of a casting or a forging, proper record must be kept to insure its timely delivery and conformity to standard, price, etc. Upon delivery, entry of the sub-contract cost is entered in the Job Cost Summary.

Job Cost Summary

The medium for accumulating costs on a job is the Job Cost Summary Card. The form is so designed as to afford ready comparison with original estimates. Variances from original estimates are individually analyzed at regular intervals, but since they are individually treated for each job, no attempt is made to accumulate such variances in general ledger accounts. While the job is in process, comparison with estimates are made on a partially completed basis. It is, therefore, necessary to organize the methods of estimating so that they are analyzed to conform with the manner in which actual component costs are accumulated. Provision is also made to carry out direct labor hours at standard rates in order to obtain the necessary information pertaining to variances in the actual rates paid. The cards are so designed as to provide for operation on each machine during two separate days, but this may be expanded to allow for more extended operation on any single machine.

Machine Operations Accounts

In order to accumulate in convenient form the record of actual hours of operation of each machine, it is necessary to post from the Worker's Time Card (Figure 2) the number of hours of machine operation therein indicated. Figure 4 provides for the accumulations by months and the average for a year. This provides a guide to management in its determination of the normal average number of hours of operation of each machine. Production reports are prepared monthly from this record.

JOB COST SUMMARY

Job No._____

Customer's Name _____ Part No. _____ Order No. _____

Date Started _____ Date Completed _____ Shipped _____ Invoice No. _____

Description of Job _____

Price Quoted $ _____

MATERIALS

Estimated				Consumed			
Item	Qty.	Price	Amt.	Date	Qty.	Price	Amt.

SUB-CONTRACTS

Estimated				Incurred			
Item	Qty.	Price	Amt.	Date	Qty	Price	Amt.

MACHINE OPERATION	ESTIMATED			DIRECT LABOR					OVERHEAD			DIRECT LABOR					OVERHEAD			TOTAL		
	Hrs.	Labor	Over-head	Date	Wkr. #	Hrs.	Rate	Amt.	Mch. #	Rate	Amt.	Date	Wkr. #	Hrs.	Rate	Amt.	Mch. #	Rate	Amt.	Hrs.	Labor	Over-head
Saw																						
Lathe																						
Miller																						
Shaper																						
Drill Press																						
Screw Mch.																						
Jig Borer																						
Grinder Surface																						
Grinder Cylinder																						
Grinder Centerless																						
Power Press																						
Foot Press																						
Planer																						
Boring Mill																						
Assembly																						
Inspection																						
Other																						
Total																						

Fig. 3.

MACHINE OPERATION

Machine No._____ Hourly Rate_____

Day	JAN.		FEB.		MAR.		APR.		MAY		JUNE		JULY		AUG.		SEPT.		OCT.		NOV.		DEC.	
	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.	Job #	Hrs.
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31																								

Total Hours for Year_____

Average per Month_____

Fig. 4.

III. How the Cost Data is Summarized

Production Report

The Production Report (Figure 5) is prepared from Machine Operation Accounts and is a guide in examining the relative productivity of each machine and the proportion of normal capacity being utilized in production by the plant as a whole. It enables management, moreover, to examine wide variances from normal in plant overhead. This is done by first reflecting overhead absorbed in operations and that charged to abnormal idleness. The total is then compared with the actual overhead for the month and variances noted and investigated. This report, therefore, is a prime factor in establishing the point below which production cannot fall without endangering the profits of the company.

Completed Job Report

This report analyzes for production management the final results of completed jobs. All the amounts are obtained from the totals reflected in the job costs summaries and are set forth in detail to reflect the variances from original estimates.

Since all results reflected in the cost summaries reflect overhead at standard rates, the variances, therefore, give effect only to differences in:

(a) Variances in lapse of time for completion.

(b) Variances in rates paid for direct labor.

The manner in which these variances are obtained is, first, by comparing the hours estimated with the hours actually consumed and, second, the direct labor at standard rates with the actual direct labor paid.

PRODUCTION REPORT

Month of_____19____

Machine	Mach. No.	Normal Hours	Operating Hours	Idle Hours	Overhead Absorbed	Idle Time Cost	Total Overhead	Actual Overhead	Variances	
									Over	Under

Fig. 5.

Uncompleted Job Report

For the purpose of controlling costs while jobs are in process, the periodic report of the progress of operations attempts to describe the trend in variances while the job is still incomplete and at the same time serves as the basis of independently determining a Work in Process Inventory. This is done by examining the Cost Summary Card and by first establishing the stage in production of the job. For practical purposes, a comparison of the detailed estimate of the time to complete the then present operation with the time already consumed in that operation provides a basis of a percentage completion of such an operation. All operations not commenced are completely omitted in the report. Hence, the report will reflect the sums of results for only completed operations and for a partially completed operation of which the estimates will be reduced by the percentage of theoretical partial completion. Figure 6 provides for reporting, therefore, actual variances for the completed component operations comparable to only corresponding estimates and theoretical variances and pertaining to a partially completed operation.

General Ledger Control

All direct labor will be controlled through the General Ledger by proving the detail in the following manner:

Total of Actual Direct Labor on completed jobs.
Plus: Actual Direct Labor on uncompleted jobs at end of period.
Less: Actual Direct Labor on uncompleted jobs at beginning of period.
Equals: General Ledger Balance of Direct Labor paid or accrued during the period.

COMPLETED JOB REPORT

Month of_____19____

Job No.	TOTAL HRS.		DIRECT LABOR					OVERHEAD			MATERIALS			SUB-CONTRACTS			TOTAL COSTS			Selling Price	Profit	Loss
	Esti-mated	Con-sumed	At Standard			Actual	Rate Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance			
			Esti-mated	Con-sumed	Hour Variance																	

Fig. 6.

UNCOMPLETED JOB REPORT
(WORK-IN-PROCESS)

Date_____19____

Job No.	TOTAL HRS.		DIRECT LABOR					OVERHEAD			MATERIALS			SUB-CONTRACTS			TOTAL		
	Esti-mated	Con-sumed	At Standard			Actual	Rate Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance	Esti-mated	Actual	Variance
			Esti-mated	Con-sumed	Hour Variance														

Fig. 7.

All material consumed will be controlled through the General Ledger Account by proof of detail as follows:

Total Materials consumed in completed jobs.
Plus: Materials consumed in uncompleted jobs at end of period.
Less: Materials consumed in uncompleted jobs at beginning of the period.
Equals: General Ledger Balance of Materials requisitioned during the period.

All sub-contracted costs incurred may be proved with the appropriate General Ledger Account by the following method:

Total Sub-Contract costs on completed jobs.
Plus: Sub-Contract costs on uncompleted jobs at end of period.
Less: Sub-Contract costs on uncompleted jobs at beginning of period.
Equals: General Ledger Balance of Sub-Contract costs incurred during period.

COST ACCOUNTING FOR TRADE ASSOCIATIONS

By

O'NEAL M. JOHNSON *

I. DESCRIPTION OF THE INDUSTRY

Trade Association Services

The general objective of the trade association is to do the most good possible for all of the industry it represents. In order to accomplish this objective, it follows that the trade association must render many different services. The number of trade associations has increased greatly during the past fifteen or twenty years. Accompanying this expansion, there has been also a very considerable development.

Many of the services of trade associations are informational in character. As a rule, this information is furnished to many classes of people; often to members or to members and the public, and some to the public but not generally to members. Much information is furnished to specific classes of the public such as teachers, contractors, doctors, etc.

The highly developed trade association often has several classes of members, for example, active members, branch members, associate members, senior members, junior members, sustaining members, domestic members, foreign members, as well as other classes being not uncommon. Each class of members may pay dues differing in amount.

Often these differences in dues reflect differences in services rendered but in some cases they represent simply the ability of the different classes of members to pay. Some of the services of the trade association are non-recurring and therefore often are paid for when rendered, either by members or by non-members.

Designations of classes of membership are not always the same in different trade associations. However, in general, it might be said that active members are usually the voting class of members and that type of member which makes up the trade or industry which the trade association serves. Branch members often represent plants which are branches of the companies which make up the active members. It follows, of course, that branch members probably do not vote. Associate members, as a rule, make up those who may be interested in the industry but are not directly engaged in it. For example, companies supplying active members with machinery, supplies, advertising services, etc., may make up the class of associate members. The designations "senior" and "junior" members are sometimes used in place of "active" and "associate" members; however, these designations of membership are found more often in professional associations than in trade associations. Sustaining members are usually members who pay more into the treasury of the association than

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the regular amount of dues which would be required. Domestic members are members of the country in which the trade association operates, whereas foreign members would be those members in countries other than the country in which the trade association operates. It is not uncommon to find a well-developed trade association with as many as five classes of members—for example, active, branch, associate, sustaining, and foreign.

Informational Services

One of the most important services of every trade association is that of keeping the industry informed of all latest developments affecting that industry. This is done by the publication of bulletins, news letters, and various other publications of this type. In some cases, trade associations publish a regular trade magazine covering the industry in which they operate. Other informational services may consist of a general research department to answer all types of inquiries by members and others. A product research department is not at all uncommon in many trade associations; marketing research and merchandising research are other types of services rendered frequently; statistical research is a service which has increased rapidly in trade associations as its real value has been realized. Law informational research and a department to operate a convention or exposition for the industry are frequently found in trade associations.

Direct Services

In addition to the informational services, many trade associations render direct business aids of many kinds. Some examples of this are an accounting department for the installation of accounting systems and help to member companies in operating them, a public relations department, and training schools of various types. Some activities of trade associations are combinations of the informational services and the direct business aids. For example, in accounting, the direct aid may be in cost installations and work of that type, while, at the same time, the accounting department may conduct cost comparisons or expense comparisons or profit and loss surveys for the industry and issue the summaries of this information to all members. The collection of costs statistics might very well also come under the statistical research department. Thus, in trade association activity as in all other business activities, there are certain phases of the work which cannot definitely be defined as coming under one department or another department.

Such conflicts in activities must be ironed out by the top management of the trade association if the department heads immediately interested cannot reach an agreement. Another example of this conflict between possible departments might occur in the field of public relations. The public relations department may conduct a program of general information or advertising to place the industry's story before the public in the light in which the industry wishes it to appear. As a sideline, or as an entirely different activity, the public relations department may also publish for the use of the member companies specific applications on how they can utilize this over-all program in their own particular public relation or advertising activities. Here there might be a conflict between the public relations department and the advertising department, if two such departments happen to be operating in the same trade association.

Certain departments may use the products of other departments in order to

complete the work that they are promoting. Separate departments may prepare two different types of work which, in turn, are passed on to a third department that will use these efforts of the first two departments to prepare material of its own for presentation. An example of this might be the following: The legal research department prepares an analysis of state and national laws. The statistical research department uses statistics it has prepared to justify certain objectives. The public relations department takes the results of the work of these two departments and presents to the lawmakers the information which the industry thinks the lawmakers should have concerning it.

Service Departments

In trade associations, as in any industry, there are always certain service departments whose main duties are to serve the other departments of the association. Examples of these are the printing department, mailing department, the stenographic pool, although generally, in trade associations, this latter activity is not popular. Most trade association executives prefer to have either their own secretaries or secretaries assigned only to individual departments. The bookkeeping department is another example of service departments.

Products and Their Origin

The products of trade associations may be many different services. Most of these services are evidenced in some way by printed matter, for example, general bulletins or bulletins on specific subjects. Very often during the period when the state legislatures are meeting, a national trade association will carry bulletins almost daily on legislation which has been introduced concerning the industry in various state legislatures. It also may carry the progress of these bills from the stage of introduction, through readings, committee hearings, the progress through both houses, being passed or defeated, and being signed or vetoed by the governor.

News letters are also quite a common product of the well-organized trade association. News letters may be issued at specific intervals such as weekly, biweekly, monthly, etc., or they may be issued as required, as news develops which makes its publication worth while.

Special bulletins, pamphlets, or booklets are frequently issued by the trade association. Usually, publications of this type deal with only one subject, such as, for example, the results of a statistical research project.

Manuals on a variety of subjects are published by many trade associations. Accounting manuals, manuals for the operation of machines in the members' plants, manuals on truck operation, and on plant sanitation, on labor relations, on public relations, on job evaluation, all are published by various trade associations.

Books are not an uncommon type of publication of the modern trade association. Such books usually are histories of the industry or the trade association, possibly a treatise on the economic factors affecting the industry or on many other subjects of interest primarily to members of the industry which the trade association serves.

Although many services of the trade association are evidenced in some way or another by printed matter, there are other services which deal with the problems of individual members and whose results are not usually published. For example, in the accounting department, there may be installations of the association's accounting system or cost accounting system for members of the association. Associations

operate schools to teach plant operation, as well as the latest and best methods in merchandising. Some trade associations maintain specialists who visit the plants and help each member company with its manufacturing problems and in organizing their company so that it will operate in the most efficient manner. All the services just described are specific services for individual members, and although it may be truthfully said that helping each member does elevate the tone of the whole industry and thus help the industry in general, nevertheless such services are usually considered by the trade associations rendering them as being for the individual member. Very often, but not always, this type of service is charged for separately and paid for by the member who benefits directly by the service.

Source of Raw Materials

As can readily be seen by the discussion which has preceded, the payroll is the most important raw material cost of any trade association. In informational services the editing, writing, and the preparatory research work usually, if not always, make up the greatest cost of this type of project. It is true that paper, printing, binding, and supplies are also raw materials which must be obtained in order to issue the various types of publications which a trade association may publish; nevertheless, almost without exception, the greatest cost is that of the labor involved in preparing these publications.

In some cases, trade associations send all their work to outside printers. More generally, however, trade associations hire some outside printing but do some of their own printing—mimeographing, multigraphing, multilithing, or imprinting on paper by some other means information which the association desires to impart to its members or to the public.

Organization of the Office

The following description of cost accounting for trade associations pertains particularly to (1) the trade association which operates a number of departments, each department producing certain services for the membership or for the public at large or for both and (2) to the trade association which has more than one class of members. A tabulation of the processes or cost centers or departments in a trade association and their grouping into accounts follow:

Direct Departments	*Work Involved*	*Equipment and Facilities*
Editorial	The usual duties of writing in an editorial department.	The ordinary office equipment consisting mostly of typewriters and desks.
General Research Dept.	Answering inquiries on questions requiring some research.	General office equipment.
Product Research	The ordinary research problems involved in Product Research of any industrial company—in this case the association conducts the research for the member companies.	Laboratory or other equipment necessary in product research.

Marketing Research	The analysis of markets and the applicability of the particular product involved to markets, the determining of any peculiarities in different markets which might affect the product involved.	The usual equipment which is expected in activities of this type.
Merchandising Research	Trying new methods in marketing, or new products, or new forms of old products on the public or samples of the public to determine their worth. Making or supervising opinion surveys or surveys on frequency of purchases.	Usual office equipment, sometimes model stores, particularly specialty shops.
Statistical Research	Sending out questionnaires to industry and collecting statistics which may be of value to the industry. Summarizing and writing reports on such surveys. Also the analysis of statistics which may be collected by a state or national government or other agencies in addition to the trade association. Supervising surveys made by outside agencies.	Calculating machines, adding machines, slide rules, book of precalculated tables, typewriters, etc.
Schools	Schools conducted by experts in any special line to teach the employees of member companies how better to do their job. For example, the Dry Cleaners' Assoc. operates near Washington a complete dry cleaning plant. The Ice Cream Merchandising Institute, an affiliate of the International Assn. of Ice Cream Mfrs., operates an ice cream fountain laboratory and school in which merchandising men in the ice cream industry are taught the best methods.	The equipment which would be required for such a school. For example, all the equipment necessary in a small dry cleaning plant or a soda fountain or other equipment necessary in the soda fountain school. Class rooms, motion picture or slide projectors.
Service Departments	*Processes*	*Equipment and Facilities*
Printing	Mimeographing, dittoing, multigraphing, multilithing, or any other process for printing on paper for distribution to members the information the association wants to impart.	The mimeograph, ditto, multigraph, multilith, or any type of photo reproduction machinery.

Mailing	The collection of the pieces to be mailed, inserting them in the envelopes, addressing the envelopes, and, if third-class mailings, the tying of envelopes by states in classifications required by the Post Office Dept.	The addressograph, graphotype, sealing machine, postage meter, tying machine, and other equipment that may be required for the mailing department. Storerooms with adequate indexed shelving or other facilities for storing material which may be on hand for shipping out from time to time.
Bookkeeping Dept.	The ordinary duties of the bookkeeping department.	Ordinary equipment of a bookkeeping department.
Stenographic Pool	Taking dictation and transcribing of dictation for the executives and department heads of the association.	Typewriters, vari-typers, and other equipment such as stenotype machines, etc., that may be required for the stenographic pool.

The segregation of departments just listed is rather complete. However, trade associations, if larger than the types discussed, may make a further segregation of departments and facilities wherever the requirements seem to indicate the desirability of such additional segregation.

Production Order System

Ordinarily, in the trade association of the kind described, the office manager is the one who writes up the production orders for the printing department or for the mailing department. Trade associations should have, at the first of each month, each department list on a proposed mailing sheet the mailings which it expects to make during the month. The office manager then can apportion when necessary the work for the addressograph so that it all can be completed on schedule. For regular mailings, such as regular bulletins, etc., it is often desirable to keep on hand at least one set of envelopes fully addressed, so that, when it is necessary to get out a bulletin quickly, filling the envelopes will not have to be delayed until the complete set of envelopes can be run through the addressograph.

It is possible to obtain a numbering machine for most addressographs which will number the envelopes as they go through. This is especially useful for third-class mailing where a count is necessary for the post office. In first-class mailings, some associations use the metered mail machine which also has a counter on it so that the number of pieces for each mailing is easily determined.

II. How to Design the Cost System

What Information Is Required

Each of the activities in the trade association should be costed. When this is done and a record is kept of each service rendered each class of members, it is only a matter of arithmetic to know the relation of income to cost in each membership

classification. It is possible when proper cost records are maintained to know whether the cost of printing by an outside concern compares favorably or unfavorably with the cost to the association when it does its own printing. The same is true with other operations, such as mailings which may be done under contract by firms which make a specialty of this type of work.

Considerations in Designing System

In the case of trade associations, the cost system is designed primarily to keep management informed as to the cost of services that are rendered to each class of people served. In trade association work it is not customary to change dues often. The proper cost system will enable management to know the difference between the income received and the cost of maintaining service. In other words, the information required by the trade association is not essentially different from that required by the ordinary industrial company.

The Job Order Cost System

Usually, in trade associations where the job order system of costing is not used, the survey system of costing is employed when need of costs is felt. A complete analysis is made of all the factors involved for each cost job which is undertaken. When this is the case, unit costs are not kept but, as there is reason to think any cost may be varying from what management thinks it should be, a survey is made to determine exactly what that cost is.

The job order type of cost system is favored by trade associations because it enables them at all times to determine the cost of each of the various services, many of which vary from each other a great deal. Although the cost estimates of contemplated projects may be made up by the type of cost accounting known as standard costs, it is seldom used by trade associations. In fact, cost accounting of any kind in trade association work is decidedly new as compared with cost accounting in industry generally.

III. Description of the Cost System

The most important steps in establishing a cost system for trade associations are as follows:

1. Design the Statement of Income and Expense for management (Figure 1).
2. Design the statement of Time per Project (Figure 2).
3. Design the Departmental Works Budget.
4. Design the Job Order Cost Form for the departments (Figure 3).
5. Establish the procedure for using the cost system to produce the data desired.
6. Set up the chart of accounts which is required by the results that it is wished to obtain.

Statement of Income and Expense

The Statement of Income and Expense is the most important statement from the standpoint of management in controlling the affairs of the trade association. All the cost methods and accounting methods are pointed toward producing data which will be appropriate for this statement. There is one very important difference between the average trade association and the average business or industrial concern: The trade association is almost invariably a non-profit organization. For this

INTERNATIONAL ASSOCIATION OF XXXX MANUFACTURERS

Statement of Income and Expense

Period Ended_____

	Budget	*Income and Expenses*
Income:		
Membership Dues, Active	xx	xx
Membership Dues, Associate	xx	xx
Membership Dues, State Association	xx	xx
	xx	xx
Less Provision for Bad Debts	xx	xx
	xx	xx
Other Income:		
Sale of Bulletins, Pamphlets, and Books	xx	xx
Fees for Services	xx	xx
Interest Received	xx	xx
Discounts Received	xx	xx
Miscellaneous Income	xx	xx
Total Other Income	xx	xx
Total Income	xx	xx
Expense:		
Association General		
Salaries	xx	xx
Rent	xx	xx
Postage and Office Supplies	xx	xx
Printing and Stationery	xx	xx
Telephone and Telegraph	xx	xx
Travel	xx	xx
Committee Expense	xx	xx
Bulletins and Postage	xx	xx
Special Mailings to Members	xx	xx
Mailings to Directors and Officers	xx	xx
Counsel	xx	xx
Convention	xx	xx
Taxes	xx	xx
Depreciation	xx	xx
Office Equipment Expenses	xx	xx
Directors and Executive Committee Exp.	xx	xx
Member Solicitation Expense	xx	xx
Total Ass'n. General Expense	xx	xx
Department of Accounting	xx	xx
Department of General Research	xx	xx
Department of Product Research	xx	xx
Department of Marketing Research	xx	xx
Department of Merchandising Research	xx	xx
Department of Statistical Research	xx	xx
Schools	xx	xx
Printing Department	xx	xx
Mailing Department	xx	xx
Total Departmental Expense	xx	xx
Total Expense	xx	xx
Excess of Income over Expense		

Fig. 1. Statement of Income and Expense.

reason, the item of profit is not present at all in the trade association Statement of Income and Expense. Rather the Statement of Income and Expense is prepared to show how near the income received comes to the estimated income for the year, and how the expenses compare with the budget of expense for the year or the month or other period for which the statement is prepared.

At the beginning of the year when approval for the budget is sought, it is customary at the same time to present a general program of work for the coming year so that the executive committee or board of directors or other body of the association that approves the budget may have some idea of what will be accomplished for the amount of expenditures that is authorized. In connection with the study of the Statement of Income and Expense, the departmental work budget should be considered.

A departmental work budget is in effect only a program of work for each department submitted by the department head to the top trade association management for two purposes: First, to show top management the program of work it is expected to accomplish for the coming month or quarter (preferably, these budgets are submitted on a quarterly basis); second, it keeps management informed concerning the work of the department without unnecessary supervision by management.

Statement of Time for Production Departments

It should be remembered that in the ordinary department of the trade association most of the cost often is the salary of its manager or director. A man of the type capable of carrying on the work of such department should not be burdened by an undue amount of clerical work. However, the statement should be such that it will enable the accountant to obtain a reasonable idea of the amount of time

PROJECT TIME REPORT

Week of_____

Department_____
Name of Project_____

With this report is the work on the project Complete_____
Incomplete_____

Name of People Participating: Time in hours

	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	

Initials—Dept. Mgr.

Fig. 2. Statement of Time per Project.

devoted to each project. In all probability, at least in the busier departments of a trade association, there will be a difference between the total time put in by the manager for a day and the total time recorded on the projects of the department. Actually, this difference in time should be considered the time devoted to the routine tasks that are a part of the duties of every departmental manager. It should always be borne in mind that the time reports are not those of the ordinary factory worker or other person whose labor turns out salable material; rather they are reports of the time devoted to special projects by a man who could be trusted to put in a complete day's work each day regardless of whether or not he were making out a time report.

Departmental Work Budget

A report of this nature not only enables top management to know what is going on in each department but it also enables the office manager or other person responsible for routing work through the service departments to know what is coming up and what will be expected of the service departments under the supervision of the

COST SUMMARY

Project _____ Date Completed _____

SALARY COST

Department	Total Time	Cost
		$

DEPARTMENTAL OVERHEAD

Department	Time	Cost
		$

MATERIAL - PRINTING AND MAILING ONLY

Material	Amount	Cost
Printing Dept.		$
" "		
" "		
Mailng Dept.		
" "		
" "		

Total Cost $

Unit _____ Cost _____

Fig. 3. Job Order Cost Form.

office manager. When departmental work budgets are submitted for sufficiently long periods ahead of time and are reasonably adhered to, they enable the scheduling of work in other departments in such a way that it is much less likely that a bottleneck will develop, for example, in the printing department or in the mailing department. Also, the program of work will enable the association management to plan ahead, and this is particularly valuable where it is necessary for management to coordinate the work of two or more departments so that a project which is contributed to by several of the departments in the association can be developed and completed on time.

Job Order Cost Form

The Job Order Cost Form is the form which enables the accountant to gather together various costs which make up the total and unit cost for each project. It is a key form in the obtaining of costs and it is particularly useful in such departments as the printing department, the mailing department, and other departments where labor rather than abilities of a professional nature are the predominating costs.

Using the Costs

After the unit costs are obtained for each operation or for each project, all the costs involved for each membership class should then be combined into the various

MEMO TO MAILING CLERK

FROM _____ DATE _____

TO BE MAILED ON _____ TYPE OF ENVELOPE _____

INSERTIONS _____

TO BE MAILED TO:	U. S.	CANADA	FOREIGN	REMARKS
ACTIVE MEMBERS				
ACTIVE BRANCHES				
ASSOCIATE MEMBERS				
ASSOCIATE BRANCHES				
ALLIED ASSOCIATIONS				
MISCELLANEOUS				
BOARD OF DIRECTORS				
EXECUTIVE COMMITTEE				
ADVISORY BOARD				
PROFESSORS				
STATE SECRETARIES				
TRADE PAPERS				
SALES MANAGERS				
ACCOUNTANTS				
PRODUCTION MANAGERS				
COUNCIL UNITS				
PROSPECT A				
PROSPECT B				
PROSPECT C				
PROSPECT ASSOCIATES				

TOTAL MAILING _____ ORDERED _____ SUPRLUS _____

RECEIVED FROM PRINTERS: DATE _____ HOUR _____

SENT TO POST OFFICE: DATE _____ HOUR _____

TIME REQUIRED: HOURS _____ MIN. _____

MAILING CLERK

Fig. 4.

totals. For instance, the mailing records when collected for active members show the number of mailings and the cost of each mailing that have been made to active members. It can be easily computed from these records just what is the total cost of servicing each class of members in this respect as compared with the amount of dues that are collected. It is also of importance to trade association management to know the cost of pamphlets and books that are sold to others than trade association members as well as the income received from them.

Information developed from studies of this type is also quite useful when membership is discussed with prospective members. Most businessmen realize that there is a certain amount of value in co-operating for the good of the industry as a whole.

MONTH OF_____, 19__ MAILING SCHEDULE COPY TO_____

DAY	DATE	MAILING TO BE MADE	BY	SIZE	MEMO TO MAIL CLK.	REMARKS
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					

Fig. 5.

However, there is very often doubt in the minds of these same businessmen as to just what this value may be to them in dollars and cents. When these businessmen can see what it is costing to service the individual member in a trade association and what that member gets in the way of information and other services from the trade association for the amount of dues he pays, belonging to a trade association takes on much more the aspect of a business transaction and much less the aspect of just giving money to a good cause. Particularly in times of depression, it is easier for the manager of a business to sell his board of directors on maintaining the membership of a trade association when he can show that it is good business to belong than when all he can tell the board in requesting the appropriation for the dues is that it is good ethics to belong.

COST ACCOUNTING IN THE VEGETABLE OIL INDUSTRY

By
DOUGLASS M. BARROWS *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Vegetable oils are, as the name implies, the oils obtained from products of the vegetable kingdom, such as seeds and nuts, in differentiation from the oils and fats derived from animal sources. Although there are probably hundreds if not thousands of seeds, nuts, fruits, and leaves that contain greater or lesser quantities of oils, there are comparatively few whose oil content is great enough to warrant production on a large scale. There are many vegetable oil manufacturing plants in the United States, representing large investments, and which are designed to operate almost entirely on some one of the more plentiful seeds or nuts. When on occasion the supply at the mill is exhausted, other raw material can be used by making comparatively minor changes in the mechanical or chemical equipment of the plant. It is vital, however, that the supply be sufficient to warrant a mill run of satisfactory duration.

The residue left from the raw material after the oil has been removed is of value as a livestock feed in almost all instances. It is usually a good concentrate for mixed feeds or to be fed without admixture. Protein content is high and generally the residual meal is considered to be easily digested by the animals or fowl. As far as the industry is concerned, even though the residue is valuable, it is chiefly thought of as a by-product.

Marketing of the oil to a very large degree is done through the medium of brokers who are in touch with both users and suppliers and through whom contacts are made and business closed. The residual cake or meal is sold directly to feed dealers or handled by brokers either for their own account or as intermediaries. It is common practice for sales of oil and to some extent, of meal, to be made for future delivery at prices agreed upon at the date of sale.

Origin of the Products

Certain of the vegetable oils almost antedate recorded history. Egyptian ladies were fond of cosmetics, of which many had a vegetable base. Olives were pressed by crude methods to produce the useful edible oil. Natives in tropical countries, when first discovered by whites, anointed their bodies and their hair with coconut or palm oil. Gradually the uses of these vegetable oils expanded, some for edible use, some for cosmetics, some for pharmaceutical purposes, and some for industrial ends. With the expansion of chemical research in recent years has come an ever-widening use for these oils, particularly in industry, until today a vast number of

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articles of common use either contain vegetable oils or have been produced by their aid.

The oils are now being broken down chemically into their component acids which are opening up new uses and being employed in numberless new processes. No one can prophesy the end.

Sources of Raw Materials

Fundamentally, the source of all vegetable oils is the soil itself. They are crops, just as wheat and potatoes are crops, and like ordinary farm crops they must be bought from the grower. The material may pass through several middlemen before reaching the plant, but it is a crop and must of necessity be treated as such. Most "oil bearers" are seasonal, such as cottonseed, flaxseed, and soya bean. Some are produced the year-round, such as coconut. Each type presents its own problems. The seasonal crops must be bought and stored in great volume during a very short period each year. Contacts with growers or middlemen generally are made long before actual harvest or even planting periods. Often, seed is furnished and cash for raising and harvesting the crop is supplied by the plant to insure its supplies for the coming season's operations.

These problems are not present in the care of the non-seasonal crops. However, as most of these are from tropical sources, contacts with reliable suppliers must be made, storage arrangements in foreign ports must be arranged, shipping space must be contracted for, and the thousand and one financial details connected with foreign trade must be very carefully taken care of.

Organization of Plant

Since raw material and finished product alike are of a bulky nature, proper storage facilities are the primary requisite. In the care of domestic crops, plants are centrally located in the growing areas to hold down transportation costs of the raw material. For foreign materials, plants are built on tide-water with dock facilities. Once the material is received, manufacturing processes follow smoothly. The costing methods could well be adapted to almost any plant producing vegetable oils by mechanical means from any of the more plentiful seeds or nuts.

The departments of such a plant would be grouped about as follows:

First, the various service and managerial departments such as plant management, purchasing, personnel, maintenance, control laboratory, and research laboratory. Their functions are those usually associated with such departments in other industrial plants and they may be expanded, contracted, or combined as the needs of the individual mill may require.

Since production is not on a job order basis but is a continuous run of one raw material to produce one major product and one by-product, production orders need not be considered. Occasionally, oils of different degrees of refinement are required, but a simple instruction from the head office is sufficient to divert a portion of the product into a further process.

Operating departments can be divided as follows:

A. *Warehousing.* Here raw materials are received, weighed, and stored and fed to the conveyors. Oil and meal from the processes come to rest here until shipped out. Oil may go out in cans, drums, barrels, tank cars, trucks, or aboard barges or ships.

Meal is sacked and shipped by truck, rail, barge, or steamer. Sufficient storage space must be provided for all these materials in the form of huge bins and accurately gauged tanks. Scales must be provided for weighing materials in and out, together with sacking machinery and equipment for filling and handling drums, barrels, and tank cars.

B. *Milling.* Since we are not considering plants where oils are produced by chemical methods usually grouped under the term "solvent processes," milling becomes a series of mechanical operations. The materials must be cleaned by screening or other methods, reduced by grinding to a size easily handled by the machinery, excess moisture removed by driers and then fed to the crushing machines, known as "expellers." Here the material is squeezed again and again until by far the greater part of the oil is drained off, the residue in the form of broken cakes going into storage to await grinding into meal. The oil is filtered and run into storage. As far as possible, all movement of the material is automatic by means of drag or screw type conveyors and in the case of oil, by pipeline pumping. Samples of material are taken at many points along the production line and sent to the Central Laboratory for quick analysis, so that variations may be checked and adjustments made to insure a uniform product. This is quite necessary, as two lots of the same raw material although appearing to be exactly alike can easily differ to a marked degree in free fatty acid content, in moisture, and in oil content. The industry is dealing with a product which is not uniform in quality but which merely approximates uniformity; hence the need for full laboratory control.

II. How to Design the Cost System

What Information Is Required

Cost control of the various operations is best exercised by a combination of two sets of figures. As in all industries, it is essential that actual direct and indirect costs be ascertained accurately, but it is equally important to the vegetable oil products to have accurate weights and measures of raw material put into the operations and of finished products obtained. Division of the dollar and cent cost of each operation by the weight of raw material used during a given period will give the cost expressed in cents per 100 pounds, per ton or per bushel.

Similar figures are obtainable by using the weight of the oil produced as the divisor of the cost figures, thus obtaining the cost expressed in units of the product rather than that of the raw material. Comparison of these two sets of figures are most useful to management in controlling not only cost but in obtaining maximum efficiency in operation.

Spot checks as to efficiency can be taken at intervals of a day or less by the supervisory executives, since laboratory tests of raw material constantly show to a fraction of a per cent what the output should be.

Since operations are continuous, it is a simple matter to distribute such direct costs as payroll expense, power, steam, and manufacturing supplies (filter material, etc.). These can be accumulated either by departments or broken down to the individual machine if that refinement should be considered necessary. Such indirect costs as depreciation and other forms of plant burden can be allocated in a similar manner. It is customary to group general service costs applicable to the entire plant, such as watchmen's wages, janitorial service, timekeeping, etc., in one category, thus showing these services as if they constituted a separate department.

EXHIBIT 1

X.Y.Z. VEGETABLE OIL PRODUCERS

PROFIT-AND-LOSS STATEMENT MONTH OF_____1947

	This Month	*Year to Date*
Gross Sales		
Oil_____Lbs. Av. per lb._____.	xxx	xxx
Meal_____Tons. Av. per ton._____.	xxx	xxx
Total Gross Sales	xxx	xxx
Cost of Sales		
Raw Material	xxx	xxx
Inventory Change	xxx	xxx
Standard Operating Costs	xxx	xxx
Total Costs of Sales—Standard	xxx	xxx
Gross Profit—Standard	xxx	xxx
Plus or Minus Variances		
Labor	xxx	xxx
Supplies	xxx	xxx
Other	xxx	xxx
Net Variances	xxx	xxx
Gross Profit—Actual	xxx	xxx
Deduct		
Selling Expenses	xxx	xxx
Administrative Expenses	xxx	xxx
Research	xxx	xxx
Total deductions	xxx	xxx
Net Profit/Loss	xxx	xxx
Total volume crushed _____.	100.00%	
Total oil produced _____.	xxxx %	
Total meal produced _____.	xxxx %	
Total milling loss _____.	xxxx %	

Types of Systems

Fundamentally there are only two types of cost systems truly applicable to the industry. One is the actual cost of operations without allowances for variances of any nature. The other is a modified form of "standard" costs. The word "modified" indicates that true standards are not as a rule used because of the impossibility of including a standard cost of raw materials. Such costs fluctuate widely and very rapidly, and inclusion of any figure presuming to represent a standard cost of raw material would involve so much pure guesswork as to render it valueless. This will be touched upon later under the headings of "Standards" and "Variances."

III. DESCRIPTION OF THE COST SYSTEM

It is necessary to take the following steps in laying out a cost system for this industry:

1. Prepare a profit-and-loss schedule for management showing not only dollar and cent results but production figures as well.
2. To prepare these figures a cost of operations sheet is essential.
3. If modified standards are to be used, a master standard cost sheet at varying rates of production should be set up.

Profit-and-Loss Statement

This statement must show top management a compilation of the results of operations during the accounting period in such form that it can be readily seen where profits were made or losses incurred. Exhibit 1 is a sample of such a statement. Here it will be noticed that the bottom entry regarding volume of raw material used, milling loss, and oil and meal produced is an essential part of the statement giving management an insight into plant efficiency which can vitally affect the profit-and-loss figures.

Standards

As already pointed out, it is impractical to apply standards to raw material costs because of their wide fluctuations. Since by far the greatest number of sales of oil are made for future delivery, it is essential that costs be known well in advance. The modified standards in general use provide this knowledge. It is sufficient to know that the cost of producing oil is a constant figure. By the use of this constant, it is easy to construct tables showing different prices of the raw material vertically and the varying prices at which the by-product will be credited horizontally. The figure shown where the two lines cross will be the cost of oil, as illustrated below:

Raw Material (per ton)	Recovery Price Meal (per ton)		
	$20	$25	$30
$100	$.09375	$.09269	$.09062
$110	$.10218	$.10052	$.09896
$120	$.11042	$.10885	$.10730

Basis—Oil recovery —1200 lbs.	Operating Expense
Meal recovery— 750 lbs.	$20 per ton
Mill loss — 50 lbs.	Cost of oil, cents per pound

Thus if raw material costs are at the moment $110 per ton and recovery of the by-product meal can be taken at $25 per ton of meal, oil will cost $.10052 per pound. Tables of this nature are most valuable in setting prices at which the oil will be sold. It will be apparent, however, that, unless the standards are most carefully set, heavy operating losses may be incurred by having them too low or else good business may be passed up by having them set too high.

To provide for good control, it is essential that the standard over-all operating cost be broken down at least by departments so that variances may be properly applied and steps taken to correct inequalities which will be disclosed. Exhibit 2 shows a type of schedule which may be used for this purpose.

On this schedule the direct, indirect, and total costs of each department are posted from the ledger accounts. Each of these figures is then divided by the num-

EXHIBIT B

X.Y.Z. VEGETABLE OIL PRODUCERS

ANALYSIS OF COSTS MONTH OF_____1947

DEPARTMENT	DIRECT			INDIRECT			TOTALS		
	Actual	Per Ton	Standard	Actual	Per Ton	Standard	Actual	Per Ton	Standard
Feeding Mill	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Grinders	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Driers	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Expellers	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Filters	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Feeding Storage	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Mill Service	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
TOTALS	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

Total volume crushed_____.

Total days worked _____.

Average per day _____.

ber of tons of raw material handled during the period. This figure shows under the heading "Per Ton" and is in direct comparison with the standard figure per ton inserted alongside of it. Variances immediately are apparent and comparison with former analyses will show clearly and quickly if any one department is consistently too high or too low as compared with the standards. This variance may show that the department is at fault or else that the standard has been improperly set and should be changed.

Although this schedule is primarily designed as an accounting work sheet to be used in making up the profit-and-loss statement, it can be used daily by the plant accountant as a rough approximation of the previous day's run, thus giving the plant executives prompt opportunity to make any needed corrections.

Raw material may be charged out of inventory on the basis of first-in, first-out, last-in, last-out, or average costs, as may best suit the needs of the particular business. Since both purchase of raw materials and contracts of sale are normally for future delivery, the average cost method is the one most widely used. Where open markets are in operation, as in the case of flaxseed, hedging is a common practice in order to protect manufacturing and selling profits. Even where no open market exists it is often possible to hedge in a similar commodity actually traded in on the exchange.

Variances

Using the analysis of costs illustrated in Exhibit 2 as a basis, the cost accountant's work sheets should subdivide each major department. This subdivision should show standard labor, material, power and steam costs expressed in dollars and cents per 100 pounds, per ton, or other unit of weight or measure convenient. It is well to carry these figures at least three places beyond the cent column. A second column is then filled in by multiplying the standard per unit by the volume handled during the period. Actual costs are in the third column and variances appear in the fourth (see Exhibit 3).

A few minutes each day is sufficient to prepare such a variance sheet for the guidance of the plant executives. At the close of an accounting period the total figures may be obtained from the daily summaries and it becomes extremely easy to see the individual items responsible for the variances, and also to ascertain if any one item is consistently running over or under the standard. This allows steps to be taken promptly to fix responsibility and make any adjustments, either in the operation itself or in the standard set for it.

How Data Are Obtained for Cost Summary

Time Cards are simple, showing only the employee's name, clock number, department in which employed, and time worked. Since these operations are continuous, working on one raw material and culminating in one finished product, good plant management consists of training a man for one job and leaving him on it, without changing him to other operations.

Manufacturing supplies, such as filter material, lubricants, etc., are issued by the storekeeper and slips sent to the cost accountant showing the volume applicable to each department. Steam and power may be metered.

Repair parts present a somewhat different problem. The machinery is heavy and rugged but still subject to rather unusual wear and tear.

EXHIBIT 3

X.Y.Z. VEGETABLE OIL PRODUCERS

VARIANCES MONTH OF_____1947—GRINDING DEPARTMENT

	Standard Cost per ton	Standard Cost per crush	Actual Cost per crush	Variance Accounts	
				Over	Under
Labor	xxx	xxx	xxx	xxx	xxx
Repair Parts	xxx	xxx	xxx	xxx	xxx
Power	xxx	xxx	xxx	xxx	xxx
Steam	xxx	xxx	xxx	xxx	xxx
Other—Specify	xxx	xxx	xxx	xxx	xxx
Totals	xxx	xxx	xxx	xxx	xxx

Total volume crushed_____.

It is customary to charge repairs to a prepaid expense account. An estimate is then obtained from the plant engineers as to the number of units of raw material which in theory at least should be crushed before similar repairs would become necessary. This prepaid expense is then written off against actual operations based entirely on the volume of raw material handled during the estimated period. The same method may be followed for many manufacturing supplies, such as filter material, which may have a fairly long life before being discarded.

Inventory Variances

Considering raw materials first, the largest problem is that of shrinkage. All the seeds and nuts as received include a certain volume of foreign matter, such as steam, hulls, straw, dirt, etc. Also, even those which appear quite dry contain appreciable quantities of moisture. Storage is in bulk, in grain elevators, tanks, or large bins. During hot weather, loss of moisture occurs whereas heavy humidity will often cause an increase in the moisture content. Loss or gain in total gross weight is the result.

Foreign matter can be removed by screening or other mechanical cleaning devices, leaving only the clean material to go into operations. Moisture must be figured, however, by the laboratory, and the volume of clean material brought to a constant basis, either treating it as being bone dry or as containing a normal amount of moisture.

Raw materials are weighed and analyzed as received, then again when cleaned and conveyed to the mill machinery. Inventory is charged with receipts and credited with all withdrawals, but a physical check of inventory remaining on hand is almost always impossible. As stated, storage is in bulk and no accurate measurement of amounts on hand can be made. Running book inventories are kept of each tank or bin and they can only be reconciled when a final clean-up is made. At that time the overage or shortage discovered should be charged or credited to the cost of sales over the period lapsed since the last clean-up.

Oil and meal present similar inventory problems. Weights can be taken of all

materials put into and withdrawn from storage, but the taking of a physical inventory is as difficult as in the case of the raw materials. Again storage is in bulk. The volume of the meal can only be estimated until a bin is cleared out. Oil can be stored in carefully calibrated tanks, but as the volume of the oil depends upon the temperature, the measurement of each tank must be adjusted in accordance with thermometer readings. Absolute accuracy in this regard is only a goal at which to shoot. Further, many oils solidify at ordinary temperatures and, hence, cannot be measured by means of floats. Weighted steel tapes have to be dropped from a manhole in the top of the tanks and the volume of oil figured from the "outage" or vacant space above it.

In addition to the oil stored in tanks, there is always a substantial quantity in the pumps, pipe lines, and filters throughout the plant. It is advisable at the start of a run when the system of piping is clean to estimate closely the volume of oil coming from the expellers before any of it reaches the storage tanks. This volume then is taken as a constant figure to be added to the inventory. The system remains with this quantity of oil spread throughout the lines until the run is completed, which may often be a matter of months. When the run is completed, all pumps and lines are cleaned out and the oil finally placed in storage. Any discrepancy between the amount estimated and that recovered can then be included in cost of sales for the period.

COST ACCOUNTING FOR WINERIES

By
GEORGE A. MAXWELL *

I. DESCRIPTION OF THE INDUSTRY

The Alcohol Tax Unit (ATU) is the agency through which the Government supervises the production of wines and brandies. Regulations No. 7 and No. 5 have been issued for the guidance of producers and a strict compliance therewith is enforced.

Wine products are described and a nomenclature of the industry is given in the regulations, a few of which are:

Must	Expressed juice of grapes and fruits before fermentation.
Natural Wine	The product of a normal fermentation of the juice of sound, ripe grapes, without addition or abstraction, except such as may occur in the cellar processes.
Still Wine	Wine that is not effervescent.
Table Wine	A still wine with alcoholic content of about 14% by volume—called "table wine" because it is served with meals. Most of them are "dry."
Dessert Wine	A still wine with an alcoholic content of about 20% by volume. Most of the dessert wines are sweet and include such types as Port, Muscatel, and Tokay.
Sparkling Wine	An effervescent wine. Carbon dioxide, generated during a secondary fermentation, produces the effervescence and sparkle. Champagne and Sparkling Burgundy are typical.
Varietal Wine	A wine named for a particular variety of grape from which at least 51% of the wine has been derived, e.g., Muscat grapes predominate in the making of Muscatel.
Vermouth	An aperitif or appetizer wine flavored with aromatic herbs and roots in accordance with the maker's formula, which must be filed with the ATU.
Brandy	A spirituous liquor distilled from grape wine. If distilled from any other fruit, the particular fruit must be named, e.g., Apricot brandy would be a distillate of Apricot wine.
Bonded Premises	Premises approved by the Commissioner of Internal Revenue as suitable for the production of wines and brandies. To qualify, the producer must file notice of intention to produce, obtain permits, and execute satisfactory bonds. Bonded premises must be constructed to meet the requirements of the law so that wine products will be protected.

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Equipment ..... Tanks must be labelled as to the contents. The serial number and gallonage capacity must be painted conspicuously on each. Wineries must be equipped with measuring and testing instruments such as Balling saccharometers for ascertaining sugar content and ebullioscopes for measuring alcoholic content.

Federal Excise Taxes .. Excise taxes are paid on all wine products upon removal from Bonded premises to Tax-paid storage. Payment is effected by affixing revenue stamps to the containers. The rates are an amount per gallon on wines not exceeding 14% in alcoholic content; there is a higher rate on wines from 14% to 21% and a still higher rate on wines from 21% to 24%. If the alcoholic content exceeds 24%, the wines are taxable as distilled spirits.

Tax-Paid Storage ..... Wines are removed from Bonded premises, i.e., from in-bond storage, upon payment of the Federal excise taxes. Removal may be made in casks, barrels, cases, tank cars, etc. Containers must be stencilled in accordance with the regulations and bear a tag giving the name of the consignor and a description of the contents.

Under the regulations, wine growers are required to submit on Government forms a number of monthly returns to the Alcohol Tax Unit. These are generally spoken of as the ATU reports. They furnish quantitative data and, in addition to fulfilling the requirements of the law, are of the utmost importance to the accountant in the control of costs. Their titles are indicative of the information they contain; those of primary importance from an accounting standpoint are:

Form 701 —Winemaker's production record
Form 702 —Winemaker's report of production, receipt, treatment, and disposition of Still Wines
Form 702-A—Winemaker's report of production, receipt, and disposition of Champagne and Sparkling Wines
Form 702-B—Winemaker's Vermouth report
Form 703 —Shipment of Bonded Wines
Form 15 —Monthly return of fruit distiller
Form 261 —Winemaker's monthly report of materials for fortification and amelioration of wines

ATU reports, of which there are more than those mentioned, when filled in as they must be are replete with data that are invaluable to the cost accountant. The limitation of space does not permit description, but a part of Form 701, Winemaker's Production Record, is shown in Figure 1.

An understanding of the processing operations will enable the accountant to coordinate his function with those of the operating departments.

Crushing and Fermenting

Grapes are received, weighed, unloaded, stemmed, and put through the crushers in this department. The sweet must is then pumped to the fermenting tanks, inoculated with a wine yeast, and the process of fermentation is set in motion, which takes anywhere from about five to thirty days.

If table wines are to be made, the must is allowed to ferment completely. If dessert wines are to be made, fermentation is "arrested" by adding a certain amount of high-proof brandy. Table wines are sent to the Cellar Department for finishing and dessert wines to the Fortifying Department.

Distilling Department

High-proof brandy is distilled from pomace, residues, and substandard wines which come mainly from the Fermenting and Cellar Departments. When made, the brandy is delivered to the Fortifying Department.

Fortifying Department

"Arrested" dessert wines and high-proof brandy are received from the Fermenting and Distilling Departments, respectively. Brandy is added to the wines to increase the alcoholic content to the point best calculated to stop effectively any further tendency to ferment and to maintain the degree of sweetness desired.

Concentrates Department

Sweet must from the Crushing Department to be condensed for amelioration and sweetening purposes is boiled and otherwise processed in this department.

Cellar Department

Operations in this department have to do with clarifying, aging, blending, and finishing the wines and involve inspection, temperature control, racking, leak hunting, coopering, filtering, and fining.

Selected wines are sent to the Sparkling Wines and Vermouth Departments to be converted into those types; others, when "ripe," to the Bottling Department to be packaged for sale.

By-products Department

Valuable by-products, such as tartrates, pomace meal, etc., are captured in this department by dehydration from the residues of other departments. This is where the "squeal" is made salable.

Sparkling Wines Department

The effervescence and sparkle that characterize Champagne, Sparkling Burgundy, and wines of this type are produced by a refermentation within closed containers, during which carbon dioxide is generated.

Two methods are in general use, the bulk method and the NFB (Naturally Fermented in Bottle) method. Under the NFB method, the cork is released and, by pressure of the carbonic acid gas, the sediment, which has been "frozen," is blown out. This is known as the disgorging operation. A replenishing "dosage" is added and the bottle quickly recorked for aging. Operations consist of preparing the "dosage," refermenting, chilling, filtering, bottling, binning, packaging, affixing excise stamps and inspection, after which the wines are transferred to tax-paid storage.

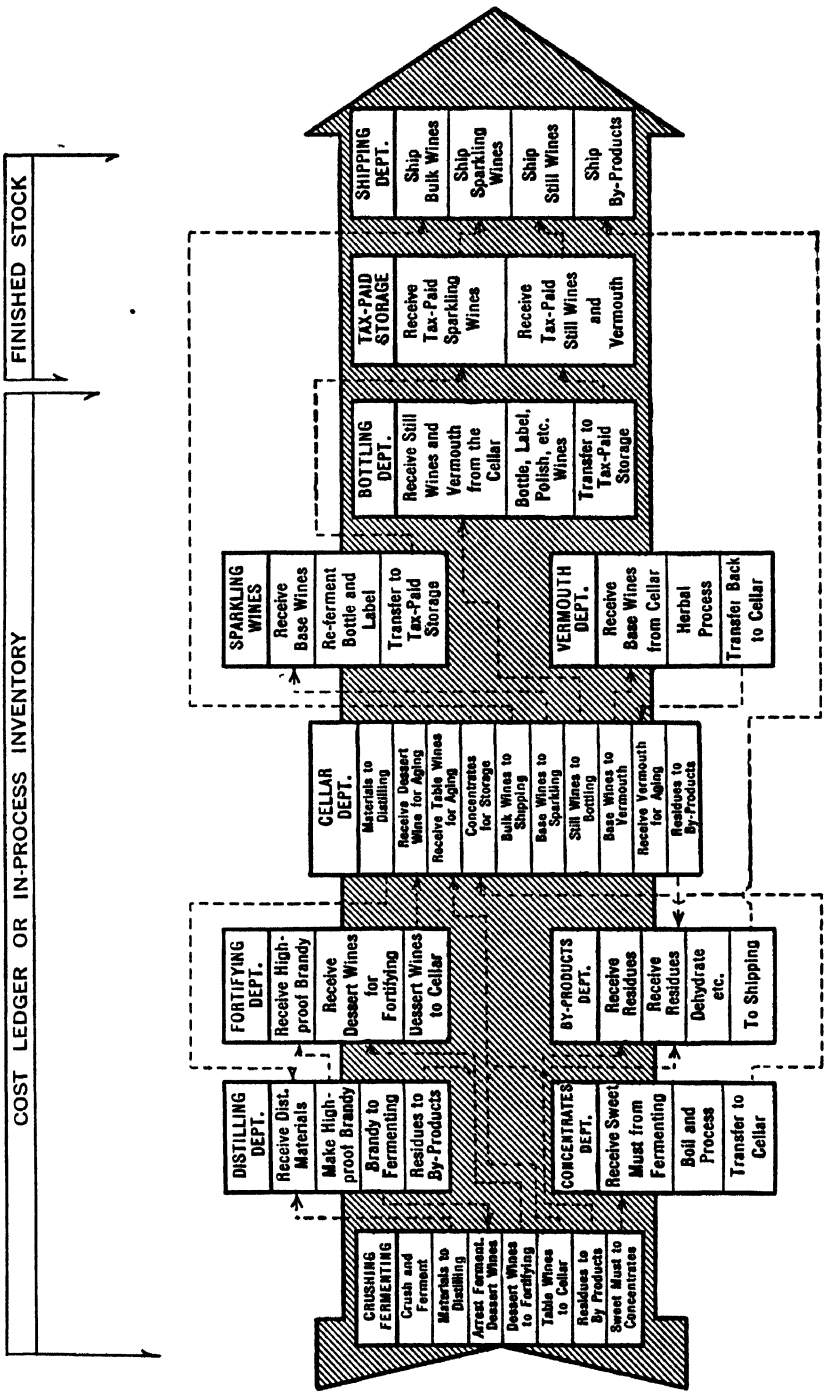

Fig. 2. Production Flow Chart.

Vermouth Department

Selected base wines are taken from the Cellar and processed under the particular herbal formula of the maker. After cooling and blending, the Vermouth is racked to the Cellar for aging.

Bottling Department

Still wines "ripe for bottling" are packaged in this department. The bottles are filled, capped, labelled, polished, and cased. The cases are stencilled and, after affixing the excise stamps, transferred to tax-paid storage.

Tax-Paid Storage

Finished stock, on a tax-paid basis, is warehoused in this department.

Shipping Department

Here documentation, shipping permits, bills of lading, affixing State seals, tallying, and loading are attended to.

Organization

Before the accounting system is designed there should be a definite agreement on the plan of organization as well as a common understanding of what constitutes cost.

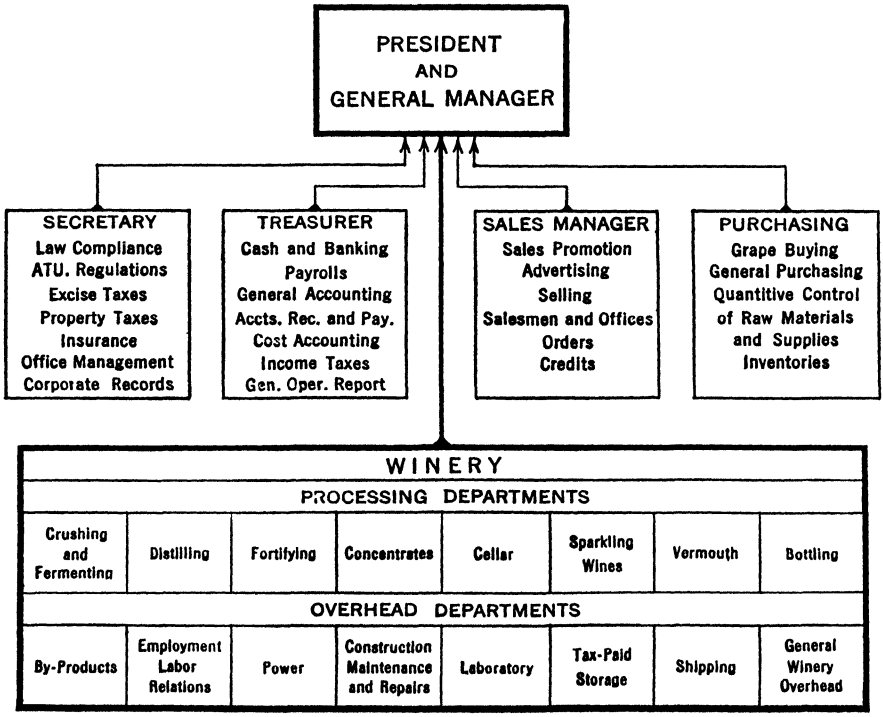

Fig. 3. Organization Chart.

Figure 3 illustrates the simplest form of organization, is self-explanatory and discloses a logical delineation of responsibilities for the small company.

II. How to Design the Cost System

A common understanding of the components of Cost should be agreed upon; to many the following will be acceptable:

Basic Material Cost	
(Grapes, yeast, chemicals, etc.)	$ xxxx
Direct Labor Cost	xxxx
Winery Overhead Cost	
(Indirect labor, operating supplies, property taxes, depreciation, etc.)	xxxx
Cost of Production	$ xxxx
Selling Cost	xxx
General Administrative Cost	xxx
Interest	xxx
Total Cost	$ xxxx

Although cost of production is not the total cost, it should be independently developed. It is controlled by the cost accounting and is the basis for inventory evaluation. The above formula has the approval of the United States Treasury Department which defines cost of production as "the cost of raw materials and supplies entering into or consumed in connection with the product, expenditures for direct labor, indirect expenses incident to and necessary for the production of the particular article, including in such indirect expenses *a reasonable proportion* of management expenses, but not including any cost of selling or return on capital whether by way of interest or profit."

If costs are too high and management learns of it only from the meager profits determined at the close of the year on an "inventory basis," only a hope remains that next year will be better. Moreover, if the general manager merely surmises that the costs were high because the profits were low, the glimmer of hope remaining may be a forlorn one. To know whether the cost of production is high or low, and by how much, we must know what the cost *should* have been. There must therefore be predetermined costs, or norms, or standards that can be brought into contrast with the actual costs, so that the *difference* will be known.

The secret of achieving a low and controlled cost depends upon a knowledge of three figures, namely, the *standard* cost, the *actual* cost and the *difference* or *variance* between them. The Handbook of Accounting Methods by J. K. Lasser (D. Van Nostrand Company, Inc.), Section 1, Chapter 12, page 190, puts it this way:

> Inasmuch as it is impossible to measure anything, or to gauge a result (such as plant performance) without comparison to some norm or standard, the establishment of standard costs is a prerequisite to cost control.

Consequently, the cost accounting system recommended is a simple adaptation of standard costs.

Under standard costs the actual cost is found on an aggregate basis only. This requires few accounts and calls for the simplest kind of bookkeeping. Under the

old-fashioned job-cost method a futile attempt, involving much bookkeeping, was made to develop the actual cost each month of each product. When the bookkeeping was done, twelve actual costs for each product, all different and all presumably correct, were found.

Which of the twelve should be used to value the inventories and determine the cost of sales and thus the profits? Space does not allow an adequate answer so we leave the unhappy bookkeeper to your sympathy, floundering in a morass of useless figures. But it is quite simple to obtain the actual cost on an aggregate basis, since only the standards need be worked up for each product, *once* each year. When worked up, they are set down on cost sheets similar to that given in Figure 4.

Wines are arbitrarily considered to be In-Process until transferred to Tax-Paid Storage, at which point they become Finished Stock (see Figure 2). Should any bulk wine shipments be made they are entered on the Finished Stock Production report, costed out of In-Process inventory, and charged to Finished Stock. These identical shipments also appear on the report of billings and are costed out of Finished Stock again, in the same month, leaving the Finished Stock inventory unaffected.

The formula by which the standard cost sheets are controlled and the *variation* determined will be readily understood from a consideration of the following equation. It should be given as an exhibit in the General Operating Report and is generally described as the Conversion statement.

AURORA WINE CO. CONVERSION STATEMENT, MARCH 1945 EXHIBIT NO. 11

		MONEY				QUANTITY
		Basic Mat'l. Cost	Direct Labor Cost	Winery Over-head Cost	Total Cost of Prod.	Proof Gal. Equiva-lent
A	In-Process Inv'y at Start of Month—at the Standard Cost	$ xxx	$ xxx	$ xxx	$ xxx	xxxx
B	Actual Expenditures and Charges	xxx	xxx	xxx	xxx	xxxx
C	Total of A plus B	$ xxx	$ xxx	$ xxx	$ xxx	xxxx
D	In-Process Inv'y at End of Month—at the Standard Cost	xxx	xxx	xxx	xxx	xxxx
E	Approximate Actual Cost of Finished Production for the Month (Case goods transferred to tax-paid storage plus bulk shipments, if any) C minus D	$ xxx	$ xxx	$ xxx	$ xxx	xxxx
F	Finished Production at Standard Cost (by applying cost sheets to the Production reported)	xxx	xxx	xxx	xxx	xxxx
G	*Variation from Standard* Difference between E and F	$ xxx	$ xxx	$ xxx	$ xxx	xxxx

The figures at G are vitally worth knowing, especially if the *variation* is a loss, and the quantity column shows a corresponding loss in gallonage. Suppose the figures at G are as follows:

		Basic Mat'l.	Direct Labor	Winery O'head	Total Var'n.	Proof Gal. Equiv.
G	Variation from Standard (Loss)	$7,500	$1,500	$1,000	$10,000	5,000

The quantitative loss of 5000 proof gallons of wine, equivalent to about 22,000 gallons of table wine or 10,000 gallons of dessert wine, has caused a dollar loss of $10,000.

The In-Process inventory at A will consist of must, concentrates, bulk table, and dessert wines; the Actual charges at B will consist of tons of grapes, brandy in gallons, etc. Such denominations cannot be added together to get the quantitative total at C. Similarly, the Finished Production at F will be in cases, gallons, etc. Quantities must therefore be converted to a common denominator which, in the wine industry, is the proof gallon.

A proof gallon is a wine gallon at 100 proof or a U. S. liquid gallon containing 50% alcohol. To convert wine products at various stages of processing into equivalent proof gallons, it is necessary to have a set of conversion factors. These are found by laboratory tests, in which due allowance is made for shrinkage, etc. The following are several of a list so arrived at and are given merely for illustration. Each winery should make its own list every year.

CONVERSION FACTORS (Illustrative only)

		Proof gal.
Grapes at 20° Balling	1 ton	= 40.50
Must	1 w. gal.	= .22
Grape Concentrate	1 w. gal.	= 1.00
Table Wine	1 w. gal.	= .23
Dessert Wine	1 w. gal.	= .51

The cost system for a winery must therefore have these qualifications:

1. It must show what the wines *should* cost (Standards).
2. It must show what the wines *did* cost (aggregate basis).
3. It must show the *variation* from Standard, in *dollars* and in *quantity*.
4. It must be the *simplest* and *quickest* method of accounting.

When all entries are made the cost control data is there *in* the accounts, but there it will stay unless it is brought *out* again in the form of a General Operating Report each month. Posting the data into the books is the bookkeeping; bringing it *out* again is the accounting.

The General Operating Report should include the following statements as a minimum requirement:

Exhibit
1. Balance Sheet
2. Profit-and-Loss Statement
3. Surplus Account
4. Schedule of Accounts Receivable

5. Schedule of Accounts Payable
6. Fixed Assets and Depreciation Reserves
7. Analysis of Selling and Administrative Expenses
8. Analysis of Sales, Cost of Sales, and Gross Profits, Classified by Products
9. Analysis of Production, Classified by Products
10. Summary of Inventories
11. Conversion Statement
12. Explanation of Standard Cost Variations

Each of these exhibits should be designed with the greatest care and none of them should be more than one typewritten page in size.

Exhibit 11, the Conversion Statement, is perhaps the most important; it shows the loss on Standard Cost and has already been discussed.

When the winery is organized and the accounting control picture to be given in the General Operating Report has been determined, the system should be designed accordingly and the following steps taken:

1. Prepare a chart of accounts so that there will be an account for almost every item appearing in the General Operating Report. All accounts need not be kept in one ledger. Subsidiary ledgers may be used for Accounts Receivable, Materials Inventory, Finished Stock Inventory and, of course, a Cost Ledger for the In-Process Inventory.
2. Design the "posting media" for the ledgers, that is, the records from which the ledger accounts are posted, such as the Cash Books, Sales Register, Voucher Register, and Standard Journal Vouchers.
3. Design the "source data" documents and forms supporting the entries in the "posting media." These include the ATU reports already mentioned, showing production, shipments, etc., and such forms as time tickets, payrolls, purchase orders, weighmaster's grape purchase certificates, materials used tickets, shipping orders, etc.
4. Prepare a manual of accounting procedures to facilitate an equitable distribution of duties and to guarantee consistency in the accounting treatment of transactions, preparations of reports, etc.

Many systems are deficient because of a careless disregard for the rules concerning "source data." Chemicals, for example, used in the winery, will not get into the costs unless materials used tickets are made out. The omission to make out the tickets will not be discovered until a physical inventory reveals an unexplained shortage. The rules should therefore be enforced and the forms be simple in design.

III. Description of the Cost System

It is assumed that the reader has a knowledge of general accounting, for which reason the brief description that follows is confined to the cost control phase.

The chart of accounts includes a controlling account for the Cost Ledger or In-Process Inventory. The balance in this account at the close of each accounting period represents the standard cost value of all the wines in process, in all departments from crushing and fermenting through bottling (see the Production Flow Chart, Fig. 2).

The Cost Ledger contains about twenty-two columnar accounts, namely:

Processing	1. Crushing and Fermenting
	2. Distilling

3. Fortifying
4. Concentrates
5. Cellar
6. Sparkling Wines
7. Vermouth
8. Bottling

Overhead

9. By-Products
10. Employment, Labor Relations
11. Power
12. Construction, Mtce., and Repair
13. Laboratory
14. Tax-Paid Storage Department Expenses
15. Shipping Department Expenses
16. General Winery Overhead (Supt., Clerks, etc.)
17. Depreciation
18. Insurance
19. Taxes (except income taxes)

Miscellaneous

20. In-Process inventory at beginning and end of *each year*
21. Finished production transferred to Finished Stock
22. Standard Cost Variations written out

Each account should be in columnar form; for example, the following indicates the columns that might be required for the crushing and fermenting cost account (credits should be posted in red figures):

Cost Ledger Account No. 1		CRUSHING AND FERMENTING																
Date 19__	Reference	Basic Material		Direct Labor	Overhead Redistributions from Accounts No. 9 to 19 inclusive													Total Costs
		Quantity	Amount		By-Products Dept.	Employment Dept.	Power	Mtce. & Repair	Laboratory	Tax-paid Storage Dept. Exp.	Shipping Dept. Exp.	Gen'l Winery Overhead	Depreciation	Insurance	Taxes			

During the crushing season, August through December, the cost sheets, Figure 4, should be prepared, one for each wine and wine product, to be used as the Standards for the ensuing year. Some wines will be carried over from the preceding year's crush so that the figures for the cost sheets should be weighted averages. This annual job is done on work sheets and should be careful estimates of achievable costs. It should be done by the general manager, the winery superintendent and the chief accountant working together so that all will agree on the standards set.

The Cost Ledger should be opened with the In-Process inventory at the standard cost value, the entry being posted to Cost Ledger Account No. 20.

Each month thereafter the charges for materials used, wages paid, supplies,

expenses, etc., are posted to the accounts from the Materials Used Distribution report, payrolls, voucher register, cash books, and journal entries. Overhead Accounts, No. 9 to 19, inclusive, are next redistributed to the Processing Accounts No. 1 to 8, inclusive, on a realistic and consistent basis.

The Finished Production Report is then costed by applying the cost sheets, and a standard journal entry made crediting Cost Ledger Account No. 21 and charging Finished Stock Ledger.

The next entry clears the standard cost variation out of the Cost Ledger. ATU regulations make it mandatory to take a physical inventory each month. When taken it should be costed at standard cost and the Conversion Statement prepared. This will show the loss or gain on standard cost, the amount of which is then posted to Cost Ledger Account No. 22 and charged or credited to Profit and Loss as the case may be.

At this point we are in possession of that vital item of information on which cost control is focussed. We know what the cost of production for the month *should* have been, how much it *actually was* and the *difference* or *variation.*

When all postings are made and the ledgers balance, the General Operating Report should be prepared.

Using standard journal entries exclusively for the General Ledger is an excellent habit and affords protection against omitting any phase of the accounting. About twenty will suffice for the ordinary winery system. For example, those that have to do with the cost accounting might be the following and the numbers should be the same in each period.

Standard Journal Entry No. 1

Dr.	Cost Ledger	$ xxx	
"	Fixed Assets	xxx	
"	Selling Expenses	xxx	
"	Administrative Expenses	xxx	
Cr.	Accrued Payroll		$ xxx

To charge controlling accounts with the payroll for the month of_____

Standard Journal Entry No. 2

Dr.	Cost Ledger	$ xxx	
"	Fixed Assets	xxx	
"	Selling Expenses	xxx	
"	Administrative Expenses	xxx	
Cr.	Materials Inventory		$ xxx

To charge controlling accounts with materials used during the month of_____ per Materials Used Distribution report.

Standard Journal Entry No. 3

Dr.	Cost Ledger	$ xxx	
Cr.	Reserves for Depreciation		$ xxx

To charge depreciation on Fixed Assets for the month of_____

COST SHEET NO. 63

Type of Wine *Aurora Brand Muscatel*

Conversion Factor-One Wine. Gallon is Equivalent to Proof Gal's.

Date of this Cost Sheet *September 12, 1945*

Elements of Cost	Basic Material and Processing and Bottling Supplies	Direct Dept. Processing Labor	Winery Overhead Cost (See the Chart of accts.)	Total Standard Cost for Ensuing Year (Weight & Average)
Basic Mat'ls. per W. Gal.				
Muscat Grapes	.153	—	—	.153
Other Grapes	.132	—	—	.132
Brandy	.144	—	—	.144
Chemicals	.011	—	—	.011
Other Processing Supplies	.007	—	—	.007
Processing Cost per W. Gal.				
Crushing and Fermenting	—	.017	.005	.022
Distilling	—	—	—	—
Fortifying	—	.013	.011	.024
Concentrates	—	—	—	—
Cellar	—	.026	.027	.053
Sparkling Wines	—	—	—	—
Vermouth	—	—	—	—
	—	—	—	—
Bulk Wine Cost In-Bond per Wine Gal.	.447	.056	.043	.546
Bulk Wine Cost In-Bond per Case of *12/5 ths*	1.073	.135	.103	1.311
Bottling Cost per Case	.706	.101	.093	.900
Cost per Case In-Bond	1.779	.236	.196	2.211
Federal Excise Tax				1.440
Cost per Case Tax-Paid				3.651

Approved by:

General Manager	*John Hancock*	*9/3/45*
Winery Superintendent	*Adam Smith*	*9/5/45*
Chief Accountant	*Henry George*	*9/18/45*

Fig. 4.

Standard Journal Entry No. 4

Dr.	Finished Stock Ledger	$ xxx	
Cr.	Cost Ledger		$ xxx

To transfer finished production from In-Process for the month of_____

Standard Journal Entry No. 5

Dr.	Profit and Loss	$ xxx	
Cr.	Cost Ledger		$ xxx

To write out the Standard Cost Variation for the month of_____

Standard Journal Entry No. 6

Dr.	Standard Cost of Sales	$ xxx	
Cr.	Finished Stock Ledger		$ xxx

To charge Cost of Sales with the Cost of Billings for the month of_____

At the close of the year all the cost ledger accounts are closed out to Account No. 20, the balance in which will represent the In-Process Inventory at the end of the year at standard cost. It is also the opening balance for the ensuing year.

An investigation of the causes of the variation is made and the accountant is ready to present his General Operating Report *to* and review it *with* the general manager. Based on this review, if the *variation* is a loss, executive action is taken to prevent its recurrence. If it is a gain, the standards may need revision downward.

The benefits to be derived from a few, simple, colored charts to cross-section certain of the cost control exhibits of the General Operating Report should be considered. These should show the trends and later bring out the effectiveness of the action taken to correct unfavorable tendencies.

With this kind of accounting, in the course of a short time, the management of a winery should have the costs and yields under sharp control and reap the fruits of a well-managed enterprise.

COST ACCOUNTING IN WOOLEN AND WORSTED MILLS

By

A. H. PUDER *

I. DESCRIPTION OF THE INDUSTRY

Classification of Products

Production of woolen and worsted mills is broadly divided into yarns, fabrics, carpets, and felts. Yarns are produced either for conversion into fabric, etc., or for sale for machine- and hand-knitting purposes. Fabrics are generally classified as men's wear, women's wear, blankets, and specialty fabrics, the last group including such items as upholstery and decorative fabrics, etc.

The manufacture of carpets and felts is a specialized industry and, although various processes are similar to those used in textile production, it is not intended that this chapter cover those divisions of the woolen industry.

Although some mills produce finished products manufactured from the yarn or fabrics, this practice is not prevalent in the industry, and the cost procedures outlined herein will, therefore, be limited to the manufacture of the basic products.

Many mills are integrated, that is, production from grease wool to finished fabric is performed within the one plant. However, a great number of the smaller mills limit themselves to one or more of the operational processes such as: scouring, carding, and combing; drawing and spinning; weaving; and dyeing and finishing. Mills lacking facilities for any of these operations will have that phase of the processing done at another plant which either specializes in or has extra capacity for such production.

Sources of Raw Materials

The raw wools used in the United States are principally received either from domestic producers or from Australia, South America, or South Africa. Boston is the center of the wool market of the United States although smaller markets exist, principally in Philadelphia, Chicago, and St. Louis.

Wools may be purchased either from the source or through the wool markets. In any case the wools are inspected by the buyer and a price is agreed upon which is in line with the market values but which is dependent upon the quality and shrinkage of the particular lot being purchased.

Many mills do not have the facilities for sorting, scouring, carding, and combing and therefore purchase top, which is the product obtained after the combing operation. The top may be purchased from the same markets as the raw wool is acquired.

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Organization of Plant

The manufacturing and service departments in a large, integrated mill producing both worsteds and woolens, together with the processing covered by each manufacturing department, are listed below. The functions of the service departments are self-explanatory.

Department	Process
Manufacturing Departments	
Yarn Manufacturing	
Wool Sorting, Trapping, and Dumping	Grading and disposition of raw wools, etc.
Scouring, Carding, and Combing	Cleaning of wool, removing of burrs and other matter, blending and arrangement into a continuous sliver of parallel fibers known as top.
Worsted Yarn Manufacture	
Drawing	Reduction of thickness of top sliver, producing roving.
Spinning	Production of single yarn.
Doubling and Twisting	Twisting of two or more yarns and giving added twist to single yarns.
Spooling and Winding	Change from spinning package to some other form of package.
Top and Yarn Dyeing	Dyeing of top, woolen stock, and finished yarn.
Woolen Yarn Manufacture	
Scouring and Carbonizing	Cleaning of wool and removal of burrs and other matter.
Carding and Spinning	Blending or mixing of wools and production of single yarn.
Fabric Manufacturing	
Roller Warping	Preparation of warp beams generally for plain fabrics.
Sectional Warping	Preparation of loom beams generally for fancy fabrics.
Sizing	Application of sizing material to warp yarns and preparation of loom beams.
Drawing-In	Drawing of warp yarns through heddles.
Rewinding	Change of yarn package for weaving purposes.
Weaving	Interlacing of warp and filling yarns.
Burling and Mending	Removal of knots and correction of defects in weaving.
Piece Dyeing	Dyeing of fabrics.
Finishing	Various operations in finishing the cloth.

Service Departments

Yarn Division
- Wool Storage and Handling
- Willowing and Pressing
- Top and Roving Storage
- Yarn Manufacturing Office
- Waste Collection, Sorting and Storage

Fabric Division
- Fabric Manufacturing Office
- Designing

General
- Employees' Welfare
- Steam Plant
- Electric Plant
- Chemical Plant
- Automobiles and Trucks
- Bag Sewing
- Laboratory
- General Plant Maintenance

In a non-integrated mill certain of the above manufacturing departments and related service departments would not exist.

Raw materials and work in process are conveyed from one department to another by chute, blower pipes, conveyor, and hand or electric truck. Where the succeeding department cannot immediately process the product of a department, the materials are held in storerooms. These storerooms, in addition to the manufacturing departments, are steam-conditioned in order to maintain the necessary moisture content in the product.

Storerooms for manufacturing and operating supplies are situated throughout the plant at locations close to the department or departments which they serve.

Production Order System

The production order procedure originates with an estimate by the sales department of the styles which it is known or anticipated will be sold during a given period. Based on the styles to be produced, the yarn requirements by type are determined. Spinning orders are then issued for the required yarns, and the yarn deliveries are charted. Weaving orders for the fabric production are issued, and a weekly schedule of production of raw goods by style is prepared. On the basis of the weaving and spinning orders, other production orders are issued to all manufacturing departments, and notification is given to the wool purchasing department as to raw material requirements.

Because of various factors, the production schedule may require revision, whereupon specific orders would be cancelled and new orders issued.

In an integrated mill, where weaving and finishing facilities are sufficient to absorb more yarn than is produced within the mill or if yarn production is partly sold, due consideration to such factors must be given in the scheduling previously outlined.

II. How to Design the Cost System

What Information Is Required

The cost system in this industry must furnish to the management the following information:

1. The estimated cost of a product to be manufactured and the price at which such product should be sold.
2. The cost of a product being manufactured and the relation of such cost to the selling price.
3. The cost of each operation entering into the product.
4. An inventory for balance sheet and profit-and-loss statement purposes.
5. Statement of profit and loss by class of product.
6. Statistical data for analyzing plant efficiency.

In order to obtain the above information, it is essential that book inventories be maintained both as to quantity and as to dollar value.

Consideration in Designing the System

The cost system should be designed to produce the required results as promptly as possible. To embody excessive detail in the general cost books may result in delay in preparation of statements. Accordingly, a differentiation must be made between the items which are to be embodied in the general books and the items which must be obtained analytically.

Profit-and-loss statements submitted to management shortly after the close of a period will provide information upon which to base further investigation.

The Standard Cost System Is Favored

In the standard cost system the normal cost is predetermined, and any variances from such cost are made evident through the function of the system. In using an "actual cost" system, the efficiency of operation cannot be determined without analytically following the procedures on which the standard cost system is based. Such a procedure would, of necessity, take place subsequent to the determination of the actual cost, and the interim delay may result in financial loss to the company.

Maximum control, which is a primary object of any cost system, is best obtained through the prompt disclosure of variances, and the standard cost system performs this function.

In addition to informing management as to the efficiency of the mill, department heads may also be advised of the variances from standard which are attributable to the operations under their control. This is often done, in the case of direct labor, on a weekly basis. Such information is an invaluable aid to proper control and can best be obtained through standard costs.

III. Description of the Cost System

Profit-and-Loss Statement

A suggested form of profit-and-loss statement is shown in Figure 1. The columnar headings on this form are omitted in that such headings would be de-

WOOLEN AND WORSTED MILLS, INC.
PROFIT - AND - LOSS STATEMENT

Period_____
Division_____

Gross Sales to Customers									
Less: Returns									
Allowances									
Discounts									
Total Deductions									
Net Sales to Customers									
Transfers									
Total Net Sales and Transfers									
Cost of Sales and Transfers									
At Standard Cost									
Adjustments to Standard Cost									
Variances:									
Direct Labor									
Overhead - Variable									
Overhead - Fixed									
Manufacturing Supplies									
Profit or Loss on Transfers									
Inventory Write-offs									
Inventory Adjustments									
Other									
Total Adjustments to Standard Cost									
Total Cost of Sales									
Gross Profit									
% of Gross Profit to Net Sales									
Expenses:									
Packing and Shipping									
Transportation									
Selling									
General and Administrative									
Total Expenses									
Profit									
% of Profit to Net Sales									

Fig. 1. Profit and Loss Statement.

pendent upon the extent of the breakdown desired by class of products. In some cases it is desirable to prepare separate statements for the yarn division and for the fabric division. Under these circumstances a consolidated report would be prepared in addition to the divisional statements. Interdivisional transfers should be eliminated so that the figures in the total column will correspond with the financial profit-and-loss statement prepared from the general books.

In the transfer of yarns from the yarn division to the fabric division such transfer may be made either on the basis of standard cost or at an established transfer price. In either event the yarn division would reflect a profit or loss for each product transferred due to variations from standard, write-offs, adjustment of physical inventory, and, if present, the difference between transfer price and standard cost. The elimination of this interdivisional profit or loss is provided for in Figure 1.

From the amounts reflected in the profit-and-loss statement, graphs may be prepared which readily show the trend of the operating results either in total or by class of product.

Variances Used

The following variances are those generally reflected in the records of most mills:

Variance	*In Reflecting Variance Between*
Direct Labor	Actual labor cost and total labor at standard rates.
Variable Overhead	Actual variable overhead and total variable overhead at standard rates.
Fixed Overhead	Actual fixed overhead and total fixed overhead at standard rates.
Manufacturing Supplies	Actual cost of manufacturing supplies and total manufacturing supplies consumed based on standard rates. The manufacturing supplies consist of dyes, oils, chemicals, sizes, etc., which are added in processing.

In determining actual labor costs, such items as night work and other bonuses, overtime premiums, and vacation and holiday pay should be excluded from direct labor and included in overhead. Indirect labor is also included in overhead.

Material price variance is not reflected above. In a mill producing several products and numerous styles of each product with the various styles manufactured from different raw materials, the allocation of the material price variance becomes a complicated matter. Also, under normal conditions, raw materials prices are subject to more fluctuations than other costs. Consequently, mills generally base their product costs on actual costs of raw material plus standard costs for labor, overhead, and manufacturing supplies.

The variance accounts listed above are maintained for each department. In general practice, one departmental overhead rate for both fixed and variable expenses is applied to production. At the end of the month, the total overhead absorbed is segregated between fixed and variable on the basis of the percentage relationship of such expenses to the total budgeted overhead.

Some mills apply only variable overhead departmentally and combine the fixed overhead of several departments so that the fixed overhead is applied when the

product reaches these overhead centers. Where this procedure is followed, separate rates are generally used for variable and fixed overhead.

The most troublesome factors in costing in a woolen or worsted mill are the yarn manufacturing yields and the fabric shrinkages. Yields and shrinkages over or under the standards used on the cost sheet will result in a final product cost, as shown on Finished Stock Inventory Cards, different from that determined on the cost sheet. Where yarn consumed in weaving is charged out on the basis of standard quantities per woven yard for each type fabric, variance in yields will be reflected in inventory adjustments at the time of taking physical inventories.

Although humidifying systems are prevalent throughout the manufacturing departments, the product will gain or lose in moisture content during the operational processes. Such change in moisture content affects reported production weights, and such variances will be reflected in inventory adjustments.

How Variances Are Allocated

Variances are generally allocated monthly to products on the basis of the relative amounts of labor, overhead, or manufacturing supplies consumed at standard rates, each variance account being treated individually. This distribution may be made on the cost ledgers, or may be done only for statement purposes.

Determination of Costs of Individual Products

Before a product is manufactured, cost sheets are prepared to determine both the cost thereof and whether the mill can profitably market the item. In determining fabric cost, two calculations are made, one for the yarn cost and one for the fabric. The yarn cost sheet is calculated from a predetermined top or blend cost. Such top or blend cost may be the current market value, the present inventory value of top or blend on hand, or the standard top cost if materials are priced at standard rates. Where materials are absorbed in production at standard rates. predetermined yarn costs are often used as a basis of calculating the fabric costs.

For completeness the forms submitted herewith follow the calculation of the cost of a fabric from raw wool. The yarn and fabric cost sheets are adaptable to both woolen and worsted products. The top cost sheet with slight revisions could be converted for the calculation of woolen blends for woolen production.

Yields, operational percentages, and standard rates on these forms do not necessarily reflect true conditions but are shown for illustrative purposes.

Comments covering the cost sheet forms follow:

Top Cost. The form used for calculating top cost is shown in Figure 2. The basic data for this determination is the total weight of the sorting lot, which in the illustration is 162,100 pounds, and the total cost of the lot, which is $108,607.00. The weights of the various grades of wool obtained on trapping are derived from sorting reports. The grades of wool other than the main sort are valued at market value, and the main sort bears the balance of the total cost.

The cost of the clean wool is then determined by adding freight and storage and standard costs for direct labor, overhead, and manufacturing supplies. These standard rates are applied to grease wool weights since the clean wool is not generally weighed before carding.

The total of the tops, noils, various wastes, and shrinkages are obtained from combing department reports. Noils and waste are valued at market values, or at market values

WOOLEN AND WORSTED MILLS, INC.
TOP COSTS

Grade, _____
Date, _____

SORTING

Type of Sort. *Trapped* Lot No. *1101*

SORT	%	WEIGHT	PRICE	TOTAL	TOTAL
70/80's	83 93	136 045	.672		91 427 75
66/70's	15 02	24 350	.66	16 071 00	
64's	1 05	1 705	65	1 108 25	
Strings					
Skirts					
Britch					
Burry					
Stained					
Tags					
Tar Wool					
					17 179 25
TOTAL	100 00	162 100	.67		108 607 00

SCOURING

Lot No. *10054*

GRADE SORT. LOT	WEIGHT	COST-LB.	TOTAL	TOTAL
Grease Wool				
70/80 Aust 1101	136 045	.672		91 427 75
TOTAL	136 045			91 427 75
Freight and Storage				948 39
Direct Labor - Sorting		.0045	612 20	
" " - Scouring		.0040	544 18	
Overhead - Sorting		.0060	815 27	
" - Scouring		.0068	897 90	
M'f'g Supplies - Scouring		.0025	340 11	
Total Conversion Cost				3 210 66
Clean Wool Cost	83 860			95 586 80
Shrinkage 38.80 %				

CARDING AND COMBING

Type. *French* Lot No. *20080*

	%	WEIGHT	PRICE	TOTAL	TOTAL
Top-(15 % Regain)	84 90	70 688	1.258		88 921 80
Noils	11 14	9 275	.60	5 565 00	
Comb Bits - Clean	73	608	1.10	668 80	
Comb Bits - Soiled					
Sweepings	26	216	.15	32 40	
Comb Waste	1 04	866	.10	86 60	
Card Waste	48	400	.48	192 00	
Strippings					
Burr Waste	1 45	1 207	.10	120 70	
					6 665 50
TOTAL	100 00	83 260			95 586 80

CALCULATION OF TOP COSTS

	COST-LB.	TOTAL	TOTAL
Material Cost of Top - 70,688 Lbs.	1.258		88 921 80
Labor - Carding	.021	1 484 45	
" - Combing	.062	4 382 66	
Overhead - Carding	.019	1 343 07	
" - Combing	.050	3 534 40	
M'f'g Supplies - Combing	.007	494 82	
Total Canversion Cost			11 239 40
TOTAL TOP COST	1.417		100 160 70

SUMMARY TOP COST

	COST-LB.	TOTAL
Material Cost -	1.213	85 710 64
Canversion Cost	.204	14 450 06
TOTAL 70,688 Lbs.	1.417	100 160 70

Remarks:

CALCULATED: *A.C.*
CHECKED: *E.C.*
APPROVED: *S.*

Fig. 2.

WOOLEN AND WORSTED MILLS, INC.
YARN COST ESTIMATE SHEET

Count 2/32

Date 9/30/46

Count	2/32
Type	M. W. Colored
Quality	66/70s Aust.
Color Group	4
Roving	4.2
Twist-single	15½ Z
Twist-ply	12½ S
Take-up	—
Spinning	M R
Delivery	Cones
Remarks:	
Calculated	A.C.
Checked	E.A.
Approved	S.

Operation	% Yield	Yield Weight	Labor Rate	Labor Amount	Overhead Rate	Overhead Amount	Mf'g Supplies Rate	Mf'g Supplies Amount	Material Cost Less Waste	Total Cost of Yield	Total Cost 100 Lbs.
Top or Blend	*	100	*	*	*	*	*	*	142 00	142 00	157 62
Dyeing	100 00	100	2 13	2 13	3 44	3 44	6 00	6 00	*	11 57	12 84
Recombing	— 00	—							*		
Drawing	96 00	96 00	7 80	7 49	4 51	4 33	*	*	*	11 82	13 12
Spinning	96 25	92 40	17 17	15 87	6 67	6 16	*	*	*	22 08	24 45
Doubling	99 50	91 93	5 05	4 64	2 55	2 34	*	*	*	6 98	7 74
Twisting	98 50	90 55	2 92	2 64	1 47	1 33	*	*	*	3 97	4 41
Winding	99 50	90 09	2 10	2 79	1 70	1 53	*	*	*	4 32	4 80
Cyeing									*		
Winding							*	*	*		
Waste Credit	*	*	*	*	*	*	*	*			
Total-Yarn No. 1											
Total- Lbs.											
Yarn No 2- Lbs.											
Total									*		
Doubling							*	*	*		
Twisting							*	*	*		
Winding							*	*	*		
Dyeing									*		
Winding							*	*	*		
Waste Credit	*	*	*	*	*	*	*	*	(3 06)	(3 06)	(6 73)
Cost 90.09 Lbs.			*	35 56	*	19 13	*	5 10	135 94	196 68	*
Cost 100 Lbs.			*	39 47	*	21 23	*	6 65	150 89	*	218 25
% To Total	*	*	*	18 08	*	9 73	*	3 05	69 14	*	100 00

WASTE CREDIT

	Worsted Single Lbs.	Worsted Single Value	Worsted Single Am't	Worsted Ply Lbs.	Worsted Ply Value	Worsted Ply Am't
Stubbing	4.0	.90	3.60			
Soiled Sliver	.5	.45	.23			
Ring	1.5	.83	1.25			
Thread	.5	.55	.28	1.0	.55	.55
Soiled	.5	.15	.07	.5	.15	.08
Total	7.0	*	5.43	1.5		.63

Woolen Type	Woolen Single Lbs.	Woolen Single Value	Woolen Single Am't	Woolen Ply Lbs.	Woolen Ply Value	Woolen Ply Am't
Preparing						
Roving						
Fly						
Stripping						
Thread						
Sweeping						
Total						

Manufacturing Cost		218 25
Packing & Shipping		
Total		
Selling	%	
Gen. & Admin.	%	
Terms	%	
Total		
Profit	%	
Selling Price-Calc.		
Selling Price		

Fig. 3. Yarn Cost Estimate Sheet.

less disposition costs if sold, and the material cost of the top yield consists of the total clean wool cost less the value of the noils and waste. Standard rates for direct labor, overhead, and manufacturing supplies of the carding and combing departments are then added to the material cost to determine the total cost per pound of top. Carding and combing rates are applied on the basis of pounds of top produced.

Yarn Cost. A form of cost sheet which may be used for the calculation of both single and ply yarns is presented as Figure 3. The construction information reflected on the left side of the form is supplied to the cost department by the designing department and is essential to the proper determination of the applicable standard rates.

On this form the cost of a 2-ply 32-count top dyed yarn made from 66/70's quality Australian top is calculated. This 2-ply yarn is constructed from 2-single 32-count yarns. However, the cost sheet is designed to provide for the doubling and twisting of different count yarns entering into the final yarn in any proportion. In such cases, the costs of the different count yarns are calculated on separate cost sheets, one of which is used to calculate the total cost of the final yarn.

If the yarn is to be sold, provision for expenses and profit determination is made in the lower right-hand corner of the cost sheet.

The reverse side of the yarn cost sheet is set forth in Figure 4. In the event of a change in top or blend cost, a quick calculation of the resulting new yarn cost and selling price may be made on this form.

Fabric Cost. A fabric cost estimate sheet is shown in Figure 5. The number of ends of warp yarn, the picks per inch of filling yarn, the count, weight, and description of both warp and filling yarns in addition to the construction information at the left hand side of the form are furnished by the designing department. In the case of a fabric not previously manufactured, the construction data relative to the harness, draw, reed, cuts per warp, loom speed, looms per weaver, and dressed yards are known factors, and the remaining information must be estimated based on past experience with similar style fabrics.

The unit base column reflects the quantities on which the standard rates are applied. These are identified as follows:

Rewinding	Gross pounds of filling yarn
Warping	Net pounds of warp yarn
Sizing	Dressed yards
Drawing In	Thousands of warp ends divided by cuts per warp
Weaving	Woven yards
Burling and Mending	Woven yards
Piece Dyeing	Woven yards
Finishing	Woven yards
Rolling and Measuring	Finished yards

No unit base or standard rates are shown for sizing, since 2-ply yarns are not generally sized, nor for dyeing, since the yarn used was previously top dyed.

The final weight of the warp yarn entering into the piece of fabric is calculated by multiplying the number of ends times the dressed length and dividing the product by the yards of yarn per pound. The final weight of the filling yarn is determined by multiplying the picks per inch times the inches per yard times the reed space times the woven length and dividing the product by the yards of yarn per pound times the inches per yard. In practical application, the inches per yard are eliminated from the dividend and the divisor in the latter formula.

WOOLEN AND WORSTED MILLS, INC. Count 2/32

Yarn Cost and Sales Prices Based On Current Raw Material Cost and Standard Conversion

Date	10/15/46	
Yarn No. 1		
Top or Blend Cost-New	146	00
Yield-Single Yarn - %		
Yield-Ply Yarn - %	90	09
Raw Material Cost-New	162	06
Waste Credit 606 + 9009	6	73
Material Cost-Yarn No. 1	155	33
Material Cost 100 lbs.	155	33
Yarn No. 2		
Top or Blend Cost-New		
Yield-Single Yarn - %		
Yield-Ply Yarn - %		
Raw Material Cost-New		
Waste Credit		
Material Cost-Yarn No. 2		
Material Cost- lbs.		
Conversion Cost-100 lbs.	67	36
Total M'f'g. Cost	222	69
Packing and Shipping		
Total		
Selling %		
Gen. and Admin. %		
Terms %		
Total		
Profit %		
Selling Price		

Remarks:

Fig. 4. Reverse Side of Yarn Cost Estimate Sheet.

WOOLEN AND WORSTED MILLS, INC.
FABRIC COST ESTIMATE SHEET

Sample Style *11492* Style *399*

Fabric *M W Suiting* Date *9/30/46*

Ends or Pick	Count	Description of Yarn	Top or Blend Cost Per Pound	Yarn Weight Per Piece: Final	Yarn Weight Per Piece: Yield	Yarn Weight Per Piece: Total	Yarn Cost: Per Pound	Yarn Cost: Per Piece
4,000	*2/32*	*Worsted Col. Single 13½ Z 66/70s Aust. Cones*	*1 42*	*42.41*	*.97*	*43.72*	*2 1825*	*95 42*
		2 Ply 12½ S						
57	*2/32*	*Same as Warp*	*1 42*	*35.47*	*.96*	*36.95*	*2 1825*	*80 64*

		Operation	Unit Base	Material: Rate	Material: Amount	Direct Labor: Rate	Direct Labor: Amount	Overhead: Rate	Overhead: Amount	M'f'g Supplies: Rate	M'f'g Supplies: Amount	Cost: Per Piece	Cost: Per Fin. Yd.
Harness	*16*												
Draw	*Fancy*												
Reed *15½ X 4*	*64.5*	Warp Yarn No 1	*43.72*	*69.14*	*65 97*	*18.08*	*17 25*	*9.73*	*9 28*	*3.05*	*2 92*	*95 42*	*1 14 96*
Cuts per Warp	*4*	No 2											
Loom Speed P.P.M.	*128*	No 3											
Loom Efficiency %	*70*	Filling Yarn No. 1	*36.95*	*69.14*	*55 75*	*18.08*	*14 58*	*9.73*	*7 85*	*3.05*	*2 46*	*80 64*	*97 16*
Looms per Weaver	*6*	No 2											
Width-Woven	*62*	No. 3											
Width-Finished	*57*	Total Yarn Cost	*80.67*	*	*121 72*	*	*31 83*	*	*17 13*	*	*5 38*	*176 06*	*2 12 12*
Yards-Dressed	*95*	Rewinding	*36.95*	*	*	*6.26*	*2 31*	*2.80*	*1 03*	*	*	*3 34*	*04 02*
Yards-Woven	*86.45*									*	*		
Yards-Finished	*83*	Warping *K S*	*42.41*	*	*	*4.42*	*1 87*	*2.50*	*1 06*	*	*	*2 93*	*03 53*
Take-Up %	*9.0*	Sizing		*	*								
Shrink %	*4.0*	Drawing In	*4/4*	*	*	*2.50*	*2 50*	*50%*	*1 25*	*	*	*3 75*	*04 52*
Pounds-Woven	*77.88*	Weaving	*86.45*	*	*	*11.27*	*9 74*	*6.11*	*5 28*	*	*	*15 02*	*18 10*
Pounds-Finished	*74.18*	Burling & Mending	*86.45*	*	*	*13.04*	*11 27*	*1.11*	*96*	*	*	*12 23*	*14 73*
Ounces-Woven	*14.4*	Piece Dyeing		*	*								
Ounces-Finished	*14.3*	Finishing	*86.45*	*	*	*7.08*	*6 12*	*6.20*	*5 36*	*205*	*1 77*	*13 25*	*15 96*
Dead Loss %	*4.8*	Rolling & Measuring	*83.*	*	*	*.38*	*32*	*.31*	*26*	*	*	*58*	*00 70*
Dyeing Group	*6*	Fabric Conversion Cost		*	*	*	*34 13*	*	*15 20*	*	*1 77*	*51 10*	*61 56*
Finishing Group	*12*	Total Cost-Per Piece		*	*121 72*	*	*65 96*	*	*32 33*	*	*7 15*	*227 16*	*
		Total Cost-For Fin. Yards	*83.*	*	*146 65*	*	*79 47*	*	*38 95*	*	*8 61*	*	*2 73 68*

REMARKS:

Total Cost-			*3 32*	Packing & Shipping		*01 75*
Profit	*15%*		*59*	Total		*2 75 43*
Selling Price-Calc.			*3 91*	General & Administrative	*4.5 %*	*17 58*
Selling Price			*3 91*	Selling	*9. %*	*35 16*
Calculated	Checked	Approved		Terms	*1. %*	*03 91*
A.C.	*E.A.*	*S.*		Total Cost		*3 32 08*

Fig. 5. Fabric Cost Estimate Sheet.

WOOLEN AND WORSTED MILLS, INC. Style 399

FABRIC COST AND SALES PRICE BASED ON CURRENT RAW MATERIAL COST AND STANDARD CONVERSION

Date				10/15/36			
COST PER POUND	Top or Blend	Warp	1	1.	46	00	
			2				
			3				
		Filling	1	1.	46	00	
			2				
			3				
	Yarn	Warp	1	2.	22	69	
			2				
			3				
		Filling	1	2.	22	69	
			2				
			3				
COST PER PIECE	Yarn	Warp	43.72 lbs.		97	36	
			lbs.				
			lbs.				
		Filling	36.95 lbs.		82	28	
			lbs.				
			lbs.				
	Total Yarn Cost			1.	79	64	
	Fabric Conv. Cost				51	10	
	Cost of 88 Fin. Yds.			2.	30	74	
M'f'g Cost - 100 Fin. Yards				2.	78	10	
Packing - Shipping					01	75	
Total				2.	79	75	
General - Admin.			4.5 %		17	88	
Selling			9. %		35	71	
Terms			1. %		03	97	
Total				3.	37	29	
Profit			15. %		59	52	
Calculated Selling Price				3.	96	81	
Selling Price				3.	97		

Fig. 6. Reverse Side of Fabric Cost Estimate Sheet.

These calculations for the cost sheet illustrated were as follows:

Warp Yarn:

$$\frac{4{,}000 \times 95}{8960} = 42.41 \text{ lbs.}$$

Filling Yarn:

$$\frac{57 \times 64.5 \times 86.45}{8960} = 35.47 \text{ lbs.}$$

In determining the yards of a single yarn per pound, the count of the yarn is multiplied by 560 if it is a worsted yarn or the run is multiplied by 1600 if it is a woolen yarn. In a calculation involving a ply yarn, the yardage is then divided by the number of ply.

In order to determine the costs per finished yard, the costs per piece are divided by the finished length. The cost sheet is designed to show the total costs of material, using top or blend as a raw material basis, direct labor, overhead, and manufacturing supplies. This form therefore provides information for a quick approximate calculation of the effect on costs of an over-all wage increase.

There is reflected on the reverse side of the fabric cost sheet, which is shown in Figure 6, provision for a recalculation of fabric costs in the event of a change in top or blend prices. This form is self-explanatory.

Revision of Standard Costs

The standards should be reviewed at least once a year to determine whether there is need for revision. Changes should also be made in the event of material increases in costs such as wage increases, etc.

Analyses for Supervisory Executives

The following analyses should be submitted to supervisory executives:

1. Weekly report on labor variances.
2. Monthly report of all variances both on a monthly and cumulative basis and reflecting thereon departmental production and percentage of operation.
3. Comparison of estimated and actual top and yarn yields, weight, length and shrinkage of fabrics, weaving efficiency, etc.
4. Production by departments per man-hour.

How the Standards Are Created

The standard rates are generally calculated on the following bases:

Direct Labor Rates. All labor rates are established on the basis of time-studies. These time-studies take into consideration the wages paid to employees who work on either a time or piecework basis, the production per employee or group of employees, waiting time, time lost in cleaning machines, machine stoppage, etc. The allowance for non-productive time varies in the different departments depending upon the nature of the processing.

Time-studies must be made for all the different types of production. Yarn breakage, which varies considerably with the type of yarn, is one of the principal factors which cause a variance in the productive capacity of the machines.

Overhead Rates. In determining the overhead, consideration must first be given to the anticipated production of each department and a budget established based on such

operation. The departmental production so determined is then considered as 100% operation. Because of either the mechanical set up of the mill or the fact that the mill does certain processing for others, such 100% operation may involve operating some departments at one shift and others at two or three shifts.

After the total annual overhead for each department has been established, individual rates for each type of production must be determined. This can be done on various methods, the most simple of which is to determine the direct labor required, based on the standard direct labor rates, to obtain the production established as 100% operation. After determining the percentage relationship of the total overhead to the total labor, this percentage is applied to the individual standard labor rates to obtain the standard overhead rate for each type of production. It is preferable where labor is not a prime factor in processing, such as in the dyeing departments, to set the standard overhead rates by dividing the total overhead by the anticipated production at 100% capacity.

In some departments different types of machines may be in use, such as in the spinning department where both mule and ring spinning machines are used and in the combing department where combing may be done both on French and on English combs. Because of the differences in cost of production, it is desirable to establish rates for the production on each type of machine. This may be done by determining the overhead on a machine basis, and, after determining the productive capacity of the machines by type of production, the standard overhead rate may be set.

Some mills determine weaving department overhead on a loom week basis and then establish standard overhead rates based on the yards of each fabric woven in a week.

The nature of the processing done in a mill should be thoroughly considered in determining the method of allocation of overhead.

Manufacturing Supplies Rates

The standard rates for manufacturing supplies are determined on the basis of a study as to the quantity of such supplies which would be required to be added to the product or which would be consumed in processing. Such quantities at the estimated cost anticipated would create the standard rates.

How the Data for the Cost Summary is Obtained

Computing the Sales Deductions

The sales deductions, as shown in Figure 1, consist of returns, allowances, and discounts. Returns and allowances are often analyzed in a woolen or worsted mill to determine the reasons which caused the return of merchandise or the granting of an allowance on defective merchandise. A summary report thereon is then submitted monthly to the proper executives. Through the means of this analysis, defects in processing may be determined and corrections made in order to avoid excessive returns and allowances.

Finding the Cost of Sales

In order to determine the cost of sales at standard, the sales invoices are analyzed monthly by style number both as to units and dollar amount. On sales of fabric, the yardage should be summarized in two ways, that is, by actual yardage shipped and by yardage billed, both of which appear on the sales invoices. It is a practice in the woolen and worsted industry to make an allowance of ⅛ yard for

every defect in a fabric. Such defects are disclosed on final examination of the fabrics. The examiner ties a string on the selvage of the fabric and, on billing, an allowance of 1/8 yard is made for each string which appears on the piece. A report covering yardages shipped and billed is of interest to management in that such yardage allowance is not reflected in the dollar allowances deducted from cost of sales.

In costing the fabric sales, the yards shipped are multiplied by the unit cost appearing on the Finished Stock Inventory Cards. Yarn sales are also costed on the basis of Finished Stock Inventory Cards. The costs of production of commission work for others are generally accumulated in Inventory in Process Accounts and, on billing of the commission charges, the costs thereof are credited out of the in-process account at standard rates.

The cost of sales returns are usually reinstated in the Finished Stock Inventory Accounts at the then current cost of production.

Calculating the Direct Labor Variance

In recording labor costs, the payroll department should furnish to the cost department a weekly and a monthly summary of payrolls segregated by departments and further analyzed as to direct, indirect, supervisory, clerical labor, etc. The monthly report is used for posting the charges to the departmental direct labor and overhead accounts. From the weekly reports of production, monthly production totals are accumulated and the total of direct labor absorbed at standard rates is credited against the actual direct labor cost. Overtime premiums, night work, and other bonuses, etc., are eliminated from the direct labor accounts by transferring such items to overhead. These transfers are prepared on the basis of reports received from the payroll department.

The balance remaining in the direct labor accounts represents the direct labor variance. This balance may either be closed to a variance account or be allowed to stand in the direct labor account.

Calculating the Overhead Variances

The actual overhead is accumulated in departmental overhead accounts. Overhead absorbed at standard, as calculated from the monthly production summaries, is credited to the overhead accounts and the resultant balance represents the overhead variance. Again, this balance may either be allowed to stand in this account or be closed to a variance account.

Calculating the Manufacturing Supplies Variances

Each departmental manufacturing material account is charged with the materials withdrawn from stores at cost. The standard cost of raw materials consumed in production, as reflected on the monthly production summaries, is applied against the charges and remaining balances then represent the variance. This balance may also be transferred to a variance account or allowed to remain in this account.

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