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STANDARD COSTS FOR MANUFACTURING

BY

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PREFACE

At the top of American industry there is no place for specialists. Formerly it was a popular notion that the successful man was he who found out all there was to be known about a single subject, ignoring other fields of learning in order to concentrate on one. He could be a great financier and yet be ignorant of engineering. He could be an expert designer and know nothing of costs. He could direct vast research projects and lack information on manufacturing methods. As long as he understood one phase thoroughly, let others understand the rest. The notion was false.

Actually the man who does a good job in heading any industrial enterprise must be an expert in many lines. He cannot hope to succeed if he limits his thinking to accounting, design, metallurgy, market research, or any other one branch of knowledge. And so it is with those in the lower ranks. They put a ceiling on their future as long as they picture themselves as nothing more than, say, salesmen, chemists, time-study men, designers, or cost accountants. To satisfy the requirements of industry, they must diversify their talents.

The need for versatility is especially apparent in working with standard costs. Those who install and administer standard-cost plans must consider so many problems of labor relations, maintenance policy, business volume, utilities consumption, quality control, and accounting that they begin to think along the same lines as the plant manager. This variety of requirements makes standard costs one of the more interesting branches of the science of management.

The author's purpose is to explain standard costs from the ground up. It is assumed that the reader has already studied historical cost accounting and hence needs no further instruction in this subject. It is also assumed that standard costs have already been sufficiently publicized to obviate the need for extensive discussion of their merits. In the following pages, the reader will find a description of how to set standards, how to install a standard-cost system, and how to operate those phases of the system relating to

STANDARD COSTS FOR MANUFACTURING

CHAPTER I

THE CONCEPT OF STANDARD COSTS

The traveler on a train between Philadelphia and New York sees through the windows a panorama of American industry that is equaled in many parts of the country. Past his eyes glides factory after factory, each one the birthplace of some component of his material world, ranging from after-dinner mints to the most complicated printing machinery. Behind the façades of these establishments thousands of men daily weld their accumulated energy, wealth, knowledge, and resourcefulness together into the manufacture of products that must be sold at a profit if those men's livelihood is to continue. Hanging invisible over every one of those plants is a Damoclean sword constantly threatening the continuance of the enterprise—the menace of competition.

For every business survives only if it can sell. First it must meet the immediate contest offered by other companies with a similar product. In doing this it contends not only with those firms which operate under similar conditions in our own country but also with foreign concerns armed with the low costs that accompany an inferior scale of living. As if this battle were not enough, there is always the impending danger that some new product will spring up to starve out all its predecessors by the vigor of its growth; and remotely overshadowing the whole picture is the long-term certainty that the waste, loss, and depletion of our natural resources will, if uncurbed, effectively silence many industries altogether.

The Executive's Problem

The manager of every plant is thus met with a mighty challenge. Not merely must he see that his factory turns out products which can compete on a quality basis—he must have this done in a way that permits continued sales at a continued profit. Too frequently he cannot control prices. Hence his only recourse is to control the cost, and the test of his ability is his success in doing so.

But so various are the demands upon present-day executives that cost control is no simple problem. Compare what the average plant manager must know today with the requirements of only a few years ago. A host of new factors present themselves for his attention. He must be acquainted with a range of materials—plastics, synthetics, alloys—that were never contemplated in the days when practically all commodities were manufactured from a few simple substances. He must know an even greater variety of processes: Powder metallurgy, induction heating, production welding, electropolishing, stretch forming, are examples of a few new ones that have appeared, while the older methods have been incredibly improved and expanded. The really well-versed manager of an ordinary metals job shop must now have at least a familiarity with sand casting, permanent mold casting, die casting, innumerable methods of machining with various types of cutting tools, hot and cold forging, stamping, grinding, electrolytic processes, chemical and mechanical cleaning and polishing methods, welding, brazing, heat-treating, painting, and modern assembly methods—to name a very few of the processes associated with the metal trades only. Working with wood, textiles, plastics, or glass requires additional knowledge, and new developments occur every day.

Furthermore, quality requirements have been tremendously refined. Production workers are now pushing into an Ultima Thule of small tolerances that was formerly known only to gauge- and toolmakers. In addition to all this, the executive must be familiar with a vast array of legal requirements and union procedures that ever more closely restrict his freedom. And some portion of his teeming mind must be devoted to controlling the cost of all the products that he makes, all the processes that he supervises—whatever they may be! He may delegate his work to subordinates; still he must at the very least be capable of speaking their language, assigning their tasks, appraising their results, and acting upon their recommendations.

Cost Control

Cost control—one of the items mentioned above—has itself broadened in outlook. For some reason, perhaps because of the fascination of F. W. Taylor's revelations, it long was interpreted as consisting only of the control of labor costs, this being achieved through the use of incentive plans applied most frequently to productive workers, less frequently to the "nonproductive." Materials control was effected by means of yield or scrap reports, which did not, however, provide any more than a statement of what had happened, good or bad. Of specific techniques for controlling the costs of power, maintenance, and other overhead items on existing equipment, little was heard. As for the wage-incentive plans themselves, sometimes they helped to reduce costs, and sometimes they increased labor-relations problems; many, but not all of them, were beneficial. Now it is being recognized that the cost of labor, particularly that covered by incentive plans, is but one of many items of expense. Progressive managements, therefore, desire to employ the best means possible to control all items. Thus another burden is added to the plant manager's many responsibilities.

Certainly these duties can be discharged effectively only if they are well organized. To be specific, costs can be controlled only on the basis of accurate, comprehensive, well-coordinated knowledge of their nature, amount, and reason for existing. If costs and the variables that influence them are presented in the form of miscellaneous, unrelated statistics on isolated factors, expressed in various terms of measurement and on a constantly shifting basis, they may reveal some truths, they may effect some benefits, but they will also produce much confusion or indifference among those who should use them. The mind works best when it can concentrate its energies on decision rather than on interpretation. Costs cannot be controlled unless they are easily understood.

Why Standard Costs?

We know that it is primarily through control of costs that profits are attained or increased. Otherwise the waste, ignorance, errors, and ineptness of poorly trained or inadequately supervised factory employees may dissipate the company's potential net earnings before the product ever reaches the market. This does not imply that all personnel are inefficient; but the fact remains that if they are, management should be informed of the condition in order to take steps to correct it. For even the company that is earning profits may find its position gradually deteriorating, and even the most successful company should be anxious to improve on its past good fortune by augmenting its profits through cost reduction.

To minister to this aim of bolstering economy by eliminating waste, standard costs have been developed. These predetermined costs are necessary in any economic system. For example, writers on industrial management as practiced in the U.S.S.R. state:

". . . the Central Committee of the Communist Party resolved, on Dec. 5, 1929, that 'monthly plant statements be based on actual cost of production. . . . The difference between planned and actual cost of production—provided quality requirements are absolutely satisfied—is a basic indicator of the success of plant work.' . . . To reduce actual cost of production to or below planned level is one of the manager's most important tasks; its achievement an important indication of success. . . . Both planned and actual costs of production of each product are calculated on standard forms. . . . In every Five-year Plan, cost reduction has been regarded as one of the most important tasks of plant managers."[1]

If "planned costs" are employed in a Socialist state, how much more necessary they are for success in a competitive society! Without them the battle against waste must be fought in the dark and without weapons.

What Standard Costs Are

Most readers of this book are already familiar with the general idea of standard costs; it has been the subject of numerous addresses and publications; *viz.*, cost performance should be evaluated, not by viewing actual costs alone, but by comparing them with a fixed measure—the standard cost—and discovering the reasons for deviation from that measure. Control comes in when steps are taken to eliminate this deviation.

Fundamentally, a standard cost is a bench mark. The amount of variation between the actual cost and this bench mark is an

[1] Bienstock, Schwarz, and Yugow, "Management in Russian Industry and Agriculture," Oxford University Press, New York, 1944.

index of waste—or, to put it another way, of potential savings. Standard costs foster an optimistic attitude. They state that better performance is attainable. They constantly emphasize what *should* be. They encourage a striving for perfection.

Any cost control based exclusively on the use of actual costs is inadequate because it stresses past performances. Instead of pointing the way to the best it merely attempts to hurdle the past, and it yields little useful information. A study of historical actual costs can never be fully revealing because it does not consider comparables. For example, if we compare actual costs—either of products or of operations—in two successive periods, we may find that the totals include many mutually interrelated factors. Some elements of expense rose; others decreased; but whether they should have been expected to rise or fall is difficult to say. To determine *why* they changed is even more difficult, and to determine by how much they *should* have changed is impossible unless we have a fixed value to which to relate them—which would then be some sort of standard. The most we can do with such a system is to say that costs rose or fell, to point out certain obvious reasons (too late to do any good), and to hope piously that things will look better in the future.

Standard costs, then, have the primary purpose of establishing a "sea level," so to speak, from which to measure cost altitudes; but they also have other advantages, which will be described later. They provide an excellent insight into the causes of waste. They reveal the relationships among the true costs of various products. They frequently aid in reducing the clerical work associated with cost finding. They provide an all-inclusive foundation for supervisors' incentive plans. They greatly facilitate estimating the cost of new products or the savings from methods changes. They are an educational device for acquainting operating men with management's requirements and thus nurturing cost consciousness. They are a quick signal of any dangerous trends in efficiency.

Outline of a System

Many variations in standard-cost procedures are possible. Almost any installation, however, provides standard product costs; *i.e.*, given products are always carried in inventory at the same predetermined value, regardless of the actual cost of producing them from time to time. This standard product cost changes only when the standards are revised. It is not necessary to keep running records of actual product costs. Also, most installations provide a means for comparing the actual costs of operations with the corresponding standard cost, as a measure of supervisory effectiveness. The high lights of the system described in this book are briefly summarized below.

1. *Operational Costs.*—Standard costs are predetermined for each item of expense on each operation. All the emphasis, for control purposes, is placed on studying the cost of *operations* rather than products, since product costs are merely combinations of various operational costs (or source data). Control is best effected at the source—hence the cumulating of costs in this manner.

2. *Attainable Standards.*—In this text, the standard cost is defined as being the cost at the level of optimum attainable efficiency.

3. *Pricing.*—Materials are charged to operations at predetermined standard prices, in order to segregate the effects of variations in volume and price.

4. *Method of Recording.*—Standard costs can be compiled for control purposes only, while being withheld from the accounts, which continue to be carried on a basis of actuals. Alternatively, they can be incorporated into the accounts, in which case they are the basis of inventory valuations, as described in Items 5 and 6.

5. *Work in Process.*—The Work in Process inventory is valued at standard cost. It is accumulated on the books by charging it with the standard cost of the standard hours earned on good production on each operation.

6. *Finished Goods.*—Finished Goods inventory is charged, as Work in Process is credited, with the standard product cost of the products completed, which is based on the standard cost of the operations required for them.

Observe that Work in Process is based on operational costs, whereas Finished Goods is derived from product costs. Since both costs are figured from the same standards, they will always agree; the difference in treatment is employed for convenience in bookkeeping and analysis.

7. *Variances.*—Variances between actual and standard cost are recorded for each element of expense on each operation. A reason is assigned to every exceptional variance. If the number of opera-

tions is large, it may be necessary to combine certain variances for brevity and to high-light only the most important ones.

This is the gist of the system under consideration. It can be varied to suit individual tastes or requirements. Other features not mentioned above, the treatment of which appears to be a matter of some controversy, are discussed in later chapters. Some of these relate to normal operating capacity, the disposition of variances in the accounts, and the extent to which certain costs are considered as being nonvariable.

Conclusion

To say that these points can be handled in more than one way suggests that the make-up of a standard-cost system is influenced by the opinions of the people who operate it or by the nature of the operations to which it is applied. This is true, for standard-costs procedure is not an exact science. It is merely a forceful way of presenting information in order to stimulate corrective action. Extravagant claims may sometimes be made for it. We may be told that standard costs can successfully be applied to every industry, that the standard costs themselves are always based on "sound engineering studies" or "searching analysis," that the system effects great savings in bookkeeping costs. These statements may or may not be true. It is conceivable that there are plants in which standard costs would be more trouble than they are worth. It is extremely doubtful if standards for certain items of expense can ever be anything more than a shrewd estimate. Although the system can undoubtedly effect savings in bookkeeping costs in some installations, this depends largely upon the type of system that it supersedes, and we must remember that to operate a standard-cost system itself requires substantial expenditures. Therefore, the extent to which it succeeds depends greatly upon the conditions that attend its installation and upon the men who administer it.

Some of the factors that may cause its failure have been well summarized by a survey of 294 companies conducted by the National Industrial Conference Board in a study of the allied field of budgeting.[1] In answers to the survey these companies mentioned the following mistakes or misunderstandings that may harm

[1] "Budgetary Control in Manufacturing Industry," National Industrial Conference Board, Inc., New York, 1931.

a budget program (and are equally dangerous to a standard-cost installation):

"1. Expected too much.
2. Installed too rapidly.
3. Inadequate supervision and administration.
4. Bad organization.
5. Inadequate accounting system.
6. Inadequate cost system.
7. Inadequate statistics of past operations.
8. Expected results too soon.
9. Failure to obtain cooperation.
10. Failure of president to give active support.
11. Failure to analyze results and ascertain causes of variances.
12. Too many forms—too much detail.
13. Routine procedure not sufficiently definite."

Nevertheless, experience has left no room for doubt that standard costs are an excellent, all-inclusive managerial device for increasing profits. For this reason every executive, accountant, and engineer should be familiar with their principles.

QUESTIONS

1. Of what value would cost control be in a noncompetitive business that can set its own prices?

2. Are wage-incentive plans the only means of controlling labor costs? Why are they popular? Can they be applied to all workers in a plant? Are they usually so applied? Name another means of controlling labor costs.

3. What proportion of the average cost of manufactured goods consists of labor costs? (Consult reference works.)

4. The general manager of a certain plant has the following monthly reports prepared in order to help him control costs:

Per cent performance on incentive plans.
Indirect labor hours per direct labor hour.
Overtime hours per straight-time hour.
Machine delay hours per month.
Volume of work in process at end of month.
Report of materials spoiled.
Summary of current actual product costs.
Over- or underabsorbed burden.

Each report displays figures for the month just closed, the average for the year to date, and the average for the preceding year.

Discuss the merits of this method. Does it evaluate the relative importance of various items? Does it provide sufficient information for corrective action to be taken? Does it segregate variables in such a way as to reveal compensating losses and gains? Are the data that it presents readily understandable? Does it relate variables to a base in such a way as to eliminate the effect of production volume on changes? Does it adhere to the principle of exceptions by emphasizing unusual occurrences?

5. Does any system of presenting cost data or statistics constitute a control? Of what value is a set of actual costs to the supervisor trying to prevent expenses from increasing above their present level? Of what value is it to him in trying to reduce expenses below their present level?

6. What is the objection to the use of actual costs alone as a tool for cost control?

7. What is the general principle behind the use of standard costs for control?

8. Name seven uses to which standard costs may be put.

9. In this book we discuss only standard costs for manufacturing. From what has been said about standard costs, do you think that they could be applied to agriculture? To utilities companies? To warehouses? To institutions like colleges? To salesmen? To transportation? To a firm of professional engineers? Name three types of industry to which you do not think standard costs could be effectively applied, and state why you think so.

10. If you were installing a system of standard costs, what precautions would you take to ensure its success?

CHAPTER II

SETTING UP THE ACCOUNTS

The preceding chapter touched briefly on one of the primary uses of standard costs: the development and analysis of variances. The discussion of the technique of development and analysis will be amplified in subsequent chapters. First, however, it is essential to understand the requisites of the system that provides the actual costs from which these variances are derived; for unless the actual costs are accumulated correctly and consistently, any expression of deviation between standard and actual is inaccurate. Furthermore, the development of the standards themselves is greatly facilitated by the preexistence of a system of actual costs from which information used in setting certain standards can be derived.

The National Industrial Conference Board publication previously quoted states:

"It is axiomatic today that no business can endure under existing competitive conditions unless it is underpinned with reliable accounts and costs. . . . The account system should be so designed as to classify, record, and report financial operations and results along the lines of the organization. The budget [or standard-cost system] should be constructed on the same plan. The three should coordinate.

"The need for accounting revision in some companies prior to budget [or standards] installation is well illustrated by the following statement from a company manufacturing paper goods: 'It was found at the start of the budget installation that the company had many classes of expenditure for which nobody in particular accepted any responsibility. In fact, many executives did not realize how much their organizations were spending or with what they were being charged. It therefore became necessary to revise the accounting methods so as to establish more definite responsibility for every dollar the company spent and to educate the executives to a better understanding of the accounts for which they were to be held responsible.'"

In our discussion of actuals we shall describe only broad, general requirements that can, as a rule, be incorporated in any existing system, and we shall not tax the reader with the burden of following complicated flow charts that are so specialized as to be applicable only to individual instances.

Cost Centers

How are costs to be controlled? By fixing the responsibility for those costs and for their variance from standard upon the supervisor who regulates their amount. This can be done only when it is known exactly how much money is being spent by that supervisor and upon what he spends it. Each supervisor should be considered as being in a little business of his own, buying goods and services from other supervisors, and in turn selling them. He is, in effect, operating a small subfactory within the company.

Again quoting the National Industrial Conference Board,

"An effective system of budgetary control presupposes a properly aligned organization. . . . The budget officer of a prominent company, who has been a pioneer in industrial budgeting, declares that 'usually the success which the budget attains in any business is in proportion to how well that business is organized.' It is largely a waste of time to launch a budget on an organization until all lines of authority and responsibility are identical. Until then the shifting of responsibility will prevent its proper functioning. Responsibilities should be so clearly defined throughout the organization that no officer or department head can evade responsibility for the results recorded by the accounting system and announced in the budget reports. In short, a company should have a correct organization. . . . Some companies have ignored the factors of organization and responsibility and have forged ahead with budgeting, only to meet with unsatisfactory results and be compelled to start over.

"There is value in diagramming an organization on paper. Some executives may disdain to do so, believing that their knowledge of it is complete and that the lines of authority and responsibility are correct. Yet many an executive has admitted his error when confronted by a chart of his existing organization and by another chart of it properly revamped and realigned."

It is necessary, then, to define for each supervisor the limits of his subfactory, or "cost center," as we shall call it, so that his costs of operation can be isolated and collected. Several concepts should be remembered in recognizing and defining cost centers.

1. Size of area covered has nothing to do with the establishment of cost centers. A battery of open-hearth furnaces, covering acres of ground and employing hundreds of men, might, if coming under one supervisor, constitute a cost center. On the other hand, a small ingot-mold car-repair shop located adjacent to the open hearths, occupying only a few hundred square feet and employing only four men, yet supervised by another foreman, would constitute a separate cost center.

2. A cost center is not identical with a department. Frequently a department of a plant will include several cost centers. For example, a manufacturer of plumbing hardware includes in his plant a plating department. Reporting to the supervisor of this department are two foremen, one responsible for the actual plating operation and the other for the buffing and polishing operations. The foreman in charge of buffing has no authority over plating, nor does the tank foreman supervise buffing. In this case the department consists of two cost centers. Each foreman is responsible for his own cost center, and the department head is responsible for both cost centers.

3. Cost centers should not overlap; *i.e.*, there should be, insofar as possible, no operations jointly supervised by the heads of two centers. In the foregoing example, such a situation would exist if both the tank foreman and the buffing foreman jointly supervised a group of girls inspecting finished castings. This circumstance would make it difficult to allocate the cost of and responsibility for inspection to either foreman and would in this way violate a cardinal rule of good management.

4. Cost centers may or may not include similar operations. The boundaries of cost centers depend upon the conditions within the individual plant. In one tire factory the molding and trimming of all tires may be supervised by only one foreman. Here two different operations comprise one cost center. In another company molding may be supervised by one foreman, trimming by a second. Here each cost center includes only one operation. In still another plant a battery of presses might be supervised by one foreman and (because it is a large plant) another battery of identical

presses by a second foreman; so that in this case, with each cost center covering the presses supervised by each foreman, two separate cost centers would cover identical operations.

5. Cost centers are distinguished not according to the supervising individual but according to the supervisory occupation. Thus a single cost center—Buffers—may be the responsibility of a different buffing foreman on each of three turns in the day.

These concepts can be assembled into a definition: A cost center is a unit of endeavor under the lowest level of supervision, buying materials and services from other centers, incurring expenses within itself, and in turn perhaps selling materials and services to other centers.

Convenience in tabulating suggests that cost centers be identified by number. Thus, in a hypothetical plant

Cost Center No.	Description
101	Receiving and Stocking
102	Punch Presses
103	Screw Machines
104	Assembly
105	Painting
106	Packing and Shipping
107	Maintenance
108	General Office

Operations

Within each productive cost center occur one or more operations. Broadly speaking, an operation is a plant activity at the first degree of subdivision, which has a known unit of output and the costs of which differ from those of other activities. Some typical operations are those representing the activities connected with

No. 21 Bliss punch presses.
Blooming Mill.
Burring and filing.
Erecting floor.
Glass-cutting booths.
Nailing machines.

In these examples, each operation represents a particular cost grouping where the output can be measured, which if subdivided further would provide no additional useful accuracy in the allocation of costs to that output. Thus, the output of the No. 21 Bliss punch presses can readily be measured, and a further subdivision into suboperations such as blanking, notching, drawing, etc., would not provide any additional accuracy, since the hourly cost of these operations is relatively constant. It may seem strange to classify as large a production unit as a blooming mill as an operation, for it includes a number of different occupations and processes: rollers, manipulators, shearmen, and pilers, to name a few; and it may cover several thousand square feet of floor space. Nevertheless, this group of men and large amount of space and equipment are devoted to one purpose: the nonstop production of a bloom from a hot ingot of steel. No production can be counted until the metal has completed the entire process. The costs of the components of the unit, if they vary with production volume, vary in approximately the same proportions. Therefore, one entire blooming mill may be accounted as an individual operation, occurring in a cost center embracing perhaps several blooming mills, soaking pits, and stocking yards, all under one foreman.

An operation number is assigned to each productive activity characterized by costs peculiar to itself, so that those costs can be collected together to reveal the cost of the operation. In a large machine shop the difference in labor rates, the power requirements, the type of tool used, and the lubricants and maintenance necessary for various machines might warrant establishing operations, as follows:

Operation No.	Description
01	Milling machines
02	Engine lathes
03	Turret lathes
04	Shapers
05	Grinders
06	Boring mills
07	Planers
08	Bench
09	Erecting
10	General

Ordinarily, it is not advisable to subdivide operations more finely than costs can be collected. An excess of paper work and little additional information would result if the operation "Engine Lathes," for example, were reduced to suboperations such as turning, chasing threads, boring, etc.

Insofar as possible, all labor and expenses are charged to the operation on which they are used. Those which cannot be allocated to specific operations—overhead lighting, for example—are charged to "General" and distributed on an arbitrary basis.

Accounts

Cost Centers are established so that we may determine just how many dollars of the company's money are being spent by each supervisor. This knowledge of his expenditures, coupled with the standard cost statement of how much should have been spent for the same production, ultimately suggests means of improving his performance, and hence the net profit of the company.

But a bald statement of the total expenditures for each cost center would be unrevealing. In a given cost center it may be that economies on material costs are balanced by excesses on labor costs. Obviously such a situation can be recognized only when the total cost for each center has been broken down into its major components. These components are the expense accounts. Their nature depends upon the conditions peculiar to the plant; but certain ones are common to nearly all enterprises. Direct Labor, Indirect Labor, Maintenance Labor, Maintenance Materials, Operating Supplies, Supervisory and Clerical Expense, Power and Fuels—these are found everywhere.

Accounts should be set up in such a way as to provide a full picture of costs. To fit all costs into three classifications—Labor, Material, and Overhead—is the best way in the world to make life easy for the accountant, while concealing from management the information it really needs. Good practice demands the presentation of costs in as many separate categories as are justified by the diversity of the costs.

A number is assigned to each account; and if the Cost-center numbers are in the 100 series, then it is well to avoid confusion by listing the accounts in the 1000 series. The monthly statement of actual costs for one cost center might then look something like the following:

Statement of Expense

August, 19__

Cost Center No. 103 Screw Machines

Account		Amount
No.	Description	
1000	Direct Labor	$1,563
1002	Indirect Labor	689
1003	Supervisory and Clerical	450
1006	Indirect Materials	561
1007	Maintenance Labor	165
1008	Maintenance Material	76
1009	Power and Fuel	83
	Total...............	$3,587

This statement as it stands is of no value whatsoever to any plant manager. It does not show how much expense was incurred on each operation in the cost center. Worse, it does not evaluate the month's productive output, nor does it state how much should have been spent for that output. The figures exhibited therefore have no significance except in their relation to each other.

Nevertheless, the statement does illustrate the useful device of numbered accounts. The same account numbers are used in all cost centers in which they occur. Nearly every center will have, for example, Account No. 1002—Indirect Labor. But a cost center in the Receiving Department might have no Direct Labor. The choice and degree of subdivision of the accounts depends, as has been stated, on individual circumstances. In a steelworks, the larger number of bearings makes it helpful to have a separate account for Lubricants, although in a smaller plant this item might safely be submerged in Maintenance Materials.

One principle, however, is essential: No account should combine expenses incurred within the cost center with those charged to it by other centers. For if a single account within a cost center contains both the expenses directly attributable to that center's supervisor as well as those charged to it by other supervisors, no quantitative conclusion as to the supervisor's responsibility for the costs can be made. Such ambiguities can easily occur in the case of maintenance. One factory having a screw-machine department employs within that department, which is also a cost center, a mechanic and a helper who do nothing but service the machines. The time of these men is therefore incurred within the screw-machine cost center. In addition, occasional repairs to the electrical system are made by an electrician, the floor is periodically repaired by a carpenter, the washstands are inspected by a plumber, etc.,—all from the maintenance cost center. The cost of the latter men is *incurred within* the maintenance cost center, *charged to* the screw-machine cost center. And since the screw-machine supervisor can directly control the effectiveness of his own mechanic's work but has only a secondary influence on the efficiency of the maintenance cost center men, the two costs should be shown in two separate accounts: Maintenance Labor, Own, and Maintenance Labor, Others. There should be no overlap if the responsibility for costs is to be revealed.

Expense Items

Under the heading of each expense account are found numerous items of expense—a further subdivision of costs. These items of expense, also coded by number, show just what composes the total cost represented by each account. In subsequent variance analysis, account totals that are in line with expectations are not usually investigated too closely. But when the total for a specific account in a given cost center appears high, it is well to investigate the items of expense of which it is constructed in order to learn the reasons for the excess. Such a probe can be made only when the expense items, frequently called "standing expense orders," are so well defined as to forestall any possible ambiguity in their interpretation and when they are sufficiently discrete to avoid the combination of expenses that are actually unrelated.

For example, consider the use of lubricants in the large-scale manufacture of certain machined products. The finishing department, where bar stock is cut to length and threaded, receives the following commodities from the oil house:

1. Oil for lubricating machine bearings.
2. Emulsifying oil, a tool coolant for the cutoff machines.
3. Lard oil, a lubricant sprayed on the die chasers to facilitate the cutting of threads.
4. Zinc grease, which is used to protect the finished threads from corrosion.

5. Coating oil, which is sprayed on the entire outer surface of the finished product to minimize the possibility of rusting.

6. Grease for lubricating machine bearings.

The cost of these oils and greases amounts to several thousands of dollars per month. Three possible ways of handling this cost are available.

1. They may be included as an expense item Oils and Greases in the account Operating Supplies. The amount of money involved, however, suggests the advisability of focusing attention on it by establishing a separate account, Oils and Greases.

2. A separate account, Oils and Greases, may be established, subdivided into one or two major expense items; *e.g.*, expense item Oils and expense item Greases. But here again no exact knowledge will be available to the supervisor who wants to know why his oil cost was high. The expense item Oils will be a hodgepodge of various liquids which are used for widely varying purposes. The effect of any one of them will be lost in the total.

3. Therefore, the account Oils and Greases is resolved into a group of expense items—one for each of the six types of oil and grease listed above. The supervisor, endeavoring to account for a wide variance between the actual and standard cost of lubricants in a given month, can scrutinize the amounts in each item of expense for that month and, upon finding that most of the disparity occurs in, say, the expense item Coating Oil, may check to see if the coating system has developed a line leakage, if too much oil is being applied to the product, or if oil is being sprayed into the atmosphere rather than on the product itself.

There is only one test to be applied when in doubt as to how many expense items to establish: What is the significance of this item in the total account cost? If the item is known to be negligible in amount, no purpose is served by setting it up as an entity. It may safely be included with another expense. If, on the other hand, it is relatively large, then it should be given the opportunity to appear separately as an individual expense item. In the example just cited further examination of actual figures would show that the small cost of both oil for machine bearings and grease for machine bearings as compared with the cost of other lubricants, together with the similarity of purpose of the two commodities, justifies their merger as one expense item, Bearing Lubricants.

A second consideration in establishing expense-items codes is the degree of accuracy obtainable in the allocating of costs to them. Two illustrations will be given.

1. A good measure of a foreman's ability to utilize his workmen to the best advantage is provided by an expense item called Producers' Indirect Labor. To this item are coded the wages paid (to men normally listed as direct labor) for idle time, setups, delays due to breakdowns, and reruns of defective material. Such payments represent money drifting out of the cash box for which no value is received. The supervisor of a cost center should be told how much of his labor cost is being wasted in this way, so that he can strive to reduce the amount. However, the significance of figures in this item depends entirely upon the degree of accuracy with which time is recorded in the shop. In a shop where employees operate under an incentive plan providing separate payment for delays, setups, etc., the men have a very real incentive to record every interruption that occurs. If they do not record it, they receive no payment for it. Here there is little likelihood that the cost of this nonproductive time will be understated. In fact, constant vigilance is required to prevent it from being recorded when it does not occur, for unscrupulous employees may be tempted to overstate their delay time in order to inflate their wages. In any case, it is possible to determine exactly how much is being *paid* for producers' nonproductive labor, and the cost may well be shown as a separate expense item (if not as a separate account).

If, however, the men are on a straight piecework incentive plan with no separate delay payment, they have no stimulus to report delay time accurately to the timekeeper. Experience has shown that under these circumstances there is a tendency for delays to be overlooked or forgotten (unless an automatic time recorder is installed on the machine). As a result, any statement of producers' indirect labor cost is always open to challenge, and its value as a separate expense item is questionable.

2. Not only may time be carelessly recorded; it may be inaccurately coded because the expense items are so vaguely defined that genuine doubt exists in the minds of the timekeepers as to the correct coding. The comptroller of a plastics factory instituted two expense items in the Maintenance account. They were defined as follows:

Expense Item 000, repairs to molding presses. Includes all major jobs necessary to restore presses to operation after breakdowns.

Expense Item 001, maintenance on molding presses. Includes all jobs normally necessary to keep presses in operation.

The comptroller's intention was to isolate particular types of maintenance and repair work, but unfortunately the distinction between maintenance and repairs, as defined, was so indeterminate as to be incomprehensible to the men in the plant. At times a press would be taken out of operation for the replacement of a part before any breakdown actually occurred. Was this maintenance or repairs? At other times a press would have a breakdown because of the failure of a valve in the water lines, which would be defined as a repair; but while it was down, the pipe fitter would also take the opportunity to perform incidental jobs usually called maintenance work. How was he to split his time? Because neither the maintenance and repair crew nor the timekeeper could clearly picture the difference between the types of charges, the distinction on the books between the two expense items was meaningless. They should have been shown as one.

Situations of this sort have serious consequences beyond their effect on the particular charges concerned. When the supervisory personnel become aware of glaring inaccuracies in particular cost reports, they inevitably come to suspect the validity of all costs exhibited to them. If presented with figures that indicate inadequacies in their own performance, they will take refuge in the belief, perhaps unexpressed, that it is the cost accountant rather than themselves who is at fault. In this way the incentive to improved performance, the ultimate goal of the system being described, will be lost. It is therefore imperative that all expense-item codes be so well understood and so clearly defined that no question of the accuracy of the costs that they represent can arise.

The third point to remember in codifying expense items is that they should not be unduly numerous. Certain items will occur only in one cost center; *e.g.*, the expense item covering the cost of buffing wheels might be used only in the electroplating finishing cost center. Others, such as the cost of supervisors' clerks, may occur in every cost center. A judicious review of the list of expense-item codes before installation may suggest possibilities for combining without the sacrifice of clarity.

Operation of the System

The system of collecting actual costs that has just been described is susceptible of many modifications. It is not new, and it differs from many other successful systems only in that it emphasizes the collection of costs according to operations and cost centers rather than by product or by department. This emphasis is essential to the successful working of a standard-cost system.

Within the broad general boundaries that have been outlined, a setup of this type can be constructed for any individual plant. The work should be the responsibility of one person in the accounting department, who in a large company will require several assistants. This cost-planning division of the accounting department observes a schedule somewhat as follows:

1. The general aims of the program are explained to all supervisors in the company. The explanation emanates from the plant manager, and it is made in such a way as to make unmistakably clear the management's backing of the program. So much cooperation is needed from the operating departments that they should understand its necessity.

2. The cost-planning division obtains a complete list of all equipment in the plant and assigns equipment numbers to each item. A lucid description accompanies each number. A metal tag bearing the number is affixed to the equipment itself. These numbers serve as the basis for collecting the expenses associated with specific facilities.

3. A list is prepared of all occupations in each cost center. Each occupation is assigned a descriptive title; and where the title does not suffice to indicate the nature of the job, a brief outline of the duties follows. The list is issued to the time clerks, or checkers, with instructions that no employee's time is to be reported without the entry of the correct title for the job on which he worked and that if a man works on several different jobs, his time is to be reported in the proper amount against the occupation title of each, rather than the total time being lumped against one job. Where a mechanical tabulating system is in use, the occupations will, of course, be numbered.

The information furnished by this listing and reporting is not essential to an actual-cost system, but it will prove of great assistance later on, when standards for the consumption of labor are being set and compared with attained performances. At that time we shall want to know how many hours of labor have been used for each operation; and if we then find that belt lacers, sweepers, setup men, oilers, stock handlers, machine helpers, cranemen, paint retouchers, soldering-iron dressers, and what not are all combined in some such vague title as Indirect Labor or Service Laborers, it will be impossible to analyze precisely the charges that should go directly against particular operations as opposed to those which should be distributed to all operations. As an aid, therefore, to future determinations, this distinction between jobs should be made as soon as possible.

4. The occupations having been coded, the next step is the defining and numbering of operations.

5. Operations are now grouped into cost centers. Each operation has been listed and described. Similarly, the cost centers are itemized. The descriptions of cost centers and the operations comprehended therein are recorded on sheets somewhat as follows:

Cost Center No. 103, Screw Machines

Material enters this cost center when it has been deposited in the temporary storage racks by the trucker or craneman. It leaves the cost center when it has been picked up in trays, barrels, etc., by the trucker for delivery to the next cost center. This cost center embraces all expenses chargeable to the following operations:

01 No. 2 Brown and Sharpe wire-feed screw machines
02 $\frac{9}{16}$-in. Gridley automatic screw machines
03 Burring
04 General

6. Accounts and expense items are listed and defined (for example, see chart, page 23).

The consistency of future charges is improved by appending to the chart of accounts several paragraphs showing the distinction between direct and indirect labor and clarifying other doubtful points.

7. All sources of original entry are provided with spaces for recording the information outlined in the preceding five sections. No particular forms for this purpose are suggested here. Every

CHART OF ACCOUNTS

Account No.	Expense-item No.	Description
1000	....	Direct Labor
1001	....	Producers' Indirect Labor:
	001	Delays
	002	Size changes
	003	Reruns
1002	....	Indirect Labor, Others
1003	....	Supervisory and Clerical Salaries:
	004	Supervisors
	005	Clerks
1005	....	Direct Materials
1006	....	Indirect Materials:
	006	Tools for machines
	007	Hand tools
	008	Safety supplies
	009	Indirect materials for product
	010	Stationery
1007	....	Maintenance Labor:
	011	Oiling
	012	Repairs to machines and benches
	013	Repairs to service lines
	014	Sweeping and cleaning
	015	Repairs to buildings
1008	....	Maintenance Materials:
	016	Lubricants
	017	Parts for machines and benches
	018	Parts for service lines
	019	Cleaning supplies
	020	Materials for buildings
1009	....	Power and Fuel:
	021	Electric lights
	022	220 d.c. machine power
	023	Water
	024	Space heating
1010	....	General Factory Overhead

accountant knows what a job time card or material requisition looks like; the conditions within various factories differ so widely that forms must as a rule be tailor made; and nearly everyone has his own taste in design. It will merely be pointed out that a job time card should carry spaces for entering the incurring cost-center number, the account number, the charge cost-center number, the operation number, the occupation number, and the equipment number. Not all these spaces will be used in every case. Direct labor, for instance, is usually charged and incurred in the same cost center. Indirect labor may not utilize any facilities worthy of the assigning of an equipment number. On the other hand, an electrician's time might be incurred in the maintenance cost center, be charged to a producing cost center against the turret-lathe operation in that cost center, be listed under the account number indicating Maintenance, and be further identified as the expense item covering the replacement of motors on equipment (which is identified by the number on the job card). The fact that an electrician did the work is shown by the occupation number. In some plants short cuts may obviate the need for complete recording. Thus, unless the same expense item occurs in several accounts, the expense item will itself identify the account. Also, the occupation-number code may be set up in such a way that the occupation number will identify the incurring cost center; *e.g.*, the first three digits of all occupations in cost center 103, might be 103, as shown in the following table:

Cost center No.	Occupation No.	Occupation title
103	10321	Brown and Sharpe screw machine operator
103	10322	Gridley automatic screw machine operator
103	10323	Burring labor

In this case the separate recording of the cost-center number is unnecessary.

To continue, material requisitions should bear the cost-center number in which the material is used, the operation number on which it is consumed, and the expense-item and account numbers. Maintenance material should be charged against the specific equipment on which it is required. Purchase orders, repair orders, scrap tickets, and other papers also follow the same principles. On frequently used forms many of the necessary identifications can be preprinted by means of a duplicator.

8. The cost-planning division then puts the system into effect. After several months of operation, during which a careful scrutiny is made of sources of entry and of accumulated totals, certain changes may be found necessary for true discrimination among classes of expense. For just as a lathe operator, after chucking his

work piece, rotates the chuck several times to true up the job, so must the cost-planning division "true up" the system after it has been installed.

Collection of Costs

It has been stated several times that the system of actual costs here described is general; it is like the piece of bar stock that must be cut and shaped to the specifications of the individual product. Countless textbooks describe and every competent cost accountant knows the details of cost recording and allocation. Here we are interested in the final results and have paused only long enough to discuss some of the components of those results.

The system of actual costs, when installed, is useful if it provides the following final information:

1. The segregation of all costs into boundaries of individual supervision, called cost centers.
2. The analysis of costs within the cost center into major accounts.
3. The detailed listing of the amount of expense occurring in each subdivision—called an expense item—of the accounts within each cost center, as well as the operation and even the equipment against which that expense was incurred and/or charged.
4. The collection of expenses against individual operations within the cost center, so that operational costs may be studied.

Items 1 and 2 can be presented in the familiar expense sheet.

Expense Statement

April, 19__

Account		Cost center No.						
No.	Description	101	102	103	104	105	106	Total
1000	Direct Labor							
1002	Indirect Labor							
1003	Supervisory and Clerical							
1005	Direct Materials							
1006	Indirect Materials							
1007	Maintenance Labor							
1008	Maintenance Materials							
1009	Power and Fuel							
	Total...............							
P.s.h. earned								

Items 3 and 4 can be presented in an expense-analysis sheet for each cost center.

EXPENSE-ANALYSIS SHEET

April, 19__

Cost Center 104

Account No.	Expense item No.	Operation No.							
		01	02	03	04	05	06	07	Total
1000									
1001	001								
	003								
1002									
1003	004								
1005									
1006	006								
	007								
	009								
1007	012								
	013								
	014								
Total.									
P.s.h. earned									

A third statement exhibiting the total of each expense item for the plant may be prepared, but it is not essential. For control purposes we want costs that tie in to their source—the operation and the cost center—and over-all plant totals, therefore, have but little significance for this use. Later it will be seen how the exhibits shown are expanded to include standard-cost figures.

Equipped with descriptive operation costs; with detailed records of the use of various occupations; with data available in the original source records as to costs by equipment, if we find it necessary to dig deeper than operation costs; and with records of operational productive output (which have not been dwelt upon as they are usually available)—equipped with these tools we are now ready for the construction of a standard-cost system.[1]

[1] An excellent description of the accounting setup for standard costs in a particular company (R. G. LeTourneau) is presented in Establishing Control of Factory Overhead, by Robert W. Herr, *NACA Bulletin*, Aug. 15, 1943.

QUESTIONS

1. Define "variance."

2. Why must actual costs be grouped in the same way as standard costs?

3. Would it be advisable to install a system of standard costs without first reviewing the method of collecting actuals? State the reason for your answer.

4. Why should cost centers be defined according to supervisory responsibilities?

5. Are cost centers equivalent to departments? Could one cost center embrace several smaller cost centers? Under what conditions?

6. What limits the degree of subdivision of operations?

7. What is the advantage of using several accounts for indirect expenses instead of one overhead account?

8. Why is it advisable to subdivide accounts further into expense items? Need these subdivisions appear in the ledger?

9. What is the test for determining how finely to break expenses down into accounts and expense items?

10. What is the danger of having too many subdivisions of expense? In this connection, name two disadvantages of using numerical systems of classifying expenses.

11. Name the steps to be followed in setting up a practical system of collecting actual costs for use with a standard-cost system. Why is a written definition of the system's *modus operandi* essential?

12. What information should the actual costs provide to be used in conjunction with the standard costs?

CHAPTER III

DEVELOPING THE STANDARD-COST SYSTEM

An engineer must decide whether a given part is to be made as a stamping, sand-casting, die-casting, molded-plastic, or screw-machine product, in accordance with the use to be made of it. So must the standard-cost accountant choose among several possible means of setting up the standards on which his system is to be based. This choice results in the establishment of certain fundamental policies which dictate

1. The determination of standard dollar values for various costs.
2. The relating of these standard dollars to a denominator.
3. The degree of variability or controllability that standard dollars are expected to exhibit.

Each of these three points so affects the usefulness of the plan as to deserve discussion and decision at the very start of the program.

Determination of Standard Dollar Values

The very first question to arise is, "What does a standard represent?" A standard cost for any item may be

1. The average of past actual costs.
2. The best—*i.e.*, the lowest—cost that has occurred in the past.
3. The budget cost at either normal or expected operations.
4. The ideal cost at maximum efficiency.
5. The cost at attainable good performance.

The first possibility—averages of historical actuals—is not really a standard cost at all but a reference cost. Affected by the many individual wastes and savings of the past, it offers no fixed basis of comparison. Any variance from such a "standard" must be analyzed in the light of the changing conditions affecting both the past average and the present cost. Such an analysis is difficult and inconclusive. Moreover, every dynamic business enterprise should concentrate its energies on attaining some goal in the future, not in running away from a bugaboo cost of last year or the year before, and this future goal should be the standard. For this reason simple historical costs do not constitute a good standard.

The second possibility—lowest previously attained costs—has some advantages. Such costs can be readily determined, and the company will certainly gain by trying to repeat them. But "record" performances are not reliable criteria of what costs should be. It is quite possible that a best past cost contains within it many opportunities for further reductions that continue to exist only because they have not been brought to light by analysis. And on the other hand, "record" low costs, particularly of labor and when taken for short periods of time, may occur only because of freak circumstances. They may, in fact, have been the result or cause of high costs in immediately adjacent periods of time. Best past costs merit a suspicious scrutiny. They are too temperamental to be called standard as is.

Budget costs and standard costs are frequently confused. As a matter of fact, both may be used coordinately in the same enterprise. The difference lies in the use to which they are put. A budget is a statement of requirements, and for the manufacturing end of a business a system of budgetary control is nothing more than a device for indicating whether or not anticipated expense requirements for the actual volume of production are being met or exceeded. To be realistic, a statement of requirements should be based on good past practice; and, as has been pointed out, good past practice has no relation to good potential performance. A budget cost is, therefore, in no sense a standard.

The consideration of what does not constitute a standard has indicated, by elimination, some of the features that do constitute a standard. A standard ought to represent not what costs are or have been but what they should be. It is the gauge against which actual costs are held to see if they are oversize. It is the strait and narrow path that every supervisor should try to follow by throwing aside the needless burden of costs not allowed for at standard performance. But how tight should a standard be? The fourth possibility listed at the beginning of this section suggests using the ideal costs that would obtain at maximum possible efficiency. Mechanically this is not a bad method. It provides a means of comparing actual costs with a fixed base without saying that the base should necessarily be reached. Because there is little chance of anyone's ever "beating" standard, there should be no reason for a supervisor to relax his efforts—he will always have further reductions ahead of him. Also, variances will indicate the total cost of waste and inefficiency; for no allowance at all for such expenses is included in the standard. And it may be said that since the reduction of these expenses is the reason for installing the whole system, their entire amount should be known.

These are true statements, and the only argument against "ideal" standards is that they are difficult to sell. A supervisor who is requested to achieve perfect performance may very well retort that he is being asked the impossible. And if told that he is only to approach the standard rather than reach it, he will still not know exactly how much is required of him. A writer on the subject has pointed out that "in the related field of time study . . . it seems generally agreed that a standard rate should be attainable by a majority of the workers." [1] To extend his comparison, few plants set production rates without including allowances for fatigue, personal time, and unavoidable delays. Were these allowances to be omitted, the workers would feel that they were being cheated. In the same way cost standards should include allowances for certain minimum losses, so that the supervisors will know that they have been set a task possible of achievement.

Setting standards of this sort cannot be done by guesswork or by office clerks unfamiliar with shop practice. The standards, to be effective and reliable, must be founded on engineering and statistical studies, together with historical data from a good system of actuals. Detailed methods of making these analyses are explained in the following chapters. Only when standards are set thus can they be of the greatest value to management. The standard costs will then represent a sort of manufacturing heaven—distant, desirable, and yet attainable.

Relating Standard Dollars to a Denominator

In job-order systems each item of direct and indirect cost not only must be collected by operation but must be further broken down against individual orders. Such a subdivision requires extensive clerical work. It has already been pointed out that for

[1] McFarland, Walter B., The Basic Theory of Standard Costs, *The Accounting Review*, June 1, 1939.

standard-cost comparisons, full control can be achieved by limiting the breakdown of actuals to operational costs and, by implication, that the standards will be applied in the same way. One must therefore determine just how many standard dollars should be allowed against the actual dollars charged to any operation. A denominator, or "factor of variability," is necessary.

The denominator that serves as the basis for computing the standard cost at any level of activity should have several characteristics.

1. It must represent production. Since the company can sell only good products, standard dollars should be accumulated only on a denominator representing a good, salable product; *i.e.*, no operating cost center should earn standard dollars on defective material or on machine setups or delays. If such occurrences are unavoidable, a proper consideration will be made for them in the standard cost applied to *good* output.

2. It should be, insofar as possible, uniform. If we must apply a different standard to every product, the multiple entries of a job-order system will have been revived. For example, if we were to build up the total standard cost for a month on a product basis, we should have to ascertain, at the end of the month, the stage of completion of every item in the shop. It would then be necessary to multiply the number of pieces of each item by the standard cost of direct labor, indirect labor, and other expenses applicable to it at that particular point in its career. This is a tremendous task, which should be avoided if at all possible. Therefore, for ease of calculation, we want a denominator that cuts across all classes of product. This is no problem in a process industry—a window-glass factory, for instance, where the units of material produced are so limited that they themselves are a satisfactory denominator. But where there is a variety of products, some other unit must be found. Furthermore, a denominator that is the same for various cost centers having different operations facilitates the direct comparison of performance of one cost center as against another.

3. It should vary with costs. If there is a fixed standard cost per denominator, then a doubling of the denominator should actually represent a similar doubling of the cost. In the tubular-pipe industry it was at one time the practice to judge performance on the basis of cost per ton. This resulted in misleading figures, for costs did not actually vary wholly with tonnage. In the

finishing departments, for example, the cost of cutting and threading the ends of a piece of pipe 26 ft. long was exactly the same as for a piece of pipe 40 ft. long, although the tonnage represented in the latter case was much greater than in the former. If in a given month the production consisted principally of long-length material, the cost per ton was much smaller than in a month when the same number of short lengths was manufactured. Yet the length of pipe was determined by sales requirements, not by operating foremen. Accordingly, tons were not the proper denominator for expressing unit costs in order to reflect supervisory efficiency.

4. It should be comprehensible to everybody involved. Most companies encourage productivity by means of a wage-incentive plan. Except in process industries, where the product is limited in variety, it may be stated that without such a plan no standard-cost installation should be made. This is true not only because, as Harrison[1] points out, the savings from an incentive system itself are easier to achieve than those attainable by a standard-cost program without such a system but also because incentive plans furnish an essential, measured denominator.

Although some incentive systems are easier to work with than others, the mode of expressing the denominator is not of paramount importance. The simplest example is that of a straight piecework plan where production is expressed in terms of dollars per piece, per ton, per foot, etc. Here the direct-labor dollar is the denominator; standard costs can be expressed as "so much per direct-labor dollar." Other plans employ standard hours per piece. The Bedaux plan is built up in terms of "B's," each B representing 1 min. of productive effort, with allowance for fatigue and minor delays.

In order to avoid confusion, the productive standard hour (abbreviated as "p.s.h.") will be referred to throughout this book. Readers who are more familiar with standard dollars, standard minutes, B's, or other denominators can substitute these terms in their minds without affecting the validity of the discussion. Let us examine the p.s.h. in the light of the four requirements enumerated on this and the preceding page.

1. It should represent production. This means that we shall establish standard costs per *productive* standard hour. In some

[1] Harrison, G. Charter, "Standard Costs," p. 15, The Ronald Press Company, New York, 1930.

establishments standard hours are allowed for setups, for size changes, for defective material not the fault of the operator, and for certain delays. Since none of these represent production, they will not be used as a denominator. There will be no standard cost per setup standard hour, for example. The cost of setups will be included as an allowance in the standard cost of indirect labor per *productive* standard hour.

2. It should be uniform. This the standard hour is, for it is the common measure of output of all jobs and products, whether it applies to punch presses, blast furnaces, or bench assembly. And for a given operation on products varying by size or type, experience has shown that the standard-hour cost will, as a rule, be constant, regardless of product, for nearly all expenses except materials. Obviously, it is easier to apply a fixed standard cost to all standard hours on a given operation than to apply a separate standard cost to each of the many products undergoing that operation.

3. It should vary with costs. If incentive standards have been calculated correctly and consistently, then an operation requiring twice as much time on one product as on another and hence twice as much labor cost will also require twice as many standard hours. It is imperative that this situation actually exist. If a plant suffers from the disease of having incentive standards that are indiscriminately tight or loose for various products on the same operation, no satisfactory standard costs can be set on that operation, for the denominator will not have a uniform value. The standard cost per standard hour will be too high on products having loose rates and too low on those having tight rates. This difficulty is not infrequent. In some cases it occurs because piece rates were intentionally set loose in order to sell a new incentive plan, subsequent rates being set more in line with what they should be as efficiency improved. In other cases it is due to the ineptness of poorly trained time-study men, and it often occurs because rates were not revised in line with improvements in methods. Whatever the cause may be, if the production standards do not hold true for all classes and types of product, an effort should be made to revise them by pulling in the slack on loose rates and easing off on the tight ones to such an extent that average earnings are maintained for the men affected. This procedure is necessary only where inconsistency occurs within a particular operation. Loose rates on one operation (if consistently loose within themselves) as com-

pared with another operation can be compensated for in the standard-hour cost.

4. It should be comprehensible to everyone involved. Men who are paid on the basis of standard hours earned and those who supervise them need little explanation of what is meant by a cost per p.s.h. beyond the reminder that the emphasis is on the word "productive." It is necessary only to be sure that the accounting and executive staff who utilize the concentrated reports of standard-hour costs are sufficiently familiar with the wage-incentive system to understand just what is meant by the terminology. Therefore, that terminology should be explained in the educational work that accompanies a standard-cost installation.

Dual Use of Standards

Standards have a dual purpose: They are used to express what costs should be for particular operations and items of expense, so that those expenses can be better controlled; they are also used as a device for valuing inventories. These purposes are somewhat at odds. If the standards are set tight enough to present an attainable but hitherto unrealized picture of costs, they will probably be lower than any actuals that have been averaged in the past. For this reason any inventory valuation based on these standards will be lower than the values that have prevailed in earlier periods for identical products. Management then either must reconcile itself to skeletonized inventory prices or must find a way of adjusting those prices to reflect the actual amount of money invested in them. How this may be done is explained in Chap. XI.

For our present aims another feature of standards emanating from this duality of purpose deserves attention. It is the exclusion from "control" standards of certain items of expense that do appear in inventory standards. For example, the normal operation of the business is accompanied by expenditures for taxes, insurance, watchmen, general factory office salaries, etc. The product must eventually bear these expenses, and so in setting the standard cost of any finished product provision must be made for them. On the other hand, they scarcely come within the sphere of the average foreman in the shop. He is not responsible for their magnitude. Therefore they should be excluded from the comparison of actual and standard costs that is used to measure his performance.

Accordingly, one of the first things to decide is just what expenses are to be considered controllable by the supervisor of each cost center. For each cost center a listing is prepared of the particular expense accounts and expense items for which the supervisor is responsible. Standard costs will be developed for these and exhibited in comparison with actual costs on periodic reports for his guidance. His attention will be focused on the items that are important to him. All others will be handled separately.

Degree of Controllability

Of the expenses for which the supervisor is responsible, it is fairly obvious that the *actual* amounts of some tend to be more or less fixed whereas others vary in some ratio to production.

By fixed, we mean those portions of expense, such as overhead lighting, for example, that do not fluctuate markedly with the rises and falls of operating activity. At exceedingly low or high levels of operation they may, it is true, be affected. But as Gardner says, "No budget or any other normal process of evolution, comparison, or control can cover all the hazards involved in the range of capacities. . . . When we talk about business activities, we do not talk about operations at 10 per cent of capacity or at 125 per cent of single-shift capacity, which occur at rare intervals. . . . Operations at extreme levels do not account for a large enough share of the total time of the average year to justify such a procedure." [1]

At zero operations these expenses, unlike the fixed expenses of taxes, insurance, and others beyond the reach of the operating supervisor, may drop out altogether; we are not concerned with such circumstances. What we are concerned with is determining what the costs should be in the average spread of activity.

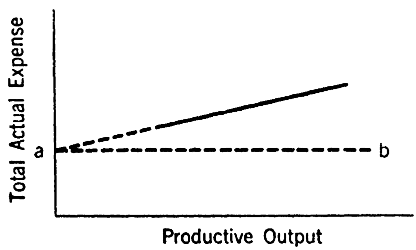


FIG. 1

If we were to plot the *actual* costs that have occurred in past periods, we should probably obtain a graph somewhat like the one above.

In this graph we see the trend of actual expenses in the solid

[1] GARDNER, FRED V., "Variable Budget Control," p. 110, McGraw-Hill Book Company, Inc., New York, 1940.

line. If it is extended to the vertical axis, it intersects at the point *a*, which may be taken as the value of *fixed expense*. The distance between the line *ab* and any point on the solid curve is the amount of *variable expense* at that level of production.

It should be noted that we are discussing only the fact that actual expenses may contain fixed and variable elements. This distinction in type of expense has, in itself, nothing to do with whether or not the expenses are reducible; it may be possible to reduce the amount of a fixed expense as well as of a variable one. But there will still be a fixed expense, though a smaller one. For example, it may be found that the actual cost of window cleaning has been relatively constant at all levels of production. It might be possible to improve the efficiency of this work so that its cost is less, without altering the fact that this lower cost is still constant at all levels.

Having seen that *actual* costs tend to display fixed and variable elements, we must now decide if we wish to allow for this condition at *standard* performance. A fundamental decision of policy depends on the answer to the question: Should any controllable expenses be recognized as fixed at all, or should it be maintained that all are to be completely variable with production, at standard performance? There are cogent arguments for either answer. In examining them in the following paragraphs, it should be remembered that we are speaking of standard, not actual, costs.

Allowing Fixed Costs at Standard

The usual construction of budgets presents a good example of the recognition of fixed expenses. Budgets are usually based on actual costs, and they state the amount of expense that a supervisor should not exceed. They are supposed to be readily attainable with the exercise of a fair degree of skill, and in fact many of them consist merely of a slight downward revision of past expenses. Being based on past actuals, most systems of budgetary control recognize that budgets differ at various production levels because of the fact that costs of foremen, clerks, heating fuels, etc., occur in the same amount regardless of the output of a cost center, whereas other costs, such as those of janitors and electric lights on machines, increase by lump amounts between several ranges of production and still others—direct labor and machine power—vary directly with production. Accordingly, the fixed and semifixed items are isolated from the variable ones in constructing accurate totals. For any level of operations the total budget is equal to the sum of the fixed, semifixed, and variable elements of expense. The budgeted total for each level is different and cannot be found merely by multiplying p.s.h. by a constant amount.

This same procedure can be applied to standard costs used for control purposes. The standard costs will probably be tighter than budget figures would be, since they represent best attainable performance, which may not be reached immediately, and since they are based on a thorough investigation of possible economies. Nevertheless, they can still admit the possibility that some expenses are fixed. Graphed, they would look like Fig. 2.

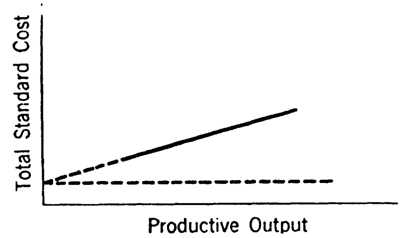


Fig. 2

Thus, at each level of production the supervisor is allowed a standard amount of fixed expenses and a standard amount of expenses that vary with production, his total standard cost being the sum of the two.

Normal Capacity

When this procedure is followed, it is obvious that the standard unit product cost will be different at different levels of production because of the greater or lesser amount of production available to absorb the fixed expenses. However, there are two objections to the existence of unit costs that vary in this manner.

1. One of the primary reasons for using standard product costs is to obtain uniformity of inventory charges.

2. It is a mistake, at low levels of production, to charge the product with a greater share of fixed expenses, which should really be charged to the cost of unused plant capacity. Although this argument is here only mentioned, it will be examined more fully in a later chapter.

Accordingly, the standard product cost is always taken to be that at "normal capacity." This normal capacity is obtained by listing the expected quantities of each product to be manufactured in a "normal" month or year, the total volume usually being approximately 80 per cent of the maximum possible output of the plant. If production standards are applied to these quantities, the total p.s.h. for each cost center are then determined. Against these are extended the fixed and variable costs. A cost per p.s.h. is then derived—the "normal" cost per p.s.h. This is the cost used in calculating standard product costs.

Suppose that we have a period in which operations are at less than normal capacity. The total standard cost used as a measure of the supervisors' performance will include fixed as well as variable expenses. At this level the standard cost per p.s.h. will therefore be greater than the normal standard cost per p.s.h. Thus, although the company is not producing enough to absorb all normal expenses, the supervisors' standards are still no more difficult to attain than at normal. If, then, we follow the plan of recognizing fixed expenses in the control standards, we do so in order to make those standards readily attainable, even though from the company's standpoint there is a greater unit cost.

Completely Variable Control Standards

There is another and sterner approach to standard costs used for control. It is based on a very simple chain of reasoning: At low operating levels the products cannot be sold at a higher price merely because they have incurred a greater share of fixed expense. Therefore every effort should be made to eliminate the fixed nature of expenses, so that total costs will decrease in the same ratio as the decrease in production. In order to encourage supervisors to participate in this effort, their standard costs should be completely variable; no expenses will be recognized as fixed. In other words, the standard cost per p.s.h. at *any* operating level will be the same as the normal standard cost per p.s.h.

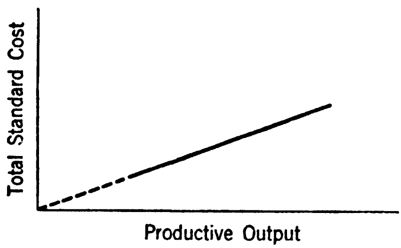


FIG. 3

When this theory is applied, a graph of standard costs looks like Fig. 3.

It is seen that the standard costs ignore the possibility that there might be fixed expenses. Rather they demand that the supervisor vary all costs in proportion to production variations.

Comparison of the Two Methods

Since the product cost is necessarily based on standard values at the normal capacity level, it presents no problem. Standards used for appraising supervisory performance, on the other hand, may or may not provide for fixed expenses, as we have seen. We must make a choice.

In favor of completely variable standards there is the argument of business necessity. We cannot always batten our business on the green pastures of unlimited consumer demand, where profits sprout up almost of their own accord. Sometimes our operations are restricted in scope, and we must cultivate a small area intensively. Then the pressure to reduce costs is greatest, and it should bear strongly on everyone in the organization.

At high operating levels the presence of fixed expenses tends to lower actual unit costs. But at low levels these fixed expenses raise the actual unit cost of whatever products are being made at the time.[1] And it is at these low levels that economies are most urgently needed, that supervisory efforts should be stimulated to the utmost, and that standards should furnish the greatest incentive for high efficiency. Therefore the standards should not consider fixed expenses as such but should incorporate them on a wholly variable basis, in order to point the way to essential cost reductions. At 50 per cent of normal capacity they should contemplate a 50 per cent reduction in the so-called "fixed" expenses, and the foreman should be held responsible for any variance from this expectation. He should realize that since the company cannot increase its selling price at low levels, it cannot afford to increase its unit costs. He can accomplish the necessary economies by doubling up on jobs or by scheduling fewer working days so that the days worked will be at 100 per cent of normal capacity. For if a clerk, for instance, is fully occupied at 100 per cent of normal, then at 50 per cent capacity he must have available time for other work. To fail to recognize this is to vitiate the effectiveness

[1] Some authorities contend that it is fallacious to recognize this expansion in actual unit costs. They recommend that only the portion of fixed expenses normally charged to unit cost be exhibited, the remainder being set up as a separate charge due to low operations. But it may be argued that regardless of the accounting, the money is still being spent and efforts must be made to reduce its amount. (See also pp. 139 *ff.* for a further discussion of "true costs.")

of the standard. To recognize it in the standard is to emphasize the challenge of low-level operations. Therefore the standard cost per p.s.h. at low-level operations should be the same as that established for normal operations.

These arguments are colored by necessity. Those in favor of providing for fixed expenses in the standards are colored by expediency. When we recognize fixed expenses, we do so because this makes the standard more realistic to the supervisors affected by them. And after all, of what use are control standards if they cannot be sold?

Any supervisor can readily point out that many expenses simply cannot be incurred on a variable basis, regardless of the desirability of so doing. Thus a furnace run at less than rated capacity uses more fuel per unit of output than at higher levels of activity, because certain losses are more or less constant.[1] Again, a crane operator in a heavy-machine shop must work full time, whether 10 or 30 machines are operating, for it is not practical to have him climb up to the crane cab every few minutes to make a lift, then climb down and go on another job until the next lift must be made. Furthermore, good management policy dictates the retention of key employees on their regular occupations, even though they are not fully employed, in order to keep them available for future work. For example, shortly before the United States' entry in the Second World War a large jobbing manufacturer, faced with a brief lag between contracts, kept 120 toolmakers and machinists practically idle on the pay roll, knowing that if the men were to be laid off, they would never return. During this period the fixed expense was high but worth incurring. In some cases, rather than double up jobs, it is better to operate on a part-time basis. But not every industry can do this; a blast furnace, for instance, must operate continuously or not at all.

For these reasons, standards set on a completely variable basis are not wholly realistic. Not every cost that is at present fixed in actuality need be considered as fixed in the standards; close examination may reveal that many supposedly fixed costs can be reduced at low operations. But some cannot. If the standards are to be attainable, then, they should be attainable at all levels of

[1] RYDER, F., Standard Costs for Steam Generation, *Blast Furnace and Steel Plant*, December, 1941.

performance. This they can be only if the development of standard costs for the operations within each cost center is based on a careful study of fixed and variable expenses.

Moreover, although it is true that fixed expenses tend to be underabsorbed at low operating levels, it should not be the operating man's responsibility to pull the company out of this danger. Rather, the excess cost of carrying a partly idle plant should be laid at the door of the sales department. Indeed, this excess (in standard amounts) can be precalculated for various operating levels, so that the management will know in advance just how much it will lose because of subnormal operations. This information should be used as a spur for the sales manager; it is beyond the realm of the operating man, who cannot control volume.

It cannot be said definitely that either method should be used in all installations. The foregoing arguments will have more bearing on some plants than on others. However, since the recognition of fixed expenses presents certain problems that do not occur when standard costs are considered completely variable, this method will appear in discussions of specific instances throughout this book.

Operating Levels

The term "normal production" has been mentioned. A hypothetical specimen of the development of such a normal will illustrate the operations preliminary to establishing standard costs for various operating levels.

The sales department of a manufacturer of domestic hot-water heaters prepared an estimate based on an analysis of the volume of business in the preceding year, which was considered normal, that in a normal month the following quantities of heaters would be sold:

Product Description	Normal Monthly Quantity
20-gal. storage heater	630
30-gal. storage heater	798
45-gal. storage heater	189
60-gal. storage heater	63

The standard-cost accountant obtained from the chief engineer a bill of materials for each of the four types of heater. From the production expediter he secured a schedule showing the operations required on each manufactured (as opposed to purchased) part and subassembly. Being familiar with the factory, he knew in which cost center each of these operations occurred. The time-study man then supplied, from his files, the standard hours allowed for each operation on each part. Those productive operations which were not on incentive were given an estimated time allowance pending the setting of incentive rates. The standard time per piece or subassembly times the number of pieces or subassemblies per heater times the number of heaters per month was then calculated in detail. A selective addition of the total p.s.h. thus obtained was made to arrive at the total normal monthly p.s.h. for each operation. We shall examine this procedure for the final assembly floor. This cost center included four operations:

1. Painting.
2. Preliminary assembly.
3. Rock-wool insulating.
4. Final assembly.

In Operation 1, the outer jackets, tops, bases, legs, door frames, and exposed gas valves of the heater were individually painted in spray booths and set aside to dry.

In Operation 2, legs were screwed to the base, the inner jacket was bolted in place, the outer jacket was set over it, the water tank was lowered inside the inner jacket, and a door frame for the gas burner was set loosely in place in the bottom of the chassis.

In Operation 3, a crew of men spilled rock wool into the space between the outer and inner jackets and tamped it down.

In Operation 4, the top was fitted over the outer jacket, a burner was inserted through the door frame, a gas line and thermostat were connected to the burner and tank, water valves were pulled into the tank through holes in the top, the door frame was screwed to the outer jacket, and name plates were affixed to the outer jacket. The heater was then transported by hand truck to an elevator which delivered it to the crating and shipping department.

The standard times furnished by the time-study man were as shown in the table on page 43.

	Heater size, gal.			
	20	30	45	60
	Standard man-hours per heater			
Operation 1:				
Paint outer jacket	0.0462	0.0521	0.0583	0.0667
Paint top	0.0153	0.0167	0.0183	0.0183
Paint base	0.0183	0.0197	0.0205	0.0205
Paint legs	0.0037	0.0037	0.0037	0.0037
Paint burner	0.0039	0.0039	0.0039	0.0045
Paint door frame	0.0053	0.0053	0.0053	0.0059
Paint valves	0.0012	0.0012	0.0012	0.0012
Total	0.0939	0.1026	0.1112	0.1208
Operation 2:				
Assemble legs and brackets to base	0.0551	0.0551	0.0912	0.0912
Assemble inner jacket to base	0.0821	0.0821	0.0881	0.0900
Assemble outer jacket, tank, and door frame	0.1422	0.1489	0.1530	0.2420
Total	0.2794	0.2861	0.3323	0.4232
Operation 3:				
Insulate with rock wool	0.2000	0.2500	0.3000	0.3600
Operation 4:				
Set top in place	0.0017	0.0017	0.0023	0.0030
Insert burner, etc.	0.0007	0.0007	0.0009	0.0013
Total	0.5322	0.5972	0.7001	0.8528
Grand total	1.1055	1.2359	1.4436	1.7568

The number of productive standard man-hours in the normal month was then calculated.

Heater size, gal.	Prod. std. man-hours per heater	No. of heaters per normal month	Prod. std. man-hours per normal month
20	1.1055	630	696.47
30	1.2359	798	986.25
45	1.4436	189	272.84
60	1.7568	63	110.68
Total normal monthly productive standard man-hours			2066.24

The standard amount of the various items of indirect expense at this level of production was then ascertained, and the total was divided by 2066.24 to obtain the standard indirect cost per p.s.h. for expenses allocable to all operations in the cost center. The direct expense per p.s.h. was also determined. In a similar way normal p.s.h. and standard costs were calculated in all cost centers. For any actual level of production the standard cost was said to be the product of p.s.h. and the standard cost per p.s.h. thus derived.

However, for the reasons previously stated, it was found that these standards did not always provide an effective tool for control. In the late spring when the volume of building construction was mounting, the demand for water heaters was far above the average for the year; whereas in the late fall and winter, sales were at low ebb. It was the company's policy to retain its key operating men by maintaining continuous operations, fluctuating in volume, whenever possible. Although this meant periodic increases and decreases in the remainder of the working force, it was considered better than to operate sporadically at maximum capacity. Accordingly, foremen could never even approach standard performance in costs during the low winter operations, because fixed costs were high; but they customarily exceeded it during the spring and summer for reasons that were actually the result of company policy rather than of their own supervisory ability.

In order to give his standards more meaning the standard-cost accountant therefore apportioned all the indirect costs into three groups.

1. Those which were fairly constant at all levels of operation; *e.g.*, the cost of the foreman in the Heater Assembly cost center was fixed.

2. Those which increased by a lump sum at certain operating levels; *e.g.*, it was found that on the average, an additional man was needed to handle materials and assist in trucking when the number of p.s.h. per day in the Heater Assembly cost center exceeded 110.

3. Those which, in accordance with the company's policies, varied with production.

For a given level of operations, expressed in p.s.h., the standard cost was then Item 1 plus Item 2 plus the number of standard hours times Item 3. This approach gave a more realistic set of figures for appraising the foremen's work than the use of a single standard cost per p.s.h. based on theoretical normal volume of production.

Later we shall see that the normal monthly volume does have its uses for obtaining costs for inventory valuation, even when it is not employed as a control of supervisory performance.

Alternative Methods

The method of determining normal operating levels just described is one of several. There is no need to repeat here a complete discussion of this complex subject, as it is amply covered in other texts. To point out alternative methods should be sufficient. These involve a decision on the following questions:

"1. Whether normal shall be set on the basis of capacity to make or capacity to make and sell.

2. Whether the normals for individual departments shall be set interdependently or independently as between departments or at a common level.

3. Whether the normal level shall be based on conditions peculiar to the plant or peculiar to the industry.

4. In cases where a number of plants are operated by one company, whether the normal level shall be peculiar to each plant or common for the company." [1]

Summary

Certain governing policies are agreed upon before any standard-cost system is prepared. Those recommended are the following: Standards should represent the best cost attainable at good, possible performance; they should be related to a universal common denominator representing production; and they should vary only to the extent that controllable actual costs are expected to vary under company policies with regard to the optimum use of labor, materials, and services. In order to facilitate the preparation of normal standard costs for valuing inventories, an exhibit is prepared showing the normal p.s.h. for all operations in each producing cost center.

[1] CAMMAN, ERIC A., "Basic Standard Costs," American Institute Publishing Company, Inc., New York, 1932. See also SCHLATTER, C. F., "Advanced Cost Accounting," John Wiley & Sons, Inc., New York, 1939.

QUESTIONS

1. If it were to be employed only for valuing inventories, what would be the best type of standard cost to use?

2. Why is this type of standard not useful for control purposes?

3. What is the objection to "ideal" standards?

4. Changing conditions make it necessary to revise standard costs from time to time. Is the frequency of revision reduced by using ideal, as against attainable, standard costs?

5. Is it of any importance at all whether standard costs are ideal, past actual, etc.? State the reason for your answer.

6. Why is it preferable to control costs on an operational rather than on a product basis? Could variances be derived under either method? Under which method would more calculations be needed to find the total standard cost for a month? Why? What is the relationship between product and operational costs?

7. Why is it better to express standard costs as so much "per standard hour" rather than "per actual hour"? Why is it better yet to express them as so much "per productive standard hour"?

8. In what type of industry would it be just as simple to use the unit of product as a basis for expressing standard costs, as to use the p.s.h.?

9. List several examples of expenses that would not be used in evaluating the performance of the supervisor of an operating cost center but that would be used in valuing inventories.

10. What are the arguments for considering the standard for a given account on a given operation as being entirely proportional to the volume of p.s.h. earned? What are the counterarguments?

11. Is it necessary to determine normal capacity when standard costs are not used? State the reason for your answer.

CHAPTER IV

PRESENTING STANDARD COSTS

There are two ways in which standard costs are assembled for use. One is to build up the standard cost of each product; the other, to build up the standard cost of each operation. Product standard costs are used for valuing inventories. Operational standard costs are used for controlling expenses. Both are necessary in a complete installation. So that we shall have a clear idea of what we are working toward in the ensuing chapters, let us examine the manner in which these two types of standard costs are presented, paying particular attention to the differences and similarities between them.

Product-cost Card

A product-cost card is a detailed statement of the standard requirements of material and other expense for an item of product at each successive stage in processing. One is drawn up for each assembly, each subassembly, and each component of each subassembly. A typical example follows:

PRODUCT-COST CARD

Part Name Housing Part No. 1203

Date Compiled May 1, 19—

Cost center No.	Operation No.	Operation description	P.s.h. per piece	Std. cost per p.s.h. Fixed exp.	Var. exp.	Tot.	Oper. std. cost	Cum. total std. cost
103	1	Material: Housing Casting #1203C—purchased	.....	.....	....	....	0.2530	0.2530
103	1	Bore and Face	0.0333	0.250	2.245	2.495	0.0831	
103	1	Materials: Scrap Credit	.....	.....	....	....	*−0.0090*	0.3271
110	6	Drill and Tap 4 Holes	0.0250	0.120	1.500	1.620	0.0405	
110	6	Materials: Scrap Credit	.....	.....	....	....	*−0.0010*	0.3666
115	2	Clean and Cadmium Plate	0.0001	0.100	2.000	2.100	0.0002	0.3668

The product-cost card has the following characteristics:

1. It shows the part name and part number.
2. It shows the date on which it was compiled. This prevents any future doubt as to the exact product specifications to which it applies.
3. It shows the materials requirements. These requirements are the amount that must be drawn from the storeroom or from a preceding cost center to make one part, including an allowance for losses.
4. It shows the standard price of the materials required.
5. It lists each standard job performed on the part.
6. For each job it shows the cost-center and the operation number within the cost center applying to the job.
7. It lists the p.s.h. per piece for each job. These are obtained from the time-study department.
8. It exhibits the standard cost per p.s.h. for each standard operation required.
9. It shows the total standard cost (standard cost per p.s.h. times p.s.h. required) for each operation.
10. It carries a cumulative total standard cost through the various operations.
11. It shows the credit for the standard amount of scrap allowable.
12. It shows the total standard cost of the part.

The information on this card enables us to determine the standard value of all inventories. Additions to Finished Goods are valued at the number of pieces of each product completed times the total standard cost per piece. Work in Process may be valued by multiplying the number of pieces at each stage in processing by the total standard cost through the last completed operation, although it will later be evident that there is a simpler way of arriving at Work in Process inventory.

All costs on the product-cost card are based on normal capacity. If the standard cost of any operation contains within it certain fixed distributed overhead charges, these charges have been assigned to the p.s.h. on the basis of normal capacity. Furthermore, *all* standard expenses of running the plant—both controllable and uncontrollable—are included somewhere in the standard costs per p.s.h. for the operations taken as a whole.

The preceding example was of a product-cost card for one component. The card for an assembly is identical except that various items of materials (perhaps in themselves subassemblies) enter at each operation.

Cost-comparison Sheet

The cost-comparison sheet is used to tell the cost-center supervisor what his costs for various operations actually are in any period and what they should be, as well as the extent by which he deviates from standard performance. An example follows:

COST-COMPARISON SHEET

Cost Center No. 103 Date July 31, 19—

Total P.s.h. 4,000

Account		Cost-center fixed expense		Operation 1 2,000 p.s.h.		Oper. 2 1,000 p.s.h.		Operation 3 1,000 p.s.h.		Total		Var.	% var.	Last mo. % var.
No.	Description	Std	Act.	Std.	Act.	Std.	Act.	Std.	Act.	Std.	Act.			
1000	Direct labor	...	...	$2,000	$2,100	$900	$900	$1,200	$1,400	$4,100	$4,400	$300	7.3	7.0
1001	Producers' indirect labor	...	...	200	300	50	60	80	110	330	470	140	42.4	35.2
1002	Other indirect labor	$400	$420	200	220	70	90	100	130	770	860	90	11.7	12.1
1005	Direct mtls.	...	...	1,500	1,800	...	...	....	....	1,500	1,800	300	20.0	15.6
1006	Indirect mtls.	...	...	250	270	80	90	80	95	410	455	45	11.0	11.7
1007	Service labor	200	220	200	240	50	60	80	90	530	610	80	15.1	17.2
1008	Service mtls.	50	55	40	45	10	20	30	35	130	155	25	19.2	22.4
1009	Utilities	200	200	100	110	40	40	40	45	380	395	15	3.9	3.8
Total controllable		850	895	4,490	5,085	1,200	1,260	1,610	1,905	8,150	9,145	995	12.2	11.0

For the sake of illustration, the variances shown in the above example have been exaggerated.

The cost-comparison sheet can be set up in many ways. The one illustrated could be modified, for example, to show the variances on each operation. Generally, it has the following characteristics:

1. It identifies the accounting period to which it applies.
2. It identifies the cost center to which it applies.
3. It shows the p.s.h. earned on each operation.
4. It shows the actual and standard amount of expenses subdivided by expense account.
5. It shows the actual and standard amount of fixed (or semifixed) expense for the cost center as a whole.
6. It shows the actual and standard amount of variable expense applicable to each individual operation.
7. It shows the variance between actual and standard amounts. This may be exhibited either in total, as in the example, or separately for each operation.
8. It shows the variance both in dollars and as a percentage of standard dollars.
9. As an indication of the trend, it shows the per cent variance for a preceding period.
10. In totals at the foot of the sheet, it shows the over-all performance of the cost center. These totals may be abstracted to summary sheets covering all cost centers in the plant to form a report for top management.

The cost-comparison sheet is used to evaluate the cost efficiency of cost-center supervisors. The fixed (or semifixed) column of standard costs is copied from a separate tabulation in the files, which exhibits the standard amount of these expenses allowable at various operating levels. The variable standard expenses are obtained by multiplying the p.s.h. earned on each operation by the variable standard cost per p.s.h. Only controllable costs are included.

Comparison of the Two Forms

A comparison of the two forms just presented reveals the following points:

1. Standard costs on the product-cost card are based on normal capacities; those on the cost-comparison sheet are based on the actual level of operations. This occurs because for consistency in inventorying, product costs must always be carried at the same

value whereas the evaluation of supervisory performance must always consider the actual operating conditions that occur.

2. The product-cost card need not break standard costs down by expense account. Such a breakdown is essential on the cost-comparison sheet, whose purpose is to facilitate the control of individual expenses.

3. The product-cost card, once drawn up, may be placed in a file for month-to-month reference. The cost-comparison sheet, depending as it does on current operations, is prepared at the end of each accounting period.

Operational-cost Sheets

Both the product-cost card and the cost-comparison sheet are developed from information contained in the standard-cost files. The first of two sources of information is the operational standard-cost sheet. This sheet shows, for a given operation in a given cost center, the variable standard cost per p.s.h. for each expense account. An example is shown.

OPERATIONAL STANDARD-COST SHEET

Cost Center No. 103 Operation No. 1

Date Compiled Jan. 1, 19—

Account	Variable Standard Cost per P.s.h.
Controllable by cost-center supervisor:	
1000, Direct Labor	$1.000
1001, Producers' Indirect Labor	0.100
1002, Other Indirect Labor	0.100
1006, Indirect Materials	0.125
1007, Service Labor	0.100
1008, Service Materials	0.020
1009, Utilities	0.050
Total controllable	$1.495
Uncontrollable by cost-center supervisor:	
1010, General Factory Overhead	0.750
Total	$2.245

It will be noted that the sheet is identified by cost-center number, operation number, and date of preparation. It is divided into two parts: controllable costs and noncontrollable costs. The first are those which find their way into the cost-comparison sheet, and the total of both the first and second is employed in drawing up standard product costs.

Cost-center Standard-cost Sheet

The second source of information is the cost-center standard-cost sheet. This sheet shows, for a given cost center, the fixed and semifixed costs at each operating level for each expense account. An example is shown.

COST-CENTER STANDARD-COST SHEET

FIXED AND SEMIFIXED EXPENSES

Cost Center No. 103 Date Compiled Jan. 1, 19__

Account		Productive standard hours			
No.	Description	3,000	4,000	5,000 (Normal)	6,000
		Standard cost			
Controllable by cost-center supervisor:					
1002	Other Indirect Labor. . . .	$300	$400	$400	$450
1007	Service Labor.	180	200	200	200
1008	Service Materials	45	50	50	50
1009	Utilities	200	200	200	200
	Total controllable.	725	850	850	900
Uncontrollable by cost-center supervisor:					
1010	General Factory Overhead	400	400	400	400
	Total.	$1,125	$1,250	$1,250	$1,300

Normal standard cost per p.s.h.: $1,250 ÷ 5,000 = $.250

This sheet is identified by cost-center number and date of preparation. It also is divided into controllable and noncontrollable items, the latter of which may well be expenses distributed from various general factory overhead accounts. For the normal level only, the costs are reduced to a p.s.h. basis, so that they may be transcribed to the product-cost cards. On the other hand, the total rather than unit costs for a given operating level are those which are inserted in the cost-comparison sheet.

Std. Amount for Actual Level

Operational Std. Cost Sheet	
CC No. 103	Oper. No .1 Variable Std. Cost per Psh
Account	
Controllable:	
1000	$1.000
1001	.100
1002	.100
1006	.125
1007	.100
1008	.020
1009	.050
Tot. Contr.	1.495
1010 (Uncontr.)	.750
Total	$2.245

Cost Comparison Sheet					
CC No. 103 Psh: 4000	Date				
Acct.	Fixed Exp.		Oper. 1 (2000 psh)		Etc.
	Std.	Act.	Std.	Act.	
1000			2000	2100	
1001			200	300	
1002	400	420	200	220	
1005			1500	1800	
1006			250	270	
1007	200	220	200	240	
1008	50	55	40	45	
1009	200	200	100	110	
Total	850	895	4490	5085	

Cost Center Std. Cost Sheet				
CC No. 103				
Acct.	Psh			
	3000	4000	5000 (Norm.)	6000
	Standard Cost			
1000				
1001				
1002	300	400	400	450
1006				
1007	180	200	200	200
1008	45	50	50	50
1009	200	200	200	200
Total	725	850	850	900
1010	400	400	400	400
Total	1125	1250	1250	1300
Normal Std. Cost/psh:				.250

Var. std. Amount/psh times psh earned

Normal std. cost/psh

Total std. cost/psh

Product Cost Card							
Part Name			Part No.				
CC	Oper.	Psh/Pce.	Std. Cost per Psh			Oper. Std. Cost	Cum. Total Std. Cost
			Fixed Exp.	Var. Exp.	Total		
103	1	.0333	.250	2.245	2.495	.0831	
110	6	.0250	.120	1.500	1.620	.0405	
115	2	.0001	.100	2.000	2.100	.0002	

Fig. 4. Relationship between various standard exhibits.

Note: As will be seen later, the flow of Direct Materials costs receives special treatment. For this reason it is not shown in the above diagram; and for brevity, materials have been omitted from the condensed Product Cost Card shown.

Flow of Data

Figure 4, page 53, illustrates how the data contained in the forms and records just described are assembled.

Summary

For control purposes, standard and actual costs for the actual level of operations are exhibited on a cost-comparison sheet. For the valuing of inventories, a card file is maintained in which standard costs of each product are recorded, being based on normal level of operations. Auxiliary files are also kept from which are obtained the data assembled in the comparison sheet and product-cost card. Subsequent discussions will describe the building up of these basic data and the uses to which the first two exhibits mentioned are put.

QUESTIONS

1. What information should appear on a product-cost card?

2. Is the product-cost card necessary for evaluating supervisory performance?

3. What information should appear on the cost-comparison sheet?

4. Is the cost-comparison sheet necessary for valuing inventories?

5. Suppose that at the end of a month in which there was no starting inventory all products finished or partly finished by a given cost center were valued by multiplying their quantity by the appropriate figure on the product-cost card. Suppose that for the same month the total thus obtained was compared with the total standard cost on the cost-comparison sheet. If the effect of controllable and uncontrollable costs is neglected, under what circumstances would the two totals be the same? Under what circumstances would the former total exceed the latter? Under what circumstances would the latter total exceed the former?

6. What is the advantage of showing cumulative total standard costs at each operation on the product-cost card?

7. Name the sources of the information appearing on the cost-comparison sheet.

CHAPTER V

SETTING STANDARDS FOR DIRECT AND INDIRECT LABOR

The purpose of this chapter is to discuss in detail the method of establishing the standard cost of direct labor and indirect labor. The chapter begins with a definition of terms and proceeds to an explanation of the manner in which the necessary basic data are obtained and the manner in which these data are employed for setting standards.

Definitions

Direct labor is that labor whose earnings can be related to p.s.h. earned on specific operations.

Indirect labor is that labor associated with production, which, because its earnings cannot be accurately related to p.s.h. earned on specific operations, must be averaged over groupings of p.s.h.

Whether a particular occupation is to be classed as direct or indirect thus depends upon how accurately its cost can be charged rather than upon the type of work that it does.

Direct Labor

Piecework Plans.—When workers are paid on straight piecework plans with production expressed in standard hours, the standard cost of direct labor per p.s.h. is virtually self-defined, being the labor rate paid for each standard hour earned, which is as a rule specified for each operation covered by the incentive plan.

In some plans, however, this labor rate per standard hour varies in accordance with the per cent performance of the workers. Suppose, for example, that employees are paid \$0.85 per standard hour for performances under 100 per cent but that high-level output is encouraged by the payment of \$1.00 per standard hour for efficiencies over 100 per cent (per cent performance being defined as $\left.\frac{\text{standard hours earned}}{\text{actual hours worked}}\right)$. Since standard costs are based on good attainable performance, the standard cost of direct labor is set at

$1.00 per standard hour, even though certain operations consistently run at less than 100 per cent. For if these operations cannot earn 100 per cent, then either the job is not being done correctly and at the right pace, or the job standards are too tight and should be revised.

An interesting feature of this type of plan just described is the fact that the standard cost may be higher than the actual cost. But presumably the desirability of achieving a high rate of production has been considered in the differential in rates and has been felt to outweigh the $0.15 increment in cost per standard hour. Here a negative variation between actual and standard of this one item would, paradoxically, indicate poor performance.

Regardless of these slight differences in the manner of payment, if a worker's pay consists entirely of a fixed rate for every standard hour earned, then that rate is the direct-labor cost per p.s.h.

Point Systems.—Let us consider a wage plan where production is expressed in points, of which the early Bedaux system is a good example. At standard performance, a worker is expected to earn 80 B's per hour. A fixed money value is paid for each B produced. The individual worker receives this B rate for all B's earned up to 60 per hour, after which he receives, for B's in excess of 60, three-fourths of the rate, the other one-fourth being split among foremen, inspectors, etc. For example:

B's earned per hour	Pay per B	Individual worker's earnings	Other participating workers' earnings from the plan *
60	$0.02	$1.20	
70	0.02	$\left.\begin{array}{l}\$0.02 \times 60 = \$1.20 \\ \$0.015 \times 10 = \$0.15\end{array}\right\}\$1.35$	$0.005 × 10 = $0.05
80	0.02	$\left.\begin{array}{l}\$0.02 \times 60 = \$1.20 \\ \$0.015 \times 20 = \$0.30\end{array}\right\}\$1.50$	$0.005 × 20 = $0.10

* The total amount available for other participants would, of course, be larger, since this column shows only the contribution from one of a number of individual workers.

From the foregoing table it can be seen that although the individual worker's cost per B varies, being $\frac{\$1.20}{60}$, or $0.02, at 60 B's per hour; $\frac{\$1.35}{70}$, or $0.0193, at 70 B's per hour; and $\frac{\$1.50}{80}$, or $0.0188, at 80 B's per hour, the total cost per B remains $0.02, regardless of to whom it is paid. Therefore, since the entire incentive earnings can be allocated directly to production on the basis of B's, the entire amount of $0.02 per B constitutes direct-labor cost.

Differential Plans.—A slightly more complex incentive system, from the standpoint of standard costing, is one in which workers receive a fixed base rate per hour worked (which may or may not be equivalent to their guaranteed hourly rate) plus a piece rate expressed in dollars per standard hour or per ton, per piece, per foot, etc. Such a plan is called a differential, or combination, plan.

ILLUSTRATION

Base rate..........	$0.45 per hour worked
Guaranteed rate.....	$0.80 per hour worked
Incentive rate.....	$0.55 per standard hour earned

Earnings = ($0.45 × hrs. worked) plus ($0.55 × std. hrs. earned)

$$\text{Per cent performance} = \frac{\text{std. hrs. earned}}{\text{actual hrs. worked}}$$

% performance	Std. hrs. earned per hr. worked	Hourly earnings			Cost per std. hr.
		From base rate	From inc. rate	Total	
50	0.50	$0.45	$0.275	~~$0.725~~	
				$0.800*	$1.600
63.6	0.636	$0.45	$0.350	$0.800	$1.258
70	0.70	$0.45	$0.385	$0.835	$1.193
80	0.80	$0.45	$0.440	$0.890	$1.113
100	1.00	$0.45	$0.550	$1.000	$1.000
110	1.10	$0.45	$0.605	$1.055	$0.959
120	1.20	$0.45	$0.660	$1.110	$0.925

* Pay guaranteed rate of $0.80 per hour.

In this illustration the total hourly earnings constitute direct-labor expense. Since the cost per standard hour decreases as per cent performance increases, the problem is to decide what per cent performance should represent standard. If the time-study man based his allowed standard hours on the expectation that men working at an incentive pace would regularly attain 100 per cent, then the standard cost should never be based on a lower level. Consistent failure of the workers to reach that 100 per cent may be cause for reinvestigation of the fairness of the time standards, but the condition should certainly not be recognized in cost standards that are based on good performance. On the other hand, most time-study men have observed that workers who are given fair time standards tend to improve their performance on a given operation over a period of years, with the result that they frequently earn more than the expected 100 per cent performance. Such a trend occurs for several reasons and is no reflection on the fairness of the standards. Its causes are

1. Increased skill on particular jobs as a result of repetitive practice on them.
2. Occasional minor improvements in methods which, although too small to be evaluated individually, have a cumulative effect in enhancing performance.
3. Desire of workers to increase their earnings by working at better than a normal incentive pace.
4. Willingness of workers not to control production in order to hide the first three factors; this situation can occur only when rates are guaranteed by the management against "cutting."

Better than 100 per cent performance can also stem from incorrect and loose time allowances. If there is a guarantee against rate cutting, this high performance must be accepted and reflected in standard costs, undesirable though it may be.

Referring to the table on page 57, we are to determine on what level of performance to base the standard cost. To guide a decision, earnings calculation sheets for the operation in question are analyzed for a representative period, which in most cases should be at least six months. The p.s.h. and actual working hours are totaled by months. These totals show the past trend in performance. They are shown to the time-study man and the foreman, and a decision is reached as to the probable future trend. To continue the example,

Month	P.s.h.	Actual productive working hours	Performance on production, %
March.....	492	510	96.5
April.......	474	500	94.8
May.......	508	519	97.9
June	523	521	100.4
July.......	530	515	102.9
August.....	520	511	101.8

The figures in the last column indicate an upward trend in performance. The time-study man, on being consulted, states that as a result of a recent production drive, the flow of materials to this operation has been more closely supervised in recent months with the result that operators have been able to improve their performance. The foreman confirms this explanation, and both men agree that a performance of 110 per cent may be attained in the future. The standard cost per p.s.h. is therefore set at $0.959, equivalent to 110 per cent performance.

Past Performance.—In setting individual operational standard costs the standard-cost accountant always investigates past records to see which way the wind is blowing. These records give him a picture of actual performance that has many uses. They provide a valuable basing point to ensure against the standard's being set too loose. But they should not be used as a sole guide in setting the standard cost. For example, it is possible to investigate past production, arrive at an average actual performance of 103 per cent, and set the standard at 113 per cent in order to provide an arbitrary 10 per cent margin for improvement. And this practice, although quick and convenient, can result in grave errors if the results are not verified by persons more familiar with the operation than is the standard-cost accountant.

The pitfalls may be illustrated by an occurrence in a plant manufacturing gas-control mechanisms. The management, having become convinced that its inspectors not only were receiving a relatively low rate of pay but were also working at a relatively slow pace as a result, decided to place them on incentive, at the same time instituting a system of checks on their accuracy. In order to encourage the men to seek higher earnings, the time-study man set, for the first inspecting operation to be placed on incentive, a deliberately loose time allowance. However, the inspectors involved had hoped for an even looser rate and for several months held their performance to 55 per cent, with practically no deviation from day to day. During this period no amount of selling by the time-study man, the foreman, or the superintendent could induce them to try to work for 100 per cent performance and its higher earnings possibility. But presently the deadlock was broken when one of the men resolved that he was gaining nothing by voluntarily abstaining from the higher wages that were within his grasp. So he began to inspect more mechanisms per day, and his performance rose week by week from 55 to 68 per cent, to 70, 80, and 90 per cent. It then leveled off somewhat. In the meantime the other inspectors had been forced to follow suit in order to avoid appearing incompetent. After performance had hovered between 90 and 100 per cent for some time, the men decided to take a chance on the company's policy of not cutting rates, and as a result their performance climbed to 120 per cent with no loss in quality, which was in line with the time-study man's knowledge that the rate was originally loose. Now if cost standards had been based on past averages during this long negotiating and progressing period, they would ultimately have been found to be far too low, even if based on 100 per cent performance. But a discussion with the time-study man would have indicated the level that should truly represent attainable, standard performance.

To summarize: Past records are analyzed for a clue to potential performance. Informed members of the organization are consulted as to just what this performance should be under best attainable conditions. The standard performance should not be lower than any past actuals. And, it might be added, if it is thought that present practice is close to the best achievable, it is still good psychology to play safe by setting standard about 5 per cent higher in order to give supervisors something to shoot at.

Nonincentive Operations.—Except in processing or highly mechanized industries, standard-cost installations can succeed only where there is a smoothly operating wage-incentive system. Only a few factories, however, enjoy 100 per cent incentive coverage. Nearly always there are some operations in the producing, as distinguished from the service, cost centers that for one reason or another (because they occur sporadically, are not always performed in the same way, are being revised in method, are new to the plant, are difficult or impractical to measure, or offer no possibility for increased efficiency) have not been placed on incentive. The many perhaps good reasons for not having incentive rates for them do not obviate the necessity of expressing, for cost purposes, the production from these operations in terms of a common denominator. Estimated standard times must therefore be applied. These are prepared by the time-study man, who arrives at them from one or more of three sources as follows:

1. Comparison with similar jobs.
2. Brief over-all time studies without extensive analysis.
3. Past production records considered in the light of his experience of the per cent performance usually attained on jobs before they are placed on incentive.

It is well not to make estimates too loose; for if they become generally known in the plant, they may have an adverse effect on subsequent attempts to install scientifically determined time standards.

The direct-labor cost per p.s.h. is the same for estimated as for incentive jobs on similar operations. Inasmuch as the estimated jobs are not actually on incentive, the standard hours earned per day on them will probably be low, and hence the direct-labor standard dollars earned will be low also. A stimulus therefore exists for foremen to have the operation standardized and timed so that their cost centers may earn more standard hours (and hence standard dollars) as a result of increased production. The encouraging of foremen to have operations placed on incentive in order to narrow the margin between standard and actual costs is one of the good effects of the system.

Indirect Labor

Because it is by definition not tied in with specific production, indirect labor must be much more thoroughly investigated than direct labor if standard costs are to be accurate. The cost per p.s.h. of direct labor is to a large extent determined by wage-incentive plans, but indirect labor is subject to no such control. True, it may be on incentive. But being indirect labor, it is by definition not on an incentive based on production. The problem, therefore, is to determine how much it should cost per p.s.h., looking beyond its performance on its own incentive plan, if any.

For example, chisel grinders in a rock quarry might be paid on the basis of tons of rock cut. Their cost would therefore be direct labor and would be well established. If, however, the chisel grinders were paid incentive earnings in proportion to the number of chisels ground, their cost, not being directly related to the production of rock or stone, would be indirect labor. We should then have to determine how many chisels are required per ton of rock in order to arrive at the standard cost of chisel grinders per ton (assuming tons to be the cost denominator). Even if the men were paid day rate, that day-rate cost would have to be allocated to tonnage.

The discussion of this allocation and determination of indirect-labor cost will be divided into a consideration of producers' indirect labor and of all other indirect labor.

Producers' Indirect Labor.—Specific occupations, normally classified as direct labor, frequently receive payments that can be described accurately only as indirect labor. These payments are indirect-labor costs because their amount is not fixed with regard to any specific standard hour earned on production. Of these costs, some examples are

Cost of separately paid for delay time.
Cost of separately paid for size changes.
Cost of separately paid for tool or die changes.
Cost of separately paid for clean-up time.
Cost of separately paid for light-up time (on furnaces).
Cost of separately paid for salvage or reclamation time.
Cost of separately paid for time to bring defective work up to inspection requirements.
Incentive earnings paid for material that through no fault of the operator fails to pass inspection at the end of the operation.

It will be observed that most of these examples are described as "separately paid for." If delays, etc., are not paid for as such but are included in the piece rates or standard times as an allowance, there is no use in considering them in setting standards, for as individual costs they are not subject to control. The management has agreed to pay a fixed amount for them, regardless of the frequency with which they occur. For every standard hour earned on production their cost is fixed. Even if their volume were to be reduced in actuality, this amount would still have to be paid unless the management wished to subject itself to bickering and discontent on the part of the workers.

But if these items are paid for separately, it is desirable to reduce their volume. A standard cost is therefore set for them. This cost is equal to the standard volume of the items per p.s.h. times the cost per item. For determination of the standard volume, a tabulation of the items is made for a representative period of time—say, 6 months. A separate tabulation is made for each operation. Here the value of a good system of historical records is evidenced. For merely to know that certain delays, etc., occurred is not sufficient. We must know *why* they occurred if we are to be able to say whether or not they *should* occur at standard performance. When the tabulation has been prepared for all operations in a given cost center, certain staff members, *e.g.*, the supervisor of that cost center, the industrial engineer, the production-planning supervisor, and the chief inspector, are called together to explain the reason for these indirect costs and in so doing to arrive at an estimate of what they should be. Such a meeting has the following advantages:

1. A fair, accurate standard can be set only on the basis of expert opinion.
2. The supervisors affected by standard costs can best be sold on the truth of the standards if they themselves have helped to set them.
3. The discussion tends to focus the supervisors' minds on the principles of standard costs, so that they become more "cost conscious."
4. The discussion frequently uncovers previously unsuspected potential savings.

Each item of producers' indirect labor is discussed in terms of the actual figures in the tabulation. And with regard to each item the standard-cost accountant asks in various ways these questions:

1. Why does this item occur at all?
2. Why does it occur to this extent?
3. Under what conditions could it be reduced in volume?
4. Is there any reason why these conditions could not be attained at standard performance?
5. If they are attained, what will be the amount of the item?

The answer to Question 5 is the information necessary to set the standard allowance. But if this question were to be asked baldly at the outset, the minds of those present at the meeting would be unprepared for any answer but a guess. By asking the first four questions the standard-cost accountant attempts to condition the thinking in such a way as to arrive at an estimate founded on knowledge and consideration of the facts.

If time is available, time and methods studies of the indirect-cost portions of various operations supply information even more close to the truth than can be developed by conferences. This work should, of course, be done in any case, but a standard-cost program cannot always wait until such studies are completed for all operations in the plant.

The historical, or reference, data that have been tabulated, together with the standard allowances per p.s.h. and their cost, are recorded in a card file. As will be seen, this information is useful in setting standards for costs other than producers' indirect labor.

Following is an example of the procedure.

A summarization of historical data for 6 months provided this information for the three operations in a punch-press cost center.

BASIC DATA

January through June, 19__ Cost center No. 102

	Shears	Large presses	Small presses
Operators' actual hours on production of good material	1,900	2,806	5,732
P.s.h. earned (from good material)	2,108	2,794	5,582
P.s.h. per actual hour on production	1.109	0.996	0.974
Paid-for delay hours:			
Wait for material	165	240	381
Wait for setup man	0	128	182
Mechanical breakdown	0	27	38
Power failure	10	15	30
Total	175	410	631
Number of setups	Not	561	1,483
Actual hours on setups (paid for)	recorded	508	622
Average hours per setup	separately	0.91	0.42
Operators' actual hours on production of material rejected for causes beyond operators' control (operators paid at regular rate)	0	41	0
Standard hours earned from this material	0	34	0

With these figures prepared, the standard-cost accountant requested the time-study man, the punch-press foreman, and the chief production scheduler to stop in his office. At the meeting that followed, he explained that those assembled would be asked to consider the above tabulation, to decide if it was representative of conditions as they had observed them, and to suggest wherein performance might be improved under the best attainable conditions. He also made it clear that nobody expected these desired conditions to arise overnight, that they were those which might be expected to obtain at some distant future time when everything was "clicking" just right, and that although they represented a goal to shoot at, failure to meet them now would not result in any penalty. After a few more preliminary remarks and questions, the group considered first the productive efficiencies of the three operations.

With regard to that for the shears, the time-study man expressed the belief that the performance of 111 per cent was due in part to slightly loose incentive rates. The foreman, however, attributed the relatively high efficiency to skill on the part of the operators. Both agreed that if the arrangement of materials at the workplace were improved, a performance of 115 per cent might be reached by skilled operators. The standard was therefore set at 115 per cent. As to the presses it was agreed that the mechanical nature of the work was such that little improvement could be expected. The standard was therefore set at 105 per cent, which was somewhat above actual performance.

Next the delay hours were examined. When asked why direct workers had to wait for material, the lost time that constituted the largest delay item, the foreman explained that production schedules were frequently revised so that jobs had to be run for which he was not prepared. A delay would then ensue while he waited for the storeroom to deliver coil stock to the presses or sheet stock to the shears. The production scheduler confirmed these statements, attributing the need for the schedule revisions to the inadequacy of the stock-inventory system, which did not provide him with sufficiently accurate data as to the number of stampings on hand, with the result that additional stampings frequently had to be ordered on short notice in order to keep the assembly floors supplied. It was agreed that the condition could be alleviated by revamping the stock ledger system. The delays on the presses were observed to be approximately ½ hr. per setup, which was exorbitantly high. It was agreed that with a better inventory system and closer cooperation between storeroom, foreman, and scheduler, the wait-for-material delays should not exceed 2 hr. per month on the large presses and 5 hr. per month on the small presses at this level of operations.

The standard-cost accountant then called attention to the setups, which occurred on an average of once for every 5 p.s.h. on the large presses and once for every 3.8 p.s.h. on the small presses. The scheduler attributed this frequency to the same causes as the wait-for-material delays, *viz.*, short-order scheduling. He pointed out, however, that stock-room limitations would prevent more than doubling the quantity of pieces on the average order. Under these circumstances it was decided to set a tentative standard number of setups per p.s.h. at half the number shown on the tabulation. The standard-cost accountant would then calculate the effect of this procedure on inventory values and present the results to the plant manager for approval. This step was deemed advisable because a fundamental question of policy on the investment in inventory volumes was concerned. The foreman stated that if the number of setups were reduced, the amount of time lost in waiting for the setup man would be practically eliminated, except for occasional conflicts. On this basis a standard allowance for this delay was arrived at. In response to a question from the standard-cost accountant, the time-study man agreed to set standards for the setup operation, which was at present on day rate. He estimated that under these circumstances the time per setup would be reduced by approximately 40 per cent. The standard allowance for setups, therefore, pictured a reduced number of setups and a decreased time for those which would be made. Other delays were similarly analyzed.

Lastly, the group considered the cost of producers' time on subsequently rejected material. This item had appeared only against the large presses. It had occurred, the foreman said, because of a particular lot of strip brass which, being harder than specifications called for, had developed cracks in the drawing process. He felt that an allowance should be made for such occurrences in the standard. But since proper preliminary inspection would have resulted in rejection of the material prior to its being worked on, the standard-cost accountant declined to make any provision for this cost at standard performance.

After the meeting had adjourned, the standard-cost accountant entered the information obtained on cards, one of which is shown on the next page

Direct Labor and Producers' Indirect Labor

Cost Center Punch Press Cost Center No. 102

Operation Name Large Presses Operation No. 3

Type of incentive plan: piecework expressed in standard hours
Operators' guaranteed day rate: $0.64
Operators' standard hour rate: $0.85
Work covered by incentive: good pieces produced only. Setups and delays paid for at day rate at present; setups on incentive at standard performance

Basic data	Base Jan. through June, 19__	Standard
P.s.h. per actual hour on production.......	0.996	1.050
Rejected material standard hours per p.s.h.	0.012	0
Delay hours per p.s.h.:		
Wait for material..................	0.086	0.004
Wait for setup man..................	0.046	0.003
Maintenance and power delays.........	0.015	0.008
Total delays.....................	0.147	0.015
Setups per p.s.h.......................	0.201	0.100
Setup hours per p.s.h..................	0.182	0.055
Cost per p.s.h.:		
Direct Labor.......................	$0.85	$0.85
Producers' Indirect Labor:		
Delays...........................	0.094	0.010
Setups...........................	0.116	0.047
Rejected Material.................	0.010	0
Total producers' indirect labor....	0.220	0.057

The card above is developed in the following manner:

1. The general information as to type of incentive plan, rates, etc., is obtained from the time-study man.

2. The basic data are listed in two columns: one for the base period (with the date shown) and one for standard performance.

3. The basic data in the "Base" column are based on the total actual and standard hours displayed in the tabulation on page 64.

4. The basic data in the "Standard" column are based on the estimates derived from the knowledge of plant operations possessed by the time-study man, chief scheduler, foreman, standard-cost

accountant, and other persons familiar with the particular operation. These estimates, made in terms of the hours that should have been required in the reference period, are divided by the p.s.h. for that period to obtain a figure in terms of the common denominator.

5. The lower half of the card displays the base and standard costs per p.s.h.

6. Since the operation pays $0.85 for every p.s.h. earned, the unit direct-labor cost is set at this value.

7. The delays and setups being paid for at day rate, their base cost per p.s.h. is equal to the day rate per hour times the number of hours per p.s.h. as shown in the basic data. For setups only, the standard cost per p.s.h. is figured at $0.85 per standard hour earned on setups, as follows:

Number of setups per p.s.h. × allowed standard hours per setup × standard-hour rate.

8. Since the operator was paid at his standard-hour rate for material rejected through no fault of his own, this item of cost is equal to the standard hours earned on such material per p.s.h., times the standard-hour rate.

Thus it is seen that all costs, both base and standard, are expressed in dollars per p.s.h. The validity of the costs obtained depends on

1. The selection of a base period in which the amount of production is neither abnormally high nor abnormally low.

2. The previous emphatic expression by the management of its confidence in the importance of, necessity for, and ultimate success of a standard-cost program. Without this backing, cooperation and interest on the part of the plant personnel may be difficult to obtain.

3. The standard-cost accountant's ability to dispel any fear or antagonism on the part of foremen and other supervisors by pointing out that there is no onus attached to an initial wide disparity between actual costs and standard costs.

4. The standard-cost accountant's ability to drive the discussions of every cost through to the ultimate reasons for and necessity for that cost.

5. The extent to which statistical analyses and shop studies can be made of the various factors of labor and material.

Other Indirect Labor.—With producers' indirect labor the only problem is to reduce the cost to a per-p.s.h. basis. But with other indirect labor, not only must the cost be reduced to this basis, but care must be exercised that the cost is prorated against the p.s.h. of the specific operations that necessitate it.

In some cost centers all indirect labor (other than direct workers') is used generally by all operations. But in others certain portions of it are incurred only when certain operations are performed. Consider the case of the canister-assembly cost center of a gas-mask factory. The operations are briefly as follows:

1. Solder tops and bottoms on canisters.
2. Fill canisters with chemicals.
3. Assemble filters and seals.
4. Assemble mounting brackets.
5. Paint.
6. Pack for shipping.

In addition to the direct workers, the following indirect workers are employed:

1 soldering-iron dresser, who should be charged entirely to Operation 1.

1 inspector who tests canisters for airtightness. Since this inspector is required as a check on the solderers, he is a charge against Operation 1.

1 or more assemblers who work entirely on repairing canisters to which filters have been improperly assembled. The hours of these employees are chargeable to Operation 3.

2 laborers who deliver materials to the workplaces and transport work in process from one operation to the next. Their cost should be prorated over all operations.

1 clerk.

1 sweeper.

2 inspectors who cover the entire department with the exception of the canister testing. These three occupations are chargeable to all operations.

Because the assembly line is not perfectly balanced, the painters occasionally get behind in their work. All other operations are then suspended for a turn while the painters catch up. If the total indirect-labor charge were prorated equally over all operations, then the standard allowance for that charge on turns when only the painters work would be too high, as it would include a provision for several indirect occupations, such as soldering-iron dresser and canister tester, not actually necessary under this circumstance.

In setting the standard cost, then, each occupation is considered separately. First, to continue the example, the soldering-iron dresser: The standard-cost accountant learns that this occupation is on incentive, being paid a fixed number of standard hours for each iron dressed. He further learns that the solderers' incentive rate includes an allowance for changing irons. This allowance provides that a new pair of irons be obtained once every 4 p.s.h. The standard cost of the soldering-iron dresser per solderers' p.s.h. is, therefore,

$$\frac{\text{2 irons} \times \text{std. hrs. per iron dressed} \times \text{std. hr. rate of dresser}}{\text{4 p.s.h. of solderers}}$$

Next, the airtightness inspector: The foreman states that when the line is operating at capacity, one inspector at this station is employed for a normal crew of nine solderers. The need for maintaining continuous flow of material is such that this man must be kept full time at his post at this level of operations. He is not on incentive. The easy way to set the standard would be to solve the following equation:

$$\text{Std. cost per p.s.h.} = \frac{\text{1 insp. hr.} \times \text{inspector's hourly rate}}{9 \times \text{solderers' p.s.h. per actual hr.}}$$

Suppose, however, that in order to increase the number of canisters per day, two more solderers are added and that the single inspector can still handle their output. The standard would then be loose, and the comparison of actual with standard cost would show a favorable variance not really the result of good performance in cost practice. This situation can be avoided either by setting up this inspector as a fixed expense or by having the time-study man make a brief study of the inspection time per canister. Considering his cost as fixed assumes that the inspector must be employed regardless of how busy he is. The second alternative, setting one cost on the basis of the actual inspection time required, assumes that he can be given other fill-in jobs to occupy the voids in his working day. Which method is to be followed depends upon company policy. In the second method, the standard cost of inspection will be

$$\text{Std. cost per p.s.h.} = \frac{\text{allowed insp. hr. per can.} \times \text{insp. hourly rate}}{\text{solderers' p.s.h. per canister}}$$

The time study would of course be used merely for the purpose of the estimate and would not mean that the inspector was necessarily to be placed on incentive. It should be based on the assumption that the inspector will work at an incentive pace, since he must keep up with solderers who are on incentive even though he is not on incentive.

The standard indirect-labor cost per p.s.h. of the repair assemblers is also based on a study of the job. From inspection records for a representative reference period, the standard-cost accountant finds how many canisters were passed O.K. after the assembly operation and how many were rejected for repairs. The chief inspector supplies him with an estimate that approximately 40 per cent of the rejects are avoidable, the remainder being due to uncontrollable variances in the material. The repair operation is one that, because it is fairly uniform in its elements, is on incentive. Therefore,

Std. repair assemblers' cost per assemblers' p.s.h.

$$= \frac{(\text{no. of cans. repaired in ref. period} \times 60 \text{ per cent}) \times \text{std. repair hr. per can.} \times \text{repair assemblers' std. hr. rate}}{(\text{no. of cans. initially O.K.'d plus number successfully salvaged in ref. period}) \times \text{assemblers' std. hr. per can.}}$$

The work of the material-handling laborers can easily be timed for estimating purposes, and the time for handling quantities of materials reduced to the fraction of that time applicable to the materials for one canister. In this case, since these men are not on incentive and are not directly paced by another sequential operation, the time should be that required when working at a day-rate pace. If they should later be placed on incentive, the standard will at that time be revised. Having been estimated, the time is multiplied by the hourly day rate; and since this cost is to be prorated over all operations, the product is divided by the total p.s.h. per canister, within the cost center.

The same procedure is followed for the sweeper, general inspectors, and clerk (who can also be timed). Or they can be set up as a fixed force.

The standards having been set, they are checked against reference costs for a representative period, which can be obtained by abstracting the cost of each indirect-labor occupation and dividing it by the p.s.h. to which it applies. A good system of actual costs is especially useful for such purposes.

Another method, not mentioned previously in this chapter, of setting standard costs for indirect labor is to reduce the reference cost per p.s.h. by some arbitrary percentage. This practice, known as "leveling," has only its simplicity to recommend it. To apply an over-all percentage to some past cost is the easiest, and for some cost items the only, approach. But indirect labor can be so readily analyzed on the basis of its potential performance that there is no reason to substitute guesses for standards that have a meaning.

To summarize, the correct method for setting indirect-labor standards is to determine by means of time studies, inspection records, production records, and materials-consumption records just how much indirect labor is required for a p.s.h. on each operation. This determination really boils down to answering the questions: What does this indirect labor do? How long should be required to do it? and How much of it should be done for every p.s.h.? There are some instances, several of which have been commented on both in this chapter and in Chap. III, where the answers to these questions must be conditioned by the factor of attainability; *i.e.*, even knowing how long it takes a given occupation to do its stint, we may be forced to allow more time and even to set up certain costs as increasing in amount per p.s.h. at low-level operations, regardless of percentage working time, because of physical plant considerations or because of company policy. (Note the crane operator mentioned in Chap. III and the airtightness inspector on page 70.) But even in such cases, analysis is necessary to reveal these necessities.

Hourly Rates

Not only is a standard labor cost affected by the quantity of labor allocated to a denominator of production; it is also colored by the labor rate.

There are two general methods of payment of hourly rates. In some companies the rate goes with the job, so that no matter who works at a given occupation, only one given rate is paid for the work. In other plants the hourly rates are set for the individual; a man receives his own rate, no matter what job he does, and conversely a specific operation may be performed by men at a variety of rates. A hybrid form occurs where there is a limited range of rates for each occupation, a worker's place in the range depending upon his service or ability but no one being employed on the occupation outside the range.

Aside from the respective merits of the three methods, the standard-cost accountant may have to set costs under any one of them. If occupational rates are used, the standard labor cost of an operation is, of course, well established.

If, however, a system of individual rates prevails, each operation must be evaluated in terms of the degree of skill, effort, etc., that it requires. These qualifications are then translated into money; *i.e.*, a given rate of pay is specified as applicable to that job at standard performance. This determination of the applicable hourly rate can best be made by the industrial engineer in cooperation with the foreman. If, for one reason or another, men are used on the job who receive a rate higher than is necessary for that type of work, a variance reflecting this fact will appear between actual and standard cost.

Where there is a range of occupational rates, the average of the range is employed.

In cases where the individual rates of the employees in a given cost center are such that it would be impossible to schedule every job at its most economical rate, an average of the rates of all men available for a given operation is better used in setting the standard cost. To do otherwise is to base the standard cost on hypothetical figures not entirely controllable by the supervisor, which could be attained only by a complete turnover of the labor force.

Summary

Direct labor and indirect labor are distinguished from each other only by the degree of accuracy with which their cost can be assigned to specific p.s.h.

Standard costs of direct and indirect labor are most effective when they are based on good, attainable future performance. This performance is ascertained through job studies and through the analysis of statistical data by all persons connected with the operation.

The costs thus obtained are tied in as closely as possible with p.s.h. on the operation that necessitates their occurrence.

QUESTIONS

1. A certain plant utilizes a wage-incentive plan having the following characteristics:

a. Production is expressed in terms of standard hours.

b. Per cent performance is defined as standard hours earned divided by actual hours worked.

c. A worker operating at an average nonincentive pace earns eight standard hours in an 8-hr. day.

d. A worker operating at a fair incentive pace earns ten standard hours in an 8-hr. day; the standards are set with the expectation that good workers will be able to maintain this pace.

e. Workers are guaranteed their basic hourly rate, and for each per cent performance above 100 per cent they receive 0.8 per cent of their basic hourly rate as a bonus.

Would you base the standard cost of labor on anything less than 100 per cent performance? What per cent performance would you choose as the level for calculating standard costs? Calculate the standard cost of direct labor per standard hour for workers whose basic hourly rate is $0.80.

2. The heavy-machine shop of a pump-manufacturing company employs in addition to machinists the following workers:

Standard quota	Occupation	Hourly rate
2	Inspectors	$1.10
2	Swarf wheelers	0.75
1	Tool grinder	0.90
1	Toolroom attendant	0.85
1	Craneman	0.90
1	Hook-on	0.80
1	Clerk	0.85

The shop operates one turn per day, five 8-hr. days per week.

a. The maximum number of available working days varies from month to month. Calculate a fixed standard cost of indirect labor that can be multiplied by the number of working days to obtain a fixed standard cost for any month.

b. If the normal monthly production of the shop is 6,000 p.s.h., calculate a normal standard cost per p.s.h.

c. Describe another way of setting a standard cost of indirect labor for this shop.

If the standard cost for any actual month were obtained by using the answer to *a*, how would it differ from that obtained by using the answer to either *b* or *c*?

CHAPTER VI

SETTING STANDARDS FOR MATERIALS

For accounting purposes material costs, like those of labor, are divided into two groups: those which can be computed exactly for each unit of product and those which cannot be so computed and must therefore be distributed over all products. The first group is called direct materials; the second, indirect materials or operating supplies. Strictly speaking, indirect materials are those which are a part of the product but which are so small or difficult to measure that it is impractical to figure their cost separately. An example is the mucilage used to attach a label to the product. Under this strict definition operating supplies are those miscellaneous materials which are used in manufacturing but do not become part of the product, *e.g.*, the brushes with which the aforementioned mucilage is applied. Since the standard-cost treatment is the same for indirect materials as for operating supplies, both accounts will in this book be grouped together under the former title.

In this chapter, the discussion of establishing materials standard costs will be subdivided into a consideration of

1. The standard price of materials.
2. The standard volume of direct materials.
3. The standard volume of indirect materials.

Standard Price of Materials

The Responsibility for Savings.—Standard costs are a device for directing the attention of the management to possibilities for economies with existing equipment, methods, and materials and for indicating who is responsible for effecting these economies. "Existing equipment, methods, and materials" are specified because no one could possibly, when setting standards, foresee all the potential improvements that might be made in the future for the sake of cost reduction. And even if such improvements could be foreseen, to incorporate them in the standard before they have been proved would make that standard so hypothetical that serious questions of its attainability would be raised. Standards must be attainable, as has been said, so that the supervisor, having a mental picture of himself meeting the standard, will be encouraged to make that mental image a reality. Of course, in the process of setting standards, certain obvious methods improvements frequently present themselves. These may safely be embodied in the standard, but only if it is certain that the supervisor is able to make them immediately effective. Otherwise, untried ideas should not be considered, so far as standard costs go, until their worth has been proved through tests. Therefore, the standard costs for materials are based only on materials that have actually been used or specified by the engineering department.

Also, the intent of the system is to fix the responsibility for savings. Therefore, care must be taken that the future comparison between actual and standard reflects only those savings possibilities which are actually controllable within the cost center affected. Materials costs are a function of two variables: the purchase price of the materials and the amount of materials used. The first is nearly always the result of conditions outside the foreman's domain. The second is nearly always directly controllable by the foreman's alertness in preventing waste. If the effects of these two variables are not separated, then the extent of the foreman's responsibility for variances between actual and standard costs of materials is concealed.

Suppose, for example, that for a given material used in a cost center the actual cost in one month is $2,000 whereas the standard cost is $1,500. A $500 variance must be accounted for. This variance may be due to an increase in the general market price, to an increase in the incoming freight charges, to a change in suppliers (assuming that the material itself is not changed; for if it were, the standard would be changed also), or to the foreman's having used more than the standard quantity. Since materials are obtained by the purchasing department, the foreman's contribution to the variance can be exposed only by eliminating the effects of all but the last-named factor.

This is accomplished by setting a standard price for each material used, whether direct or indirect. The actual charge to the cost center then is equal to the actual quantity of materials used times the standard price. The standard cost for the cost center is equal to the standard allowable quantity of materials times the standard price. As far as the cost center is concerned, price has thus been eliminated as a contributor to variances. Within the cost center the variance is influenced only by quantities. It measures nothing more than the amount of money that the foreman himself can actually save. It therefore conforms to the principle of fixing responsibility for particular costs.

Limitation on Use of Standard Price.—Failure to remember that standard prices are employed only in order to eliminate uncontrollable variances in cost-center charges may result in misleading conclusions. It might be supposed, for example, that a good practice would be to use the month-to-month variance between actual and standard prices of materials as a gauge of purchasing-department efficiency. If it were a purchasing department's job to get materials at the lowest possible price, such a usage would be defensible. In reality, however, immediate prices are controllable only to a limited extent by the purchasing department. They are much more the result of market conditions, selling practices, trade customs, supply and demand relationships, and seasonal and cyclical variations. The purchasing department has only two instruments for shaving prices down. One is the order quantity. But whether or not it is permissible to stock-pile materials, to anticipate future price increases by advance buying, to obtain discounts through quantity purchases—all in order to reduce prices—is a matter too intimately connected with general company financial policy to be subjected to the somewhat mechanical operations of variance control.

The other way in which a purchasing department can attempt to cut purchase prices is to experiment with various vendors until it finds one that can provide the desired materials at the lowest price. And here, again, it is not entirely desirable to encourage such a practice. For price is not everything. Good service, financial responsibility, reciprocal agreements (which are frequently found beneficial in actuality, though theoretically unjustifiable), accessibility, research facilities, technical assistance, all these may dictate the choice of a supplier just as much as does price. For these reasons, therefore, it should not be assumed that the existence of standard prices in the cost records implies that they are to be used as a bench mark from which to measure the performance of the purchasing department. Their chief purpose (for control) is to provide a means whereby the cost of materials used by an operating cost center will vary only because of varying quantities used.

Setting the Standard Price.—Since the standard price is to be employed only as a filter for removing all variations in the cost of materials prior to the entry of those materials into the cost center, there is no reason why it cannot be based on actual costs. In fact, a standard price can well be the average price for, say, the year preceding the time of its establishment. Or again, it may be the price that is expected to prevail in the ensuing year. If an average is used, the type of average (whether a simple average, a weighted average, one based on first-in-first-out, etc.) can be decided by the type already in use in the stores inventory records.

What *is* important is the requirement that the price of each commodity be tied in with a description of that specific commodity. This tie-in is accomplished through a listing of all items of material which

1. Names the material.
2. Either gives a brief description of the specifications or refers to the specifications sheet by number (if such sheets are used in the company).
3. Shows the standard price of the material.

The listing should also be identified with the date on which it is issued in order to facilitate future revisions. An illustration of such a listing follows:

STANDARD MATERIALS PRICES

Jan. 1, 19__

Commodity No.	Description of material	Spec. sheet No.	Unit	Unit price
4–0005	Sodium silicate	2132	Gal.	0.600
0008	Sodium bichromate	2147	Lb.	0.075
0009	Peroxide	2148	Gal.	1.037
0011	Potassium nitrate, commercial grade	2172	Lb.	0.283
0013	Boric acid powder	2030	Lb.	0.061
0014	Cupric sulphate	2182	Lb.	0.190
0016	Zinc chloride crystals	2199	Lb.	0.070

The listing may alternatively be prepared in the form of a card file, with a separate card for each item.

It is important that the item be fully described. Thus, in the above listing appears "Potassium nitrate, commercial grade," not merely "Potassium nitrate." This distinction is made because changes in a given material may be accompanied by changes in incidental manufacturing costs. In a foundry, for example, a change in core sand binders might easily result in an increase or decrease in the number of scrapped cores.

Standards are based on present attainable conditions. A change in the type of material may affect the attainability of the standard. Therefore, such a shift justifies an investigation of the need for changing the standard rate of consumption as well as the standard price. And it may be that such an investigation will reveal the rate of consumption of the new material at its own standard price to be uneconomical compared with that of the former material. In any case, the relationship between the nature of the material and its rate of consumption is so close that if standard quantities are to be set, they must necessarily be identified with a particular commodity.

One more observation may be made with regard to price establishing. Many stores commodities are not bought outside the company; they are manufactured within the plant and transferred to the storeroom pending the date of final use. In this case, the standard price is equal to the standard cost of the item, obtained by multiplying the total p.s.h. for its manufacture by the respective standard costs per p.s.h.

The Denominator

In the case of materials the rule that all standard costs are expressed only on the basis of p.s.h. is violated. For although experience has shown that for a given operation every p.s.h. requires approximately the same amount of labor and overhead, the fact is obvious that the amount of materials used may vary. Consider the operation of a nibbler in a tin shop. The operator of this machine clamps a template to a sheet of metal from which a part is to be produced. He then inserts the metal in the nibbler and manipulates it so that the rapidly vibrating punch moves around the template and "eats" out the desired part from the sheet. He finally smooths the rough edges with a hand file. On any part he is making, the cost of labor, power, supplies, etc., per p.s.h. is practically constant. But in that standard hour he may, in accordance with the requirements of the job, cut out a few small, intricate shapes requiring a relatively large amount of time per piece, or he may produce a greater quantity of larger, simpler cuttings requiring relatively little time per piece. The quantity of materials consumed in a standard hour thus depends upon the nature of the product. Standard materials costs are therefore expressed as so many dollars for each unit of product turned out.

Standard Quantity of Materials

Product.—The aid of the engineering, purchasing, stores, inspection, and operating departments is enlisted in calculating how much material should be used. The methods employed in arriving at the answer depend so greatly on the nature of the product that only a general approach to the subject can be described here.

Two procedures are available for determining the standard quantity of material required: theoretical calculation or actual test. The first requires only that the standard-cost accountant refer to drawings or bills of materials supplied by the engineering department for his data. Some examples are given.

1. *Screw-machine Product, ⅞ in. Hexagonal Nut, Brass.*—The standard-cost accountant learns from the drawing that the hexagonal nut is 7/16 in. long. From the screw-machine cost-center foreman he learns that a tool ⅛ in. wide is used to cut the nut from the bar stock of which it is made. The minimum amount of material required is therefore ⅞ in. hexagonal brass bar stock 9/16 in. long.

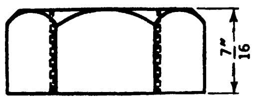


Fig. 5

2. *Punch-press Product, Housing Cover.*—From the punch-press cost-center foreman, the standard-cost accountant learns that the cover is blanked from 3-in. strip brass in the following manner:

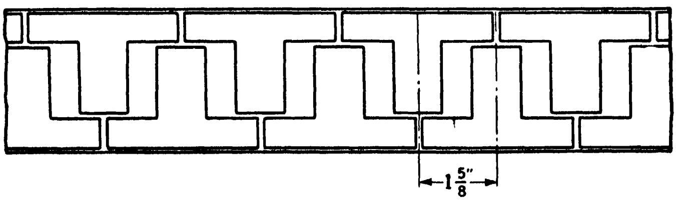


Fig. 6

The amount of strip brass required is shown by the sketch to be $1\frac{5}{8}$ in. per piece.

3. *Open-hearth Furnace.*—From the metallurgical department the standard-cost accountant learns that for grades of steel having certain ladle analyses, the following weights of raw materials are theoretically necessary for each ton of steel:

Standard Costs *

Specification—C, Si, Mn, P, S
Date of Adoption of Standards

Components of charge	Standard price per ton	S. C. 1—Standard iron charge		S. C. 2—High-silicon iron charge	
		Per ton of good steel			
		Weight, tons	Amount	Weight, tons	Amount
Basic hot metal.......	$ 28	0.68508	$19.18224	0.69029	$19.32812
Iron in ferromanganese	28	0.00111	0.03108	0.00157	0.04396
Steel scrap...........	24	0.36898	8.85552	0.37179	8.92296
Metal from ore.......	12	0.05005	0.60060	0.07136	0.85632
Pure Mn from Fe-Mn.	162.5	0.00446	0.72475	0.00626	1.01725
Gross metallic mixture.	....	....	29.39419	....	30.16861
Credits:					
Heavy scrap........	*24*	*0.01110*	*0.26640*	*0.01141*	*0.27384*
Pit scrap...........	*20*	*0.03330*	*0.66600*	*0.03424*	*0.68480*
Net metallic mixture..	....	....	28.46179	....	29.20997
Limestone...........	2	0.06940	0.13880	0.16009	0.32018
Fluorspar............	23	0.00316	0.07268	0.00319	0.07337
Total costs.......	....	....	28.67327	....	29.60352
		Say....	28.673		29.604

* Ryder, F., Standard Cost Procedures, *Blast Furnace and Steel Plant*, February, 1941.

Not always can materials requirements be calculated with sufficient accuracy to justify the time required. In this case the product itself may be measured or weighed or a test run be made in order to arrive at the answer. For example:

1. *Glass Ash Tray.*—To figure from the drawing on page 82 the exact weight of glass required would be a lengthy job.

The standard-cost accountant therefore obtains a dozen trays

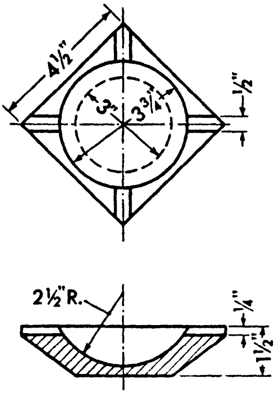


Fig. 7

from stock and weighs them in order to find the materials requirements. Allowance is made for molding losses.

2. *Paint for Toy Express Wagon.*—Bodies for toy express wagons for children are sprayed with red paint before final assembly. Although the engineering department specifies a paint thickness of 0.002 in., it is known that this requirement is highly theoretical. The standard-cost accountant enlists the aid of the time-study man who time-studied the spraying operation. With the permission of the painting foreman, an operator is instructed by the time-study man to spray each body for exactly the length of time that he tells her, which is the minimum time required for the application of an acceptable finish. The amount of paint in the can attached to the spray gun is measured before and after a run of 30 bodies in this controlled test. From the results of the test the standard-cost accountant then computes the average amount of paint used per body. Such studies as this demand a certain amount of care in their performance in order that standard conditions may exist. In this example certain variables such as the number of bodies painted at a time (and hence the amount of overspray paint that can be utilized), the relative proportions of paint and thinner, the room temperature, the surface condition of the bodies prior to painting, and the operator's dexterity can all influence the results. The standard-cost accountant obtains accurate data from his study only if he makes sure that these conditions are at the best attainable level during the study.

Scrap.—The establishing of a standard price and a standard quantity of material will not suffice to set a standard cost, for of the material originally used, a certain amount is usually salvaged and sold as scrap. Where this scrap occurs in any volume, an effort should be made to compute its effect on the individual standard costs. This can usually be done in the same way in which the quantity of original material is determined. To return to the preceding examples, the production of the hexagonal nut illustrated on page 80 is accompanied by the production of a quantity of brass turnings. Their volume can be learned by computing the volume of the finished product from the dimensions on the engineering drawing and subtracting it from the volume of bar stock consumed. Or it may be more readily determined by weighing a number of the finished nuts and subtracting the average weight from the calculated weight of bar stock per nut. A similar procedure can be followed with the strip material used for the stamping shown on page 80. And for the open-hearth furnace cited, past records can be used to predict the amount of slag or cinder produced simultaneously with the steel, which slag may or may not be salable, as well as the amount of scrap to be expected in the form of ingot butts, etc. Scrap and by-product computations can nearly always be made in connection with chemical or metallurgical processes. It is not, of course, necessary for the standard-cost accountant to perform them; he needs here, as in practically all his work, the aid and cooperation of other members of the staff.

Also susceptible of measurement is that scrap which, although not removed from the individual item produced, may nevertheless be prorated to it. To continue the example of the hexagonal nut, it is found that of every bar of hexagon brass rod fed into the automatic screw machine, approximately 6 in. at the end cannot be used, as it is the minimum length that can be gripped in the chuck. The difference between the initial and scrap values of this crop end is therefore prorated against the number of good pieces that can be cut from a bar of average length, as an additional scrap cost. Furthermore, at the time when the machine is set up, a number of trial pieces are run while the tools are being adjusted, until pieces of the correct dimensions are obtained. These pieces, scrapped because they are off size, are also considered in the scrap allowance, their number being determined by consulting the foreman and inspector or by making studies of setups.

Calculated values such as these are always preferable because they picture best attainable conditions. When, because of the difficulty of making them, they cannot be employed, actual tests may be resorted to. For example, consider the problem, How much standard scrap credit should be allowed on a given valve body casting turned out by a brass foundry? The operations involved are melting; pouring, in which the hot metal is poured into a sand mold consisting of a central runner gated into 12 individual valve body cavities; trimming, in which the bodies are severed from the gate; and finishing, in which the bodies are ground and shot-blasted. The amount of scrap in the first three operations is most accurately determined by operating the foundry for a day under close scrutiny, observing the degree of care exercised to prevent undue splashings of metal and other wastes, and having whatever defective castings are produced classified by the inspector as due to controllable or uncontrollable causes. From such a study, which may be made for general conditions insofar as the various losses due to heating and pouring are concerned and for particular products insofar as losses due to spoiled castings are concerned, a percentage ratio of allowable scrap and loss per ton of good product can be obtained. Scrap in the second operation is found by weighing the valve bodies after trimming and subtracting the value thus obtained from the average weight of a "gate" prior to trimming. Scrap loss in the finishing operation is similarly found by weighing the castings before and after. All these losses are then translated into the cost in dollars per good casting.

An alternative method of determining general scrap losses is to make a study of past average losses on all materials and set the standard scrap-loss cost as an arbitrary percentage of the historical cost. Regardless of the method of determination, care must be used in segregating the various classes of scrap that may be produced from identical original material. For example, turnings, chips, filings, or solid scrap may be obtained from the hexagon bar stock aforementioned, and each may have a different selling price. Spoilage, other than the minimum amount incident to setups, is not usually allowed for in the standard.

Setting the Standard

The standard cost of direct material can now be established. It is equal to the standard total amount of material required times the standard price for that particular commodity, minus the standard quantity of each class of scrap times the standard price of the respective class of scrap. The standard amount required is equal to quantity of material in finished product times (1.00 + per cent scrap), where per cent scrap is the ratio of standard quantity of scrap to standard quantity of material in the finished product.

This standard cost of material is set for each operation at which materials are initiated into the operations of the cost center. This method of setting standards does not necessarily imply a corresponding system of collecting actuals, for it would frequently be difficult indeed to credit particular operations with the value of scrap produced. Standard costs are cumulated at the end of the month on the basis of the status of completed operations on products transferred from or remaining in the cost center. Actuals are cumulated on the basis of total charges and credits to the cost center.

The few examples given here of direct-materials standards will serve as an indication of the general approach. They are all based on the principle that good direct-materials standards must be set as a result of knowledge of the operation, not of guesses. The standard-cost accountant who adheres to this rule can set effective standards for any operation on any product, from bonbons to locomotives.

Yield

In processing operations, where quantities of raw materials are subjected to changes in state, a valuable statistical index is provided by the per cent yield.

This percentage is equal to the amount of good material produced divided by the amount of raw material consumed. For example, in a blooming mill, the per cent yield is equal to the tons of good blooms shipped divided by the tons of ingots charged into the soaking pits. The same principle can be applied to a biscuit factory by dividing the weight of flour, egg powder, etc., consumed into the weight of cookies shipped in a given period.

From the calculations of standard quantities of good materials and scrap for a given unit of product, a standard yield can be developed. Thus, for a given size of product turned out from a blooming mill, the standard loss of metal in the form of scale is set at 2.0 per cent of charged tonnage. The standard amount of material to be cropped from the ends of the rolled bloom is set at 16 in. on one end and 40 in. on the other end of a 566-in. bloom. The standard allowance for cobbles, or spoiled blooms, is set at 0.5 per cent. These figures are set by the metallurgical department on the basis of an analysis of operations. Then,

$$\text{Per cent yield} = \frac{\text{weight of good product}}{\text{weight of material charged}} \times 100$$

For every ton charged, 2.0 per cent is lost as scale, and 98.0 per cent is rolled; 0.5 per cent of the 98.0 per cent rolled, or 0.49 per cent, is lost in cobbles. This leaves 97.51 per cent to be cropped. Of the 97.51 per cent, the crop percentage is $\frac{16 \text{ in.} + 40 \text{ in.}}{566 \text{ in.}} = 9.89$ per cent. The percentage of final product is therefore 97.51 per cent $\times$ (100 − 9.89 per cent) = 87.87 per cent, which represents the standard yield for the class of product in question.

This yield figure constitutes a useful managerial control of materials consumption. Since it is based only on quantities, the actual per cent yield is independent of variations in price—even of year-to-year fluctuations in standard price. Also, being based only on total quantities charged and produced, it is readily computed. For this reason it can be prepared daily, and any unfavorable disparities between actual and standard yield can be investigated before they have time to amplify to such an extent as to affect costs seriously.

Indirect Materials

Some examples of indirect materials are

Safety goggles.
Labels.
Cutting oil.
Brooms.
Foundry sand.
Light bulbs.
Wrapping twine.

These are all chargeable to various expense-item numbers. Some of them, *e.g.*, cutting oil, are obviously further chargeable to particular operations. But others, such as brooms, can be charged only by distributing them over all operations. For some of them, especially those which are tied in with specific operations, it is frequently possible to determine standard consumption by means of tests, just as with direct materials. It is a simple matter, for instance, to measure the amount of coolant in the pan of an engine lathe, then stand by the lathe for several hours while making sure that the coolant is pumped at the rate necessary for effectiveness without undue splashing, then measure the amount remaining. This can be done by the time-study man in the course of a time study of the operation of the lathe. The volume consumed divided by the standard hours represented by the product turned out represents the standard amount allowable.

But because it is impossible to make such tests for all commodities, the standard costs of many indirect materials are usually estimated. For this purpose a good set of historical costs is invaluable. The first step in preparing the standard is to list the various expense-item costs for a suitable reference period together with the p.s.h. for that period. Each item is then divided by the standard hours of the operation so that a unit cost may be obtained. A superficial scrutiny of the results will show which costs vary with production and which remain relatively fixed. These data can be tabulated as follows:

INDIRECT MATERIALS

Cost Center No. January through June, 19__

Expense item		Jan.	Feb.	Mar.	Apr.	May	June
No.	Description						
904	Electric-light supplies	$ 35	$ 34	$ 36	$ 33	$ 35	$ 32
908	Safety supplies	360	320	332	365	408	365
909	Cleaning supplies	45	40	33	54	62	42
920	Office supplies	28	28	25	27	30	26
912	Material racks	110	123	95	159	183	120
	P.s.h. earned.....	25,000	23,000	22,000	26,000	28,000	25,000

In this example an examination of the costs, all of which are distributive charges, shows that the cost of electric-lighting supplies alone remains relatively constant from month to month. Therefore, when total standard costs are finally built up for this cost center, the cost of this item will not be calculated on the basis of productive output, although that of all the other items will. Instead, it will be held out as a fixed expense.

A discussion with the superintendent of stores and the cost-center foreman reveals

1. That no reduction in cost should be asked for on safety supplies, since the company does not wish to discourage their use. Therefore, standard cost is set equal to the average monthly unit cost.

2. That nobody knows exactly how much reduction could be made in the consumption of cleaning supplies, office supplies, or material racks. This leaves the matter more or less up in the air. However, the standard-cost accountant knows that no great amount of attention has been given to materials conservation—that the supervisors are not as cost conscious as they might be. Therefore, since it is reasonable to expect that a cost reduction is possible and since it is desirable to set a mark to shoot at, the standard cost of these items is arbitrarily set at 80 per cent of the average monthly cost per p.s.h. for the period examined. It is understood that this standard is, like all others, subject to revision if it later develops to be out of line with attainable results. This example, it will be noted, covers only those costs of indirect materials which are general to all operations in the cost center. The same procedure can be applied to costs charged straight to specific operations.

The general method, then, of setting indirect-materials costs, is as follows:

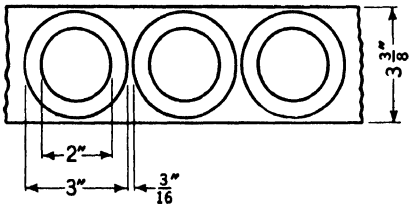
1. Determine standard consumption per p.s.h. by means of tests, whenever possible.
2. For those items which cannot be tested, summarize historical costs.
3. Separate fixed and variable expenses.
4. Reduce variable expenses to a per-p.s.h. basis.
5. Analyze each cost to see if knowledge exists as to the extent to which it might be reduced, and set the standard on this basis.
6. If no knowledge exists, arbitrarily reduce actual cost, and call this standard, earmarking it for future recheck.

Summary

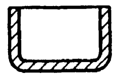
In order that the standards may measure cost-center performance, variances due to price changes are eliminated through the use of standard prices for both actual and standard costs. A standard rate of consumption is then established, being based on an analysis of minimum attainable requirements. Allowance is made for scrap and permissible overconsumption. Standard yield figures may be developed for auxiliary control purposes. Standard costs are also developed for indirect materials, although actual test measurements cannot always be employed.

QUESTIONS

1. In the punch-press department of a certain plant, rings are blanked from strip material as follows:



The loose disks that fall from the center are saved and are later formed into small cups, as shown:


(Enlarged)

Only one cup is required for every two rings, so that only one half of the disks produced are used, the remainder being sold as scrap, along with the skeleton left by the rings. The standard price of the material is $0.13 per pound, the standard scrap value being $0.02 per pound; and the strip material weighs 7 oz. per lineal foot. Calculate a standard material cost per 100 pieces for the ring and for the cup, showing the cost of the initial materials and the scrap credit separately. What is the reason for showing the scrap credit separately?

2. What are two methods of determining standard materials requirements?

3. Under what circumstances should the standard price of a commodity be revised?

4. A foreman declares that although the specifications for a certain material that he uses have not been changed, the most recent batches received have been of substandard quality, so that he has had excessive materials losses. He requests a revision of the standard of quantity to recognize this fact. You also find that the price of the material has not changed. What effect on cost control would the proposed revision have? Would you recommend making the revision?

CHAPTER VII

SETTING STANDARDS FOR MAINTENANCE AND OTHER SERVICES

This chapter discusses the setting of standards for maintenance and other services that the operating cost-center supervisor buys from other cost centers. Reserved for Chap. VIII is a consideration of a specialized form of such services: fuels and power.

The thinking behind these standards is that intraplant services are for the benefit of the operating cost centers, that they are purchased by those cost centers just like materials, and that their volume is therefore subject to the control of those cost centers. Economies in the use of services begin to be possible when the supervisor of an operating cost center grasps these ideas, when he realizes that services are neither to be presented to him as a gift nor to be thrust upon him unwanted and that he should allow his center to be charged only with those costs which he considers necessary. The supervisor who is imbued with this fundamental idea—that he is responsible for the acceptance of everything sold to him—no longer permits maintenance men, operating engineers, inspectors, or clerks to be charged to him unless he is convinced that they improve the performance of his department.

Although in accounting terminology these costs are lumped together as "overhead," "burden," or "manufacturing expense," good standard-cost practice avoids such a grouping. Rather it views them in the light of controllability and segregates them according to whether or not the cost center to which they are charged can dictate the volume of their consumption. Hence the cost sheet presented to a foreman ignores many overhead items usually included in the cost sheet for the plant as a whole. In this way it focuses the foreman's attention on those expenses which he can reduce and, by comparing actual cost with standard, suggests the extent to which he is expected to do so.

Control

For most intraplant services there is a joint responsibility for control. The purchaser of the services controls the quantity that is needed. The supplier controls the quantity needed, the quantity available, and the cost. Consider any large plant where millwrights, for example, work for a maintenance department selling its services to operating departments. An operating foreman who keeps his equipment clean and well lubricated and avoids overloading it will require less millwright service than one who does not. The operating foreman should therefore be held responsible for the number of millwright hours charged to his cost center. At the same time good maintenance work will act to reduce the amount of subsequent maintenance required. The millwright foreman, then, being responsible for the quality and efficiency of the work, also has some control over its volume. And since he alone can control the cost of tools and materials used by his men, he alone is responsible for the cost per hour of millwrights.

As far as the operating foreman is concerned, the problem is identical to that of materials: one of setting a fixed price at which he purchases the commodity or service and using this price in both actual and standard costs, so that any variance within the operating cost center will be solely attributable to volume. First, then, the fixed selling price per unit is established. And secondly, the standard consumption, or number of units sold per p.s.h., is set.

Units of Sale

Materials are sold, and the price is fixed, in terms of pounds, feet, square inches, gallons, yards, etc. Services are always sold in terms of hours.

Ideally, services would be sold in terms of the job performed. Some plants, usually large ones, have carried their time-study and estimating procedure to the point where for every maintenance and repair job performed, a predetermined time and hence a predetermined cost are set. Where such a system operates, the pipe fitters, for example, are allowed a fixed time for replacing a given valve. The department for which the valve is replaced pays for this much time—no more, no less. Any difference between the actual and standard time is charged to the pipe fitters. Again, in a large office building, standard times have been established for janitor work, so that there is, in effect, a piece rate for cleaning a sink, washing a window, scrubbing a square foot of floor, emptying a wastebasket, and so on. A third example is that of a chain-grocery firm which set standard times for trucking produce to its various outlets and for unloading various sizes and weights of containers into the stores. How much service the retail-store manager obtained from the trucking division was thus well established in terms of standard hours per job. Under such circumstances the unit of sale is so well defined that standard allowable costs for services can be very accurately established.

However, few companies are so far advanced along the road of standardization, and for very understandable reasons. In the average plant, continual improvements and changes in products and processes are sufficient to keep the industrial engineers too busy with production to spend time setting standards on auxiliary service departments. Moreover, service standards are frequently very difficult to establish. A few jobs, such as sweeping, window washing, or bricklaying, are readily time-studied. But to build up sufficient data for setting standards on, say, the numerous operations on each machine (shaper, planer, grinder, jig borer, lathe, drill press, bench) in even a medium-sized tool-and-die shop requires a number of engineering man-hours that few plants have available. And once the basic data are accumulated, the task of applying them to every different job that comes along opens up possibilities for clerical errors and loose rate applications that may undermine the value of the system. This does not mean that standards on this type of work are undesirable. Well conceived, they are a gold mine. But they can succeed only when installed by highly skilled engineers thoroughly familiar with the operations involved. And because not every company can avail itself of such abilities, service incentive standards that amount to much more than a device for paying a bonus to auxiliary workers are still relatively rare.

This being the case, prices for services are as a rule best set on the basis of the number of service man-hours sold.

Sold-hour Rates

The fixed dollar cost of a service man-hour is known as the "sold-hour rate."

For a given service cost center, this rate is developed in the following steps:

1. For a representative period, 12 average months, say, the expenses of the service cost center are summarized according to their nature.

2. The costs of supervision, operating supplies, tools, etc., are then analyzed, just as for operating cost centers, with the purpose of ascertaining what their amount should be at standard performance. If no better method is available, the standard for those items susceptible of reduction is set at an arbitrary percentage of the actual cost. This percentage is based on the opinion of those persons in the organization familiar with the cost center. Experience has shown that a figure of 70 per cent is seldom too low for items other than supervision. This method, although it may seem unscientific, provides a good working tool until better means are available.

3. The hourly rate of pay for men covered by the sold labor hours is not reduced, since it depends upon company-established rates of pay.

4. The "leveled" costs and the labor cost are then added together and divided by the total hours of labor sold to other cost centers. This figure is the sold-hour rate.

The service cost center is charged for all expenses at their actual value. It sells its services to other cost centers at the fixed sold-hour rate. The difference between its actual cost and its "income from sales" (as the product of total hours sold times sold-hour rate might be called) is a variance due to cost performance within the service cost center.

Standard Quantities

We now know how much the operating cost center will pay for every man-hour of service that it buys. But how many hours should it buy at standard performance?

Lacking predetermined job standards, resort must be had to estimates, and estimates are best made in the light of knowledge furnished by historical records. Historical records are, it is true, no criterion of what standard or good future performance should be. Estimates based on them do, however, furnish a good steering point for arriving at a standard, and subsequent experience with the estimates shows in what direction the course should be corrected in order to arrive at the final goal. Furthermore, industrial engineering experience has shown that there is a general average relationship, though only a loose one, between the working efficiency of day-rate workers and that of incentive workers. A survey of incentive plans approved in 1944 by the War Labor Board showed that on the average the output of approximately 1,000,000 dayworkers was 71.4 per cent of their subsequent production on incentive.[1] To put it another way, workers on incentive require 71.4 per cent as much time for a given job as dayworkers do. If our service workers are not going to be on incentive, we cannot expect to obtain this full reduction. But it is safe to say that a reduction to 90 per cent would be obtained by improved supervision alone. Better care of equipment, resulting in less service hours being required, should reduce the percentage to 80 per cent.

The first step, then, in setting a standard is to tabulate the number of service hours of various types sold to each cost center in a representative period. This tabulation is most useful if it shows

1. The number of hours sold to each operating cost center by each service cost center.
2. The specific operation for whose benefit those hours were necessitated, *i.e.*, how many service hours were chargeable to each machine or work group.
3. The distinction between varying and fixed or semifixed charges.
4. The number of p.s.h. earned by the operations charged.

The first point is obvious. The second is a step toward the eventual construction of a standard cost for each operation. The third is necessitated by the fact that some services, *e.g.*, window cleaning, must be performed regardless of the amount of activity in the department whereas others, *e.g.*, machine repairs, vary in amount with the level of operations. The fourth supplies the information needed to tie the varying costs in with production.

Care should be used in distinguishing between fixed and variable costs. To say that the hours of a given service are relatively unchanging, that they are just as essential at low as at high levels of

[1] "A Handbook of Wage Incentive Plans," Management Consultant Division, War Production Board, Superintendent of Documents, Washington, D.C., April, 1945.

activity, is at once the obvious and the easy solution when there is any doubt. This assumption is, moreover, usually popular with plant foremen and supervisors, since it relieves them of the responsibility for reducing the force in straitened periods. Also, it nearly always agrees with plant practice; for although the hours of what is usually termed "direct labor" nearly always fluctuate with production, the hours of indirect and service labor seldom react so sensitively—but only because they are not expected to. Accordingly, it frequently happens that the tabulation of service hours reveals as many hours being charged to a cost center at low operations as at high operations. When it exists for only a short period of time, such a condition may indicate that somebody is taking advantage of an opportunity to perform certain maintenance or repair work on equipment that is idle, a commendable procedure; but when the condition appears at all times, it is a sign that service costs are not being sufficiently controlled. Service hours are being charged to cost centers regardless of the amount of work done, merely in order to absorb the time that must be charged somewhere.

Now if the management, whether for humanitarian reasons or for the preservation of a skilled personnel, wishes to pursue such a policy, well and good. But it has no guarantee that its competitors will do likewise. Therefore, the cost of the policy should be shown by a variance between actual and standard which reflects the using of excess labor at low operating levels. This can occur only if the standard is carefully set to show the possibility of a variance in cost accompanying a variance in production. Hence the value of distinguishing between fixed and variable costs.

Whether or not a given item should be variable can usually be reasoned without too much trouble. For example, consider maintenance and repairs to equipment. The more the equipment operates, the more wear and tear there is on its parts; bearings become worn, parts subject to fatigue fail sooner. Therefore, the more maintenance it requires. But the wear and tear being proportional to production is also proportional to p.s.h. earned on the operation. And so the standard maintenance and repair cost should vary with p.s.h.

The standard is set by processing the tabulated data for each operation in the following sequence:

1. The man-hours sold by each service cost center are multi-

plied by the leveling percentage established for each service cost center on the basis of the industrial engineer's appraisal of its efficiency. Eighty per cent has been suggested as a good average.

2. The leveled man-hours are then multiplied by their respective sold-hour rates.

3. The leveled cost is divided by the p.s.h. earned on the respective operation during the reference period to obtain the standard cost per p.s.h.

For example:

Service cost center		Reference period, Jan. through Aug., 19— Hours sold to operating cost center No. 200			
		Operation No.			
No.	Description	1	2	3	4 (General)
181	Electricians	150	200	120	330
182	Janitors and Sweepers	....	....	....	600
185	Laboratory	200	450	300	
188	Truckers	....	....	....	920
194	Millwrights	100	180	280	200
P.s.h. earned..............		1,600	4,000	2,600	

In this example it will be noted that those service hours are charged to Operation 4 (General) which could not be allocated to specific producing operations. Thus, the rewiring of an overhead light fixture is charged to Operation 4. The industrial engineer, perhaps after consulting the various service-department foremen, establishes the following leveling percentages:

	Per Cent
Electricians....................	80
Janitors and Sweepers..........	80
Laboratory....................	85
Truckers......................	85
Millwrights...................	80

These percentages are a way of saying that at standard performance a janitor, for instance, would not have to do a given job so often and that when he did do it, he could do it in less time, because of better supervision, improved scheduling, etc., the total time required being approximately 80 per cent of the time required in the past. Since standards are based on attainable conditions, this means that the standard performance would result from reduced service needs, better supervision, better work scheduling, reduced delays, and systematic work methods. It is not expected to result from a faster or more energetic rate of work by the men involved, for they cannot be expected to increase their efforts appreciably unless they are paid incentive earnings, which in this example is not contemplated as an immediately attainable condition.

From a preceding cost analysis not shown here these sold-hour rates were developed.

	Cost per Sold Man-hour
Electricians	$1.53
Janitors and Sweepers	0.97
Laboratory	1.92
Truckers	1.96
Millwrights	1.41

The standard general service cost per p.s.h. is calculated as follows:

TABLE I

Service	Ref. sold hr.	Leveling %	Leveled hr.	Sold-hr. rate	Leveled cost	Total p.s.h.	General std. cost per p.s.h.
	a	*b*	*c* ($a \times b$)	*d*	*e* ($c \times d$)	*f*	*g* ($e \div f$)
Electricians	330	80	264	$1.53	$ 404	8,200	$0.049
Janitors and Sweepers	600	80	480	0.97	466	8,200	0.057
Laboratory	....	85	....	1.92	....	8,200	
Truckers	920	85	782	1.96	1533	8,200	0.187
Millwrights	200	80	160	1.41	226	8,200	0.028

In the same manner, the standard cost per p.s.h. for each individual operation is calculated. Operation 1 is handled as follows:

TABLE II

Service	Ref. sold hr.	Leveling %	Leveled hr.	Sold-hr. rate	Leveled cost	Oper. 1, p.s.h.	Oper. 1, std. cost per p.s.h.
	a	*b*	*c* ($a \times b$)	*d*	*e* ($c \times d$)	*f*	*g* ($e \div f$)
Electricians..........	150	80	120	$1.53	$184	1,600	$0.115
Janitors and Sweepers.	....	80	....	0.97	....	1,600	
Laboratory..........	200	85	170	1.92	326	1,600	0.204
Truckers.............	....	85	....	1.96	....	1,600	
Millwrights..........	100	80	80	1.41	113	1,600	0.071

In any given month, the standard allowable dollars on Operation 1 for, say, electricians, is equal to the p.s.h. earned on that operation times the general standard cost per p.s.h. from Table I and times the operational standard cost per p.s.h. from Table II. Suppose that in the month when this is being read, 1,420 p.s.h. are earned on Operation 1 in cost center No. 200. Then the standard cost of electrician's services for that month is

$$\begin{aligned} 1{,}420 \times \$0.049 &= \$\ 70 \\ 1{,}420 \times \$0.115 &= \underline{\ 163} \\ \text{Standard cost..} &\ \$233 \end{aligned}$$

For convenience the general and operational standard costs per p.s.h. of a given service, once developed, may be added together and expressed as one figure, $0.164 in this example.

For the cost center as a whole, the standard cost of electricians—and indeed of any service—is equal to the sum of the standard costs figured for each operation in that cost center.

All the standard costs of service labor so far calculated in this example have been those which were considered to be variable (at standard performance) with operations. To continue the example, it is decided that an additional service—window washing—is nonvariable, since the cleanness of the windows has no relation at all to the amount of production in the cost center. An analysis of time records provides the data in the table on page 99.

The slight changes in amount from month to month are found by the standard-cost accountant to be due to varying efficiency

Month	Window Washing Hr. Sold to Cost Center No. 200
January	120
February	128
March	120
April	132
May	150
June	125
July	154
August	141
September	158
Average	136

and attendance on the part of the window washers. He is also informed that there should be no difference in the allowance for summer as compared to winter months, since the fact that windows are sometimes washed only on the inside in the winter is balanced by their being dirtier then and needing more frequent attention on the inside. Since the cost should not change with production, a flat allowance is made each month for the standard cost of this service. It is arrived at by multiplying the actual average of 136 hr. times whatever leveling factor has been found appropriate times the sold-hour rate.

Depending upon individual plant accounting procedures, it is quite possible that the various services will not be itemized separately on the cost-center cost sheet. Instead the standard cost of all may be shown as a total figure for an account Service Labor. In this case the standard cost per p.s.h. of the individual services, although originally figured separately, may be added together for each operation, so that only an over-all standard cost need be multiplied by the p.s.h. in order to arrive at the total allowable standard cost for the account in a given month.

Service Materials

The cost of tools and supplies normally used by the employees in a given service cost center is usually included in the developed sold-hour rate. Such supplies may be

Gloves.
Goggles.

Trowels.
Hoisting blocks.
Grinding wheels.
Ammeters.
Hammers.
Nails.
Penetrating oil.
Pencils and paper.
Lathe tools (for maintenance shop lathes).

Not only is the cost of such supplies difficult to charge to specific jobs, but also it is generally true that such supplies are used by a given type of service labor to much the same extent on all jobs.

Certain other materials chargeable to specific jobs are not, however, included in the sold-hour rate but are considered separately. The reason for this is that although one sold-hour rate applies to a service regardless of where it is performed, the magnitude of each job varies from day to day and from cost center to cost center. And so also do the amounts of certain materials fluctuate. Accordingly, the standard cost of these materials is not the same in every cost center but must be established individually. In most cases such materials are used for repairs or maintenance. Thus, the cost of electrician's pliers, tape, solder, etc., is included in the sold-hour rate, but the cost of a new armature for a motor is charged directly to the operation for whose equipment the armature is used.

Again, as with service labor, the standard is in most cases established by leveling, since it is not ordinarily practical to make a detailed study of every operation to determine its standard service materials requirements. Past materials costs are summarized, multiplied by a selected reducing percentage, and divided by the p.s.h. for the period. Needless to say, the usefulness of the standard thus obtained is in proportion to the accuracy of the operational charges in the historical records used. Standard prices are, of course, essential in costing these charges, just as with direct and indirect materials; *i.e.*, standard prices should have been in existence during the historical reference period used, in order that a standard derived from past costs may furnish a valid comparison with future costs.

Abnormal Costs

In every establishment two general types of service cost may be observed: those of relatively small magnitude which occur more or less repetitively, month in and month out, and those relatively larger items which occur rather infrequently. Examples of the first are

The weekly cleaning of paint-spray booths.
The sharpening of power shear blades.
The relining of motor-truck brakes.
The replacing of a defective relay.
The welding of a cracked line-shaft bracket.
The daily oiling of bearings.
The performance of laboratory analyses of materials.
The making of time studies.

Examples of the second are

The annual overhauling of a steam turbine.
The relining of pickling vats.
The rebuilding of a blast furnace.
The rearrangement of production-line facilities.
The retruing of a lathe.
The replacement of a cracked flywheel.

Items in the first group are characterized by the frequency of their recurrence. We know that certain jobs, such as oiling, are done in exactly the same way every day or every week. Of other services in this group, such as various small electrical-repair jobs, it may be said that although the identical job may not recur at frequent intervals, a succession of similar jobs may occur. Thus, today an electrician may repair a defective light receptacle; a few days thereafter he may rewire a motor control; and still later he may be called in to the same cost center to locate a grounded wire. Over a period of months at a given production level the quantity of such jobs tends to be fairly constant; something is always coming up to be done. The standard encourages a reduction in their volume, but it recognizes that they are necessary for the continuance of operations. Hence for the p.s.h. earned every day, week, or month, a standard cost is allowed for routine services.

Because they occur less frequently and involve large sums of money, items in the second group deserve special cost treatment. Their unexplained inclusion in the cost sheets (assuming that they were not capitalized or carried against surplus) would create a misleadingly large unfavorable variance between actual and standard if no provision were made for them in the standard cost; whereas if the standard contained an average monthly charge for such work, it would appear unduly high in the months when no actual charges happened to occur. Therefore, in analyzing past costs for the purpose of constructing the standard, care is taken to exclude all expenditures that are abnormal in any one month.

These then become the basis for a separate standard for abnormal service costs. They are first examined individually. How much money is in them? One plant uses an arbitrary rule that no job costing less than $100 be considered in this class. Secondly, what is their nature? Some jobs, like the turning of bar-mill rolls or the rebuilding of the tanks in a glassworks, are predictably recurrent. It is not difficult to determine how much money has been and should be spent when they are performed. Nor is it any problem, when good records are available and an engineering study is made of the methods and materials used, to assign a cyclical life of the job in terms of production. Thus it can be said that a set of bar-mill rolls, when re-dressed, is normally good for a certain number of tons of material rolled (which can be expressed in p.s.h.) before being sent back to the roll shop to be turned down. For such types of abnormal expense, then, a unit standard cost is set equal to the total allowable cost of the job divided by the allowable p.s.h. that may be earned before it must be done again. The p.s.h. earned each month are multiplied by the standard charge, and the product is accumulated as a memorandum debit until the job is performed, at which time both the actual cost and the accumulated standard allowance are inserted in the cost sheet for comparative purposes.

If it happens that the job begins in one cost period but ends in another, it is a good idea to withdraw, at the time when the cost sheet is prepared (in the middle of the job), sufficient dollars from the memorandum standard account to equal the actual cost to date and to insert this in the cost sheet. There will then be no variance between standard and actual at this time. In the cost sheet for the close of the period in which the job is completed, the remaining balance, if any, of the memorandum account can then be shown, and the over-all variance between actual and standard will appear all at one time. This procedure accentuates the total variance, which might otherwise be indistinct if it were prorated into two different cost periods.

In addition to those large abnormal costs which can be included in the standards because they are predictably recurrent, there are others that, being unpredictable, cannot advantageously be included. The frame casting on a 50-ton hydraulic press develops a crack, and a large expenditure is required to weld it and true up the press. Aside from the question of whether or not the occurrence of the expense is controllable (which would be hotly debated by any foreman involved), it is extremely difficult to provide a workable standard allowance for such emergencies. The costs of such jobs could be analyzed for the last 10 years and divided by the p.s.h. earned in that period, and the resulting unit cost could be applied to current standard hours in order to build up an allowance for future major repairs. And if, after all this paper-work effort, the cost of "freak" jobs happened to be more or less than standard in the current month or year, who could with certainty attribute the variance to the individual performance of any cost-center supervisor? It might be entirely due to accident. And despite the safety rule that "accidents don't happen—they are caused," the fact remains that many large abnormal expenditures are so difficult to control that their occasional occurrence should not be allowed to nullify the effects of the day-to-day control accomplished through the reliable standards on all other costs.

For these reasons, only predictable abnormal costs should be included in the standard-cost program used for gauging supervisory performance. For product pricing or inventory purposes only, others may be calculated on a standard-hour basis as described in the preceding paragraphs. It should be observed that any unusual frequency of predictably recurrent jobs, which have been cost standardized, is by definition considered controllable. The actual costs in this connection are presented in the cost sheet for comparative purposes, since there is in the standard a measure of their necessity.

Summary

Within the plant, services are sold by one cost center to another. The amount of service required by any cost center is usually proportionate to production and hence controllable. The purchasing cost center is held responsible for the amount of service that it buys. In order that costs may measure only volume, the services, usually in terms of man-hours, are sold at a standard price: the sold-hour rate. Analysis of historical data together with engineering studies provides the means for setting standard allowable quantities of sold services. Recurring major jobs are treated separately so that the standard costs will be as informative as possible.

QUESTIONS

1. In a certain plant, it was found that over a period of a year the total cost of electricians per direct-labor man-hour was $0.15. Accordingly, in any month in the following year, the cost of this service with which a particular cost center was charged was equal to the actual direct-labor man-hours in that cost center times $0.15. This figure was then compared with the standard charge, which was equal to a slightly lower rate times the *standard* direct-labor man-hours for the same amount of production. Discuss the usefulness of the variance thus obtained. Of what is it an index? Does it fix the responsibility for waste? Does it enable the foremen to see where they are spending too much money? Does it tell the management when costs are getting out of line?

2. In a small plant there are only three maintenance men. It is argued that there is no point in keeping accurate records of how they spend their time or of what facilities they spend their time in repairing, since their total cost is small and since the plant could hardly get along with less than three men in this category. For this reason, it is claimed, it would be a waste of time to set up a system whereby each operation is charged with the actual hours of maintenance spent on it. Discuss this argument. Are the service costs per dollar of inventory produced any less important in a small plant than in a large one? Would it be valid to compare the controlling of costs in a small plant with the controlling of costs in a single department of a large plant?

3. What are two methods of measuring the quantity of services sold? Which is the more desirable from a costing standpoint?

4. Under what conditions should past average costs be used as a basis for arriving at standard costs? Does this mean that the standard costs should be equal to the past average?

5. How may service hours be reduced without using an incentive plan to increase the work pace of the servicemen involved?

6. In the die shop of a stamping concern, the following costs occurred in a reference period:

Account	Expense
Supervision	$1,200
Small Tools	875
Power and Light	85
Services	300
Diemakers	5,000
Die Materials	3,500
Operating Supplies	80
General Factory Overhead	600
Total diemaker hours sold... 3,200	

All expenses are leveled at 80 per cent to arrive at a standard allowance, with the exception of supervision and diemakers, which are leveled at 100 per cent. Develop a sold-hour rate for diemakers. Why was the cost of the diemakers themselves not reduced in building up the standard cost per sold hour? Of what advantage would it be to have an analysis of the sold-hour rate showing the cost per sold hour of each expense account involved? In what way could the foreman of the operating cost center for which the dies are produced do anything to reduce the number of diemakers' hours sold to him? What argument could be advanced for omitting the cost of die materials from the sold-hour rate and handling it separately?

7. In a certain producing cost center, a study of past practices reveals the following information for a single operation:

Service	Service hr.	Service sold-hr. rate	Service leveling %
Carpenters	175	$1.05	85
Electricians	200	1.35	85
Sweepers	500	0.80	70
Mechanics	230	1.15	80
Total p.s.h. earned on this operation, 35,000			

Develop a standard cost per p.s.h. of service for the operation, both by types of service and in total.

8. Why should service costs that occur only at infrequent intervals be handled separately in developing a standard service cost per p.s.h.? Why should the predictably recurring ones be separated from the unpredictable, or emergency, ones? Why should any standard cost per p.s.h. be set at all for the latter?

9. A plant that leases certain productive facilities from an outside owner has a contract with the owner whereby for a fixed monthly charge the owner's repairman calls periodically to service the machines. How would you develop a standard cost for this service? Is it controllable by the foreman of the cost center in which the machines are used?

10. Suppose that it is found that certain services do not vary in amount with the number of p.s.h. earned in a cost center but that they are relatively constant. As a result a flat allowance is made for them every month in the Fixed Expense column of the cost-comparison sheet. Is there any reason why these costs should also be expressed as a cost per p.s.h.? If so, what determines how many standard hours they should be divided by to obtain this rate?

CHAPTER VIII

SETTING STANDARDS FOR FUEL AND POWER

Fuel and power constitute a service that is sold to the majority of cost centers. This service receives a treatment different from that described in Chap. VII for the following reasons:

1. It has different units of sale.
2. The amounts of money involved are frequently large enough to warrant particular attention.
3. Specialized engineering assistance is required in setting the standards.
4. The standards can often be determined with greater accuracy than those for any other service.

How much time should be devoted to establishing fuel and power standards depends largely upon the industry being covered. In many small-assembly plants, for example, the requirements for this service do not extend beyond electric lighting and space heating. But in plants that use heavy power-driven equipment or that employ processes requiring heating, refrigerating, or high pressures, the cost of fuel and power may well be one of the largest individual items on the books and hence deserving of considerable attention.

The unit of sale will first be discussed. In the subsequent consideration of standard quantities and costs the need for technical advice for the standard-cost accountant will become apparent.

Unit of Sale

It has been stated that the great variety of service jobs, together with the difficulty of standardizing them individually, makes it expedient to consider them as being sold in terms of the man-hours or dollars of material required for them. In the case of fuel and power, however, the commodity being sold is always the same, and its cost is therefore determinable on a unit basis.

What is sold usually defines the unit of sale. The magnitude of the denominator depends upon custom and convenience within the plant. The plant mechanical engineer can readily provide the needed information on both subjects.

Listed below are some typical fuel and power services and the units in which they may be sold.

Description	Unit of Sale
110-volt, 60-cycle a.c.	Kilowatt-hour
Steam (generally expressed)	B.t.u.
or	
Steam, 250 lb. pressure	B.t.u. or pound
Drinking water	Gallon or cubic foot
Hydraulic water, 100 lb. pressure	Gallon or cubic foot
Acetylene, bottled	Cubic foot
Compressed air, 30 lb. pressure	Cubic foot
Producer gas	Cubic foot or B.t.u.

It will be noted that each of these expense items in the Fuel and Power account is fully described. Thus, "110-volt, 60-cycle a.c." is specified, not merely "electricity." To do this requires but little time, ensures that everybody is talking about the same commodity, and absolutely prevents any future inaccuracies in costs due to changes in the nature of the commodity. It is, of course, evident that the magnitude of the unit may vary, so that for convenience the cost of hydraulic water, for example, can be set up per thousand gallons rather than per gallon.

Responsibility

The general procedure in establishing standard utility costs is to

1. Determine the quantity of each utility consumed at its point of use. This is expressed in volumes or weights per p.s.h.
2. From these data construct the total quantity of that utility required at given levels of operations. Add on minimum allowances for normal line losses.
3. Develop a standard cost of generating (or purchasing from outside the plant) the total quantity of each utility at each level of operations.
4. Reduce the total normal cost to a cost per unit of utility sold.

Each of these steps will be amplified in this chapter. First, however, it is necessary to consider the fourth point, as it has a bearing on the others.

The cost per unit can be expressed in two ways: as a cost per unit generated or as a cost per unit consumed. The difference between the two costs is due to excess generation and to line losses and leakages between the points of generation and consumption. Which cost is to be used in standards calculation depends upon the way in which actual monthly charges can be allocated to the cost centers. For example:

Standard number of units generated....................	1,000
Standard number of units unavoidably lost in transmission	100
Standard number of units consumed..................	900

Standard cost of generating 1,000 units	\$1,200
Standard cost per unit consumed.....	\$1,200 ÷ 900 = \$1.333
Standard cost per unit generated......	\$1,200 ÷ 1,000 = \$1.200

Theoretically, a cost-center supervisor should be charged only for the volume that he consumes. He should not be held responsible for the fact that more units were generated than he and the other cost-center supervisors needed or for the fact that losses occurred in the lines transmitting the utility (steam, water, compressed air, electricity, etc.) to his cost center. Both of these factors are controllable only by the supervisor producing and delivering the utility.

The consuming cost center can be held directly accountable for the volume utilized only if that volume can actually be metered within the cost center. When this can be done, the operating cost-center supervisor can be allowed a standard quantity of utilities per p.s.h. at a standard price that includes an allowance for normal line losses. The actual quantity used will be sold to him at the same standard price, and the difference between the total quantities consumed times the standard price and the total actual cost of generation will be a measure of the performance of the fuels and power supervisor. Only when quantities are measured at the point of use should this method be used.

Suppose that utilities quantities are metered only at the point of generation. Then it is impossible to state how much of the difference between actual and standard volumes is due to excess generation, how much to excess line losses, and how much to excess consumption by any particular cost center. In fact, the actual monthly utilities charges to various cost centers can be made only on an arbitrary distribution—perhaps in the same ratio as standard allowances or on the basis of some informed person's opinion. This may or may not result in a true picture of the amounts of air, water, or steam really used in any cost center. Consequently, it is impossible to allocate the responsibility for variances of actual from standard utilities costs, because responsibility is jointly shared by all cost-center supervisors, including the fuels and power supervisor. Accordingly, nothing is gained in this case by expressing standards in terms of units consumed.

Throughout this chapter it will be assumed that utilities are metered where used and that standards are expressed as a cost per unit consumed, so that operating foremen can be held directly responsible for utilities within their cost centers.

For control purposes, this is a highly desirable condition. The author agrees with one authority who states that "Every fuel-consuming operation should have a fuel meter included in the installation just as surely as it must have a shut-off valve," [1] and believes that where the instrument cost can be justified by potential savings, every cost center should be provided with meters for each utility that it uses. The electric-light company does not trust our cost-center foreman to use as little electricity as possible in his house; it installs a meter, even though his bill is for only a couple of dollars a month. Is there any reason to think that he will be any more economical in the factory than in his own home, unless his consumption is metered?

Consumption

In an operating, or "production," cost center, standard labor requirements are ascertained by time study. Similarly, standard utilities requirements are arrived at through engineering measurements. These are best performed by a capable mechanical or electrical engineer, and each utility requires its own individual technique. As an illustration of the various procedures employed, the following examples are given:

1. *Hydraulic Water Requirements of a Press Used for Fabricating Plastic Trays.*—The inside area of the hydraulic cylinder is multiplied by the stroke of the piston to obtain the volume of water displaced. To this is added the volume contained in lines. The total is converted to cubic feet (or gallons) and multiplied by the

[1] FLAGG, H. V., Steel Plant Fuel Accounting, *Iron and Steel Engineer*, April, 1939.

standard number of strokes per hour, as determined by time study, to obtain the standard volume of hydraulic water per hour.

2. *Electric-power Requirements of Electric Sewing Machine.*—A watt-hour meter is attached to the motor leads. The machine is operated by a skilled operator to ensure that excess power is not consumed during the test on unnecessary seams, reruns, or other nonstandard work. Kilowatt-hours consumed are divided by standard hours earned by the operator during the period of test, to arrive at standard unit consumption.

3. *Compressed-air Requirements of Shot-blast Unit for Cleaning Castings.*—An orifice for measuring volumes is inserted in the air line, and the unit is operated experimentally to determine optimum combinations of air pressure and blast time for a good job. Study requires consideration of the following points:

a. Possible improvements in nozzle.
b. Variations in air pressure.
c. Effect of condensed moisture in air line.
d. Size and nature of shot used.
e. Degree of finish desired on product.
f. Location of work with respect to nozzle.

Results of the test should indicate what minimum volume of air, at specified pressure and with nozzle in average condition (neither new nor worn out), is required to produce an acceptable finish in a minimum time. This volume is expressed in cubic feet per minute, a ratio that gives the cubic feet of air per standard hour when multiplied by the number of "air-on" minutes per standard hour (as determined by time study). Manufacturers' tables can be used to check discharge volumes. An example is shown on pages 112–113.

4. *Electric-power Requirements of Overhead Lighting System.*—By adding up the rated wattage requirements of the individual lights (or preferably, by means of meter readings) the total kilowatts are ascertained for all lights being on. Kilowatt-hour requirements are determined by estimating the number of hours per day that artificial illumination is required when windows are clean. Different figures may be set up for winter and summer months. The resultant figure is constant for all production levels, since individual machine or bench lights are considered separately.

These illustrations of how consumption standards are arrived at are supplemented by the rules on page 114.

Discharge of Compressed Air *

Tables below give the amount of air discharged through orifices and pipes of different diameters under a wide range of line pressures.

These figures are based on a density factor of 0.07494 lb. per cubic foot for dry air at 14.7 lb. per square inch absolute pressure, at 70° F. Coefficient of flow is assumed to be 100 per cent. For practical application multiply the figures given by 0.90.

Line pressure, lb. per sq. in.	Diameter of orifice, in.					
	1/64	1/32	1/16	1/8	1/4	3/8
	Discharge of free air per min., cu. ft.					
20	0.119	0.485	1.93	7.7	30.8	69
25	0.133	0.54	2.16	8.6	34.5	77
30	0.156	0.632	2.52	10	40	90
35	0.173	0.71	2.80	11.2	44.7	100
40	0.19	0.77	3.07	12.27	49.09	110.45
45	0.208	0.843	3.36	13.4	53.8	121
50	0.225	0.914	3.64	14.5	58.2	130
60	0.26	1.05	4.2	16.8	67	151
70	0.295	1.19	4.76	19	76	171
80	0.33	1.33	5.32	21.2	85	191
90	0.364	1.47	5.87	23.5	94	211
100	0.40	1.61	6.45	25.8	103	231
	Size of pipe, in.					
	1/2	3/4	1	1 1/4	1 1/2	2
20	194	342	553	960	1305	2150
25	222	390	631	1095	1490	2450
30	250	440	712	1230	1680	2760
35	278	488	790	1370	1861	3070
40	306	538	872	1490	2060	3390
45	334	585	950	1645	2240	3690
50	362	635	1030	1780	2430	4000
60	419	735	1190	2060	2820	4600
70	475	830	1350	2340	3190	5240
80	530	931	1510	2620	3560	5860
90	586	1025	1670	2890	3940	6480
100	644	1125	1820	3160	4320	7100
110	710	1221	1990	3440	4700	7700
120	755	1325	2150	3720	5060	8340

Line pressure, lb. per sq. in.	Size of pipe, in.				
	2 1/2	3	4	5	6
20	3,060	4,730	8,150	12,800	18,500
25	3,490	5,400	9,300	14,600	21,100
30	3,940	6,100	10,450	16,500	23,800
35	4,370	6,760	11,650	18,300	26,400
40	4,810	7,450	12,850	20,200	29,100
45	5,250	8,140	14,000	22,000	31,800
50	5,700	8,810	15,200	23,800	34,400
60	6,600	10,400	17,500	27,500	39,800
70	7,450	11,550	19,800	31,200	45,000
80	8,350	12,900	22,200	34,900	50,400
90	9,200	14,250	24,500	38,400	55,500
100	10,100	15,650	26,900	42,400	61,000
110	11,000	17,000	29,200	45,900	66,300
120	11,900	18,400	31,600	49,600	71,500

* Prepared by Logan Engineering Company, Chicago.

Air Used by Pneumatic Tools *

The accompanying table shows the average amount of air, calculated as cubic feet of free air per minute, consumed by some of the pneumatic tools and equipment commonly used in industrial plants. These figures for air consumption are based on a pressure of 90 lb. per square inch, gauge.

Tool	Description	Consumption
Hand sprays, small	Paint	2 to 3 cu. ft. per min.
Foundry jolters...	Platform	30 to 40 cu. ft. per min. per ton
Hand grinders....	Wheel size Cubic feet per minute	1½ 2 4 6 8 12 16 28–35 40–45 50–60
Molding machines	Squeezers	½ to 1½ cu. ft. per min. per mold
Hand riveters....	Heavy Cubic feet per minute	Stroke, in. 4 5 6 8–10 32 34 37 38–40
Hand riveters....	Small	Average 12 cu. ft. per min.
Riveting machines	....	Average 50 cu. ft. per min.
Rivet busters.....	....	Average 55–60 cu. ft. per min.
Hand sanders.....	Pad size, in. Cubic feet per minute	7 9 35 45
Chipping hammers	Stroke, in.	1½–4, average 20–25 cu. ft. per min.
Scaling hammers..	....	Average 15 cu. ft. per min.
Air hoists........	Capacity, lb. Cubic feet per minute	500–1000 2000 3000 4000 6000 0.50 2 3.2 6.3 8.4
Geared hoists.....	Capacity, tons Cubic feet per minute per foot lift	1 1½ 2 3 4 5 6 8 10 3 5 6 8 10 15 20 25 30
Impact wrenches..	Sizes, in. Capacity, cubic feet per minute	¼ ⅜ ⅝ ¾ 1¼ 1¾ 8–9 12 22 28 38 50
Jacks...........	Cylinder diameter, in. Cubic feet per minute per lift	8 10 12 14 16 20 24 1.8 2.8 4.0 5.0 6.9 11.1 16
Motors..........	Rating, hp. Cubic feet per minute	2 4 5 8 15 40–50 60–70 90–100 140 240
Rotary steel drills	Drill size, in. Cubic feet per minute	¼ ⅝ ½ ⅞ 1 1¼–2 20 28–32 36–42 55 65 85–90
Wood boring drills	Drill size, in. Cubic feet per minute	½ ⅞ 1 1¼ 20 32 38 45
Screw drivers.....	....	Average 12–20 cu. ft. per min.
Nut runners......	Bolt size, in. Cubic feet per minute	¼ ⅜ ½ ¾ 1 12 22 38 42 46
Stone-carving tools	Weight, lb. Cubic feet per minute	1 2 3 4 5 6 3–6 4–7 5–8 6–9 7–10 12
Sandblast........	Size nozzle, in. Sand per hour, lb. Cubic feet per minute	3/16 ¼ ⅜ ½ 500 900 1700 3000 50 95 210 375
Sand rammers, hand..........	Weight of tool, lb. Cubic feet per minute	7 9 18 24 30 35 9 12 15 20 25 42
Metallizing guns..	....	Approx. 35 cu. ft. per min.

* Prepared by Logan Engineering Company, Chicago.

1. Each standard cost should include an accurate descriptive title of the utility concerned, as explained on page 108.
2. Care should be taken to recognize that certain items such as heating and overhead lighting are practically fixed.
3. Consumption should, wherever possible, be ascertained by actual test rather than from name-plate markings on the equipment. It is erroneous to suppose, for example, that the power consumption of a motor on a particular installation can be learned from the fact that it is listed as a 10-hp. motor. Actually, the power consumption depends on the load, which may be greater or less than the rated capacity.
4. Standards should not be based on wasteful, easily corrected practices, such as permitting various pieces of productive equipment to run continuously when they could just as well be run intermittently.
5. Consumption standards should tie in with utilities production. Thus, if the cost of producing a given number of pounds of steam is based on that steam's having a quality of 90 per cent (dry-steam content per pound of wet steam), then the consumption standard should not be based on any higher quality unless the costs also make provision for attaining that quality.

Cost of Production

Labor.—The distinction between fixed and variable generating expenses is, in the case of fuels and power, usually apparent upon inspection. Indeed, it nearly always resolves itself into a distinction between labor and materials costs. For within limits the labor quotas of power plants seldom change with the amount of power generated; whereas on the other hand the consumption of such materials as feed water, coal, oil, etc., depends upon output, within a normal range.

To establish standard labor costs it is necessary merely to list the occupations involved together with their rates of pay. Thus, for a small boilerhouse, see the table on page 115.

The quotas listed do not necessarily correspond to the actual number of men used. Labor economies are just as possible in power plants as in operating departments. Therefore, the quotas are predicated on the information supplied by time studies. Such studies may show that the employment of wipers, for example, can be eliminated by assigning this work to some other occupation

STANDARD LABOR COST PER MONTH

Cost Center No. 522 Boilerhouse B

Occupation	Quota	Hourly rate	Std. cost per month
Engineer..........	3 per day	Salary	$ 750.00
Fireman...........	3 per day	$0.82	590.40
Water tender.......	3 per day	0.84	604.80
Ash man..........	6 per day	0.75	1,080.00
Total	. .	. .	$3,025.20

that has available idle time. Again, they may show that certain occupations, even though not 100 per cent busy, cannot be combined or eliminated, because they are needed as a stand-by for periodic duties. In the preceding example both the fireman and water tender were found to have considerable idle time. Neither can be dispensed with, however, since their duties, when occurring, may be simultaneous and at different parts of the boilerhouse. In some plants certain facilities, being in isolated locations, must have individual attendants; whereas if they were combined in one location, they could be handled by a single attendant. Such conditions, when revealed by the analysis accompanying standard-cost installation, are studied in order to determine if the relocating of the units would be economical or practicable as a means of reducing labor cost. But the fact that standards are based on attainable performance with present equipment precludes the setting of the standard on the basis of such an ideal setup until it has actually been accomplished.

As a means of assisting the foreman to meet his quotas, the time studies can also be employed in formulating incentive plans for occupations not previously covered. For example, ash handlers can be paid a bonus based on the number of man-hours allowable per ton of ashes wheeled. Here the labor quota is variable, as the allowable man-hours can also, for cost purposes, be tied in with the output of the unit. Only where the output is relatively constant should such occupations be shown, as in the preceding example, on a fixed basis.

Materials.—As with other cost centers, the materials used by the fuel and power cost center are assigned a standard price. This price is conveniently set at the current or expected market level.

Since the determination of standard quantities of materials per unit of sale requires detailed engineering calculations, which are beyond the scope of the average accountant, technical help must be provided. Consider, for example, the problem of computing the number of tons of coal required to produce one million B.t.u. of steam. A thoroughly scientific study requires consideration of the following points:[1]

1. B.t.u. value of the coal (determined from tests).
2. Moisture content of the coal.
3. Hydrogen content of the coal.
4. Moisture content of the air.
5. Temperature and constituency of stack gases.
6. Chemical constituency of ashes.
7. Radiation losses.
8. Temperature of feed water.
9. Temperature, pressure, and quality of steam.
10. Blowoff and miscellaneous steam and water losses.
11. Frequency of shutdowns.

As this tabulation suggests, the volume of fuel required is dependent in part on the nature of the fuel itself and in part on the physical characteristics of the steam-generating unit. The point-by-point analysis of the various avenues of escape of the heat inherent in the fuel, which attends the calculation of standard quantities, frequently suggests immediate possibilities for improvement that would not otherwise have occurred to mechanical engineers engrossed in routine operating duties.

To continue the example of a boilerhouse, other materials calculations involve feed water, water-treating chemicals, and such miscellaneous items as tube replacements, lubricants, and other operating supplies. Feed-water requirements are obtained by adding to the weight of steam required the amount of water lost in blowoffs, *i.e.*, the amount lost when water is drained from the system to remove accumulated sediment and impurities. In some plants allowance must also be made for condensate returned to the system. The volume of water-treatment compounds is determined by the use of a chemical equation set up in terms of the characteristics of the feed water and the particular compound being used. Other materials standards are established by leveling

[1] Taken in part from SEVERNS and DEGLER, "Steam, Air and Gas Power," John Wiley & Sons, Inc., New York, 1939.

past costs. These may include such miscellaneous items as chart paper, lubricating oil, cleaning compound, cotton waste, etc.

When it is impracticable to derive the materials costs in the detailed manner described on pages 115 and 116, they can alternatively be arrived at by operating the unit for a trial observation period, during which the consumption and output are recorded accurately while the unit is run under the best possible controlled conditions.[1]

Although the discussion so far has been confined to steam-generating equipment, similar methods are applied to other types of power unit. By means of test, the relationship between input and output of motor-generator sets, diesel engines, turbines, and other prime movers is determined. The cost of the materials used divided by the number of units of sale is equal to the unit cost of those items of expense. In this case, the word "materials" is perhaps too confining. Thus, electric power purchased from outside sources may be used to operate a water pump. Instruments placed on the line indicate the amount of power consumed in a given period, which is divided by the number of cubic feet of water delivered by the pump to obtain the unit requirements. This is then corrected for line losses. Since the cost of electric power from outside sources usually varies with the load, the peak demand, the power factor, and other items specified in the power company's contract, these also must be considered, since they may result in different power costs at different levels of operation. Careful study by the electrical engineer in setting the standard cost of such power may show that economies are made possible by rescheduling certain operations in such a way as to reduce the load or increase the power factor. Even though such scheduling may not have occurred in the past, the fact that reductions are attainable should be recognized in the standard.

In addition to the routine operating labor and material costs, provision is made for normal repairs and maintenance (based on leveled past costs), for miscellaneous operating supplies, and, in fact, for all expenses, just as in an operating cost center. Also, a standard cost is set for such periodic jobs as boiler inspections, turbine rebladings, and motor rewindings in a manner identical

[1] For a description of such a test, see J. C. Smallwood and F. W. Keater, "Mechanical Laboratory Methods," D. Van Nostrand Company, Inc., New York, 1931.

to that described in the preceding section for other service costs.

In general, then, the determination of unit selling prices for the fuel and power cost center is carried out in a manner very similar to that for any operating or service cost center. The only difference lies in the facts that mechanical and electrical measurements are involved and that the item sold is a utility vended within the company.

Summary

The setting of standard costs for utilities requires a detailed engineering investigation of the actual quantities of steam, air, power, water, electricity, etc., required per p.s.h., as well as an exhaustive analysis of the attainable costs of producing these quantities.[1] Formidable though such an undertaking may seem, it is well worth while. Many a plant manager who insists on rigidly controlling labor costs through incentive plans and man-hour statistics accepts fuel and power costs as a necessary burden without realizing that they too are susceptible of great reduction when subjected to close study.

QUESTIONS

1. Why can standard quantities be determined more accurately for fuel and power than for services like those of repairmen that are sold in terms of man-hours?

2. The examples in this book, for simplicity, show fuel and power expense charged to operating cost centers under one account. Under what circumstances would this practice be inadvisable?

3. In a certain plant, large quantities of acetylene are consumed in welding and burning operations. Much of this gas is produced in an acetylene-generating unit located on the premises. An additional, smaller amount is purchased in cylinders from outside sources. Would you advocate including the latter quantity in the same account as the former? In what other account might it be included? Is it essential for control that similar items be included in the same account? Would the fact that the cost of the cylinder acetylene and that of the generated acetylene are controlled by different supervisors have any bearing on the treatment of charges? Suppose that for a given operation the question of whether to use cylinder acetylene or acetylene piped from the generator is decided by the fuel and power supervisor—should operating supervisors be charged different prices for the gas consumed, depending on the source? If one price were charged to oper-

[1] A valuable series of articles on this subject by F. Ryder appears in *Blast Furnace and Steel Plant*, May through December, 1941.

ating supervisors regardless of the source, who should absorb the variance due to the fact that the gas is obtainable cheaper from the generator than from outside suppliers? Would there be any other expenses involved in supplying the acetylene other than the actual cost of the gas itself? Should these be included in the intraplant selling price of the gas? What bearing would this inclusion have on the magnitude of variance incurred by the supervisor responsible for providing acetylene?

4. When is it permissible to include the cost of line losses in the standard unit price of a utility charged to a consuming cost center?

5. If the lack of meters at all consuming points necessitates charging consuming cost centers on the basis of estimated usage, are the figures thus obtained completely valueless for control purposes? Which do you think would be better—to show an estimated quantity variance on utilities used by an operating cost center or to show none at all? State the reason for your answer.

6. Why are the name-plate markings on facilities not a reliable indication of the amount of power or fuel they consume?

7. A particular heat-treating furnace is sometimes used to anneal parts (at a temperature of 1450° F.) and sometimes to draw them (at a temperature of 750° F.). In this case would it be accurate to set a single standard fuel cost per p.s.h. for the heat-treating operation? How would you handle this situation? When is it permissible to set a single standard fuel or power cost per p.s.h. for an operation?

8. In the course of determining the allowable pounds of coal per pound of steam generated in a boiler, it is found that the consumption could be considerably reduced by installing a mechanical stoker to replace the present method of hand-firing; and the mechanical engineer is able to estimate the amount of coal that would be required if the stoker were installed. Should the standard cost of a pound of steam be based on the use of stoker-firing? State the reason for your answer.

9. A certain standard-cost accountant says: "I am an accountant, not an engineer. For this reason I feel that I should not be expected to participate in the setting of standards. That task should be the sole responsibility of trained specialists in the organization. My job begins when they hand me the standards that they have developed." Discuss this statement.

CHAPTER IX

GENERAL OVERHEAD

All the costs so far discussed are those which may be controlled by the cost-center supervisor. Were standard costs to be utilized only as a means of measuring departmental performance with a view to reducing expenses, these costs are all that would be needed. Since, however, standard costs are also useful as a means of pricing inventories, as a simplification of cost-accounting procedures, and as an aid in forecasting budgets, it is advisable to set a standard cost for *every* expense, whether or not it is directly within the cost-center supervisor's control. These standards are not incorporated in the cost-comparison sheet for each cost center.

Examples of such costs are

Cost of laboratories.
Depreciation.
Cost of works manager's office.
Cost of works accounting department.
Cost of drafting department.
Building-maintenance expense.

Many of these costs are fixed. Others are semifixed, changing only with wide fluctuations in the level of operations. For example, in the works manager's office, comprehending perhaps the manager, his assistants, production planners and expediters, industrial engineers, project engineers, clerks, and stenographers, it may be found that a certain skeleton staff is necessary at all operating levels (this constitutes the fixed expense) and that additional engineers and clerks are employed when plant operations exceed a certain percentage of capacity. Ideally the standard costs would be set up in such a way as to recognize this fact. However, predicting the number of salaried workers required at various levels is in most cases mere guesswork, and the demoralizing effect of issuing cost exhibits that imply that certain occupations are of marginal utility, capable of being dispensed with, is such as to make the distinction inadvisable. Accordingly, the most practical procedure is to summarize the pay roll and allied expenses at the current level, omitting only those items which are obviously superfluous, for the cost division in question. If for any reason a standard cost is desired for other operating levels, it can be estimated and expressed in total, without revealing any unnecessary, perhaps hypothetical, details which would in any case be subject to revision later on in the light of changed conditions.

The procedure described is based on the assumption that no performance standards are to be set for these miscellaneous overhead accounts but that a standard cost is computed for them solely in order to obtain a complete standard product cost. Actually this need not be the case; analysis and improvement of office procedures, establishment of incentive rates for repetitive clerical or stenographic duties, these are all accomplished facts in many business enterprises. Where such studies have been accomplished, they provide excellent data for standard costs, which are then set in much the same way as for any factory cost center. They are, however, beyond the scope of this book.

So that they may be applied to the product, the total standard costs set up are reduced to a per-unit basis by being expressed in terms of dollars per p.s.h. Two principles guide this allocation: first, the overhead costs should be prorated to all operations that receive the benefit of them; and secondly, they should, where possible, be introduced where they actually occur in the operational sequence. Thus, the services of the works manager's office are applicable to all operations. And for costing purposes it may be said that the operation requiring the most p.s.h. usually should bear the greatest proportion of that office's distributed cost. Hence, the overhead allowance (not considered controllable by the cost-center supervisor) for this item is obtained by dividing the standard cost of the works manager's office by the total p.s.h. for the plant at the level of operations being considered; *i.e.*, if the standard cost of the works manager's office is calculated for normal capacity operations, then the standard cost per p.s.h. for each operation will include a figure which is equal to

$$\frac{\text{Std. cost of works manager's office at normal level of operations}}{\text{Total plant p.s.h. at normal level of operations}}$$

Theoretically, a portion of the works manager's office cost should be distributed to other general overhead accounts, *e.g.*, the engineering department, and then that portion should in turn be carried back to operations when these accounts are distributed. But since the ultimate purpose is to obtain unit product costs, the practical advantages of this bookkeeping detour are not evident. Clarity is best achieved by charging direct to operations when possible.

The example just given illustrates the case of a general charge made equally to every p.s.h. on an arbitrary split. But not all overhead charges need be made on an equal basis for every cost center. Building maintenance, comprehending repairs to foundations, roofs, exterior walls, general sewage lines, roadways, etc., may first be prorated to cost centers on the basis of the area occupied by each. The cost-center charge is then divided by the total p.s.h. in the cost center to obtain the unit standard cost. Building depreciation, rental, and real estate taxes are treated similarly. Accounting expenses may first be prorated to cost centers according to the standard operating dollar volume in each cost center before being reduced to a standard cost per p.s.h.

One other account deserves mention at this point. The fine breakdown of costs resulting from a cost-center system of cost sheets would, if followed completely, result in the displaying of supervisory salaries on the cost statement for each cost center. As a matter of policy, such salaries should be kept confidential. This is accomplished by using, instead of a direct cost-center charge, a Supervisory Salary account in which is charged the remuneration of all foremen and superintendents in the plant or some major subdivision thereof. This total is calculated at established standard figures and divided by the total p.s.h. in the cost centers covered. The resulting standard cost per p.s.h. is then applied to production. The monthly actual charges to cost centers are in this method also made on the basis of p.s.h., so that a comparable treatment will be afforded. In general the cost-center supervisors cannot be asked to consider this, their own pay, as a controllable cost.

Workmen's compensation insurance is accurately handled by reducing it to a cost per labor dollar, then incorporating it into the p.s.h. cost in proportion to the standard labor cost per p.s.h. for each operation. This procedure is also suitable for other overhead costs relating to labor, such as vacation-wage provision and expenses of the industrial relations and personnel offices (if these offices' expense is set up separately from the General Administrative or works manager's account). Alternatively, workmen's insurance and vacation-wage provision, if they are found to be directly variable with labor pay-roll dollars, may be considered as a portion of direct, indirect, or service labor and included as a segregated labor cost for those respective accounts when set up on standard. If thus considered, they are held to be controllable by the cost-center supervisor, since by effecting economies in labor hours he can reduce over-all insurance and vacation-wage costs.

The second principle—that overhead costs should be introduced where they actually occur—is an extension of the first rule that they should be applied to the operations which benefit by them. In the examples thus far given, overhead costs were distributed generally to all operations. However, this should not be done in every case, or the standard cost of work in process will be inflated. Assume that a given plant has a finished-goods storeroom, the cost of which is held to be an overhead item not controllable by factory cost-center supervisors. The expenses of this storeroom should, of course, be included in the total standard product cost. But it would be incorrect to include them by dividing standard stores cost by total plant p.s.h., as in the preceding examples, for this would imply that each operation should bear a portion of finished-stores charges. Actually, only finished goods should receive this charge. Hence, on the assumption that all goods will, upon receiving their final operation, be transferred to stores, the standard unit cost for this item is equal to

$$\frac{\text{Std. finished-goods storeroom expense}}{\text{Total p.s.h. on final operations}}$$

The same reasoning applies to certain other charges. Some costs occur midway in the processing and are applicable to particular operations. Thus, where manufacturing specifications demand certain product tests in a control or testing laboratory, the normal laboratory cost, which is noncontrollable overhead as far as the operating cost-center supervisor is concerned, is reduced to a unit cost by dividing by the normal p.s.h. for the operations affected.

It will be noted that here, again, an alternative treatment is possible. The laboratory cost cited may be handled as a sold service, and its cost allocated on the basis of the number of sold hours deemed necessary per p.s.h. on each operation, charged to that operation at a sold-hour rate. This method has the advantage of facilitating a comparison of variances within the laboratory, *i.e.*, a comparison of sold dollars with actual costs.

Nevertheless, this is merely a question of the extent of coverage desired in variance analysis. Those departments for which we can establish useful standard sold-hour costs and in which it can be stated that total costs should vary to some determinable degree with the number of sold hours (which should in turn vary with production) are treated as a service and subjected to variance analysis, as will be described later. Those which are not immediately susceptible of such analysis are handled as previously described. The only difference in cost treatment lies in the fact that in the monthly statements the actual cost charged to operations is either the product of sold hours times a fixed rate (requiring the recording of the true allocation of sold hours) or merely the total actual cost distributed in the same way as standard.

This choice of methods applies to a number of expenses, of which those of Time Recording, Industrial Engineering, and Inspection Departments are examples. The hours of these required may or may not be considered controllable by cost-center supervisors, depending upon the plant. If they are controllable, then the sold-hour method *must* be used in order that charged costs may reflect the difference between actual hours purchased by the operating cost center and standard allowable purchased hours. If they are not controllable, the sold-hour method is used when a cost comparison within the selling department is desired; the book distribution of total actual and standard costs is used if no particular emphasis is to be placed on analysis of overhead expenses, for in many cases it is fallacious to imply that the welfare of the company is served by a reduction in them.

Summary

General overhead expenses that are not controllable by operating cost-center supervisors are reduced to a p.s.h. cost either by means of a sold-hour rate or a direct distributive charge to p.s.h. Although those handled by the latter method may in themselves be controllable, the methods of control are such as to require an individual treatment beyond the range of a work on manufacturing standard costs. In fact, other than strictly accounting methods are often useful, and these can be supplemented by standard-cost tools.

QUESTIONS

1. Why must a standard cost per p.s.h. be established even for expenses that are not expected to undergo reduction through standard-cost controls?

2. Give examples of some of these expenses.

3. Are they truly uncontrollable? State the reason for your answer.

4. A certain plant set up a landlord's account, into which were charged actual expenses of taxes, property rental, building depreciation, and building repairs and maintenance. A standard allowance for these expenses was also set up. Each cost center in the plant was charged a fixed standard cost per square foot for the space that it occupied. An equal amount appeared as a credit to the landlord's account, the difference between it and the actual expenses being a variance controllable by the supervisor in charge of property. If the sole purpose of this procedure were to encourage this supervisor to control his expenses by reducing the variance, would the cumulation of standard allowances on the basis of square feet occupied be necessary? Suggest a shorter means of accomplishing the same result. If a portion of the plant were closed down for a year, what would be the effect on this supervisor's variance (under the system described above)? If the variance changed for this reason, what would the amount of the change represent?

5. Suppose that in the preceding example the standard allowance for space rental for each cost center is based on the standard number of square feet required for each operation times the standard cost per square foot, the actual charge being the actual square feet occupied times the standard cost per square foot. What is the only way in which cost-center supervisors can avoid a variance in this account? Under what circumstances would it be desirable to include this account in the list of expenses controllable by cost-center supervisors? When would it be undesirable?

6. The factory administrative offices of a large company maintain a central stenographic bureau, none of whose services are used by the supervisors of cost centers within the factory. Should the expenses of this bureau be included in the list of controllable costs on the latters' cost-comparison sheets? Might anyone in the organization be held responsible for controlling these expenses? Assuming that time standards have been set on the typing, transcribing, filing, etc., performed by this bureau and that quantity standards have been set on the amount of stationery used, outline a method of setting up a standard-cost control for this bureau.

7. In the examples given in Questions 4 and 6, would it be necessary to reduce the expenses involved to a cost per p.s.h. earned in the plant? If so, how might this be done?

8. What is the advantage of considering inspection as a controllable service sold to operating cost centers (assuming they do not actually supervise the inspectors themselves), rather than as an overhead cost uncontrollable by the supervisors of those cost centers?

9. Need every service *sold* to operating cost centers be considered controllable by them?

10. A manufacturer of patent medicines maintains a chemical laboratory whose staff performs routine tests on samples of materials in process. The expense of this testing is not considered controllable by the manufacturing cost centers. Would there be any advantage in selling this service on the basis of a standard cost per test? Describe two methods of allocating the testing cost to the product. Which requires less clerical work?

CHAPTER X

APPLYING THE STANDARDS TO OPERATIONS

The standards have been established. It is now time to apply them to current production, to try a test run, and to make the final adjustments necessary for their effective operation.

In an establishment of any size, it is not always desirable to wait until standards have been set for the entire plant before placing them in effect. For one thing, the time and money spent on installing a standard-cost system are usually so great that the management is anxious to see some return. Coupled with this is a natural desire and expectancy to find out just how the installation actually operates. Also, it is to the standard-cost accountant's advantage to try out the standards a step at a time so that he may have an opportunity to correct any of those discrepancies or errors which can be found only in practice, without having to revise too large a mass of previous work. And finally, successful operation of standard costs in one cost center sells other supervisors on the merit of the system, especially if there is a tie-in with a supervisors' incentive plan.

Working Schedule

For these reasons a working schedule is prepared, listing the successive events in the installation of the system. The schedule follows this sequence:

1. Define the various cost centers, operations, expense items, accounts, etc.

2. Consult the sales department, past-production data, and operating supervisors, and record the capacity of each cost center at various operating levels in terms of p.s.h. These figures are a summary of the p.s.h. on all operations within the cost center at these levels.

3. Calculate the standard cost of general factory overhead per p.s.h.

4. Develop sold-hour or sold-utility rates for service cost centers.
5. Calculate the operational standard costs for each operating cost center, one cost center at a time.

With the exception of Items 3 and 4, it is scarcely possible to construct a system of standards without following this schedule. And if for any reason the management does not care to avail itself of the analysis provided by Item 4, sold-hour rates, this function is merged with the overhead calculation.

Applying the Standards

Assuming that the schedule has been followed to the point of establishing standards for the first cost center, it is well, before proceeding further, to apply these standards for a test period. Standard costs of production may, like actual costs, be cumulated by month, week, day, or even shift. And at first, while the initial standards are, so to speak, taking their first steps and need a bit of individual guidance, they should be separately applied and examined for each operating shift. In this way, any doubtful points will become more apparent by reason of being isolated in a short space of time. On the other hand, the comparison of one shift as against another frequently reveals that what appear to be defects in the standard when all shifts are lumped together are actually indications of varying performance by different foremen.

Suppose that the standard cost of the seven-to-three-o'clock shift on the turret-lathe operation in the machine-shop cost center is being calculated. Each operator's earnings card will carry on it, at some point, the total p.s.h.e arned by that individual, as shown in Fig. 8. This operator earned 7.213 p.s.h. The total of similar figures from the cards of all operators is in this example equal to 78.721 p.s.h. Note that the standard hours earned from the setups and delays are not abstracted at this point, since a normal allowance is made for them in the cost per p.s.h.

The p.s.h. total for the operation is entered on a cost-comparison sheet, and the total standard cost for each account is computed by multiplying the p.s.h. by standard cost per p.s.h., as in the sheets on page 130. As mentioned before, the standard direct-materials cost must usually be calculated separately for each part worked on.

Standard costs from all operations are collected on a summary

OPERATOR'S EARNINGS CARD

CC No. 101 Operation No. 2 Date 9-12-19-- Shift 7-3

Operator J. Bones Clock No. 20103

Part No.	Part Name	Work Done	No. Pieces Good	No. Pieces Spoiled	Std. Hrs. per Piece	Std. Hrs. Earned	Actual Hours	Earnings
		DIRECT LABOR						
6949	Housing	Bore & Face Cap End	624	3	.00481	3.001	3.00	
6950	Valve Body	Bore, Ream, & Tap Stem End	513	0	.00821	4.212	3.50	
		TOTAL PSH				7.213	6.50	
		STD. HR. RATE				$1.00		
		DIRECT LABOR COST						$7.213
		INDIRECT LABOR						
6950	Valve Body	Re-tap Stem End	76	0	.00332	.252	.20	
		Change Setup				.333	.30	
		Delay				.750	1.00	
		TOTAL				1.335	1.50	
		STD HR RATE				$1.00		
		INDIRECT LABOR COST						1.335
		TOTAL EARNINGS						$8.548

FIG. 8

sheet for the cost center which is identical in format with those shown for costs on each operation.

The totals at the bottom of this sheet are a general index of the performance of the cost center. In Chap. XII we shall examine several methods of extracting from them the information that will enable management to reduce the gap between actual and standard. At present, however, we are merely testing the setup to ensure that the variances shown are really true measures of performance, not reflections of inaccuracies and inconsistencies in the presentation.

COST-COMPARISON SHEET

Cost Center No. 104 Operation 3 Date 7-21-19__ Shift 7-3

P.s.h. 78.721

Account No.	Account Description	Standard cost p.s.h.	Total standard cost	Total actual cost	Variance
1000	Direct Labor	$1.000	$ 78.72	$ 85.68	$ 6.96
1001	Producers' Indirect Labor	0.100	7.87	10.86	2.99
1002	Other Indirect Labor	0.700	55.11	63.38	8.27
1005	Direct Materials	....	173.24	182.16	8.92
1006	Indirect Materials	0.200	15.74	6.21	9.53*
1007	Service Labor	0.800	62.98	60.03	2.95*
1008	Service Materials	0.300	23.62	10.55	13.07*
1009	Utilities	0.500	39.36	48.44	9.08
Total controllable............		....	$456.64	$467.31	$10.67

* Favorable variance.

Or, alternatively, if fixed costs are recognized separately:

COST-COMPARISON SHEET

Cost Center No. 104 Operation 3 Date 7-21-19__ Shift 7-3

P.s.h. 78.721

Account No.	Account Description	Standard cost Fixed	Standard cost Variable Per p.s.h.	Standard cost Variable Total Var.	Standard cost Total	Total actual cost	Variance
1000	Direct Labor	......	$1.000	$ 78.72	$ 78.72	$ 85.68	$ 6.96
1001	Producers' Indirect Labor	......	0.100	7.87	7.87	10.86	2.99
1002	Other Indirect Labor	$20.00	0.446	35.11	55.11	63.38	8.27
1005	Direct Materials	......	......	173.24	173.24	182.16	8.92
1006	Indirect Materials	......	0.200	15.74	15.74	6.21	9.53*
1007	Service Labor	27.00	0.457	35.98	62.98	60.03	2.95*
1008	Service Materials	10.00	0.173	13.62	23.62	10.55	13.07*
1009	Utilities	20.00	0.246	19.37	39.37	48.44	9.07
Total controllable....		$77.00	.....	$379.65	$456.65	$467.31	$10.66

* Favorable variance.

Possible Errors

The relation between standard and actual costs for a given operation can be distorted by the following causes not due to performance:

1. Standards predicated on a denominator of which they are not a true function.
2. Arithmetical errors in computing the standard.
3. Failure to distinguish between fixed and variable expenses.
4. Omission of a portion of cost that should compose the standard.
5. Failure to collect p.s.h. properly in the period of application.
6. Flow of actual costs not paralleling that of standard.

These will now be discussed in detail.

1. *Standards Predicated on a Denominator of Which They Are Not a True Function.*—This error is one that can be very easily made when the setting of the standard is not based on a full knowledge of the facts. As an example, the case may be cited of a pickling operation, for which it was fallaciously supposed that the quantity of sulphuric acid needed would vary in proportion to the tons of metal pickled. Since the requirements were actually dependent on the surface area of metal pickled, which might or might not vary with tonnage, the standard was inaccurate. Again, on a threading-machine operation, the standard tool cost per p.s.h. was set up to cover a range of sizes and thread classes. Subsequent experience showed that the tool-life expectancy on certain sizes and classes within the range used for averaging varied to such an extent that a much finer breakdown was necessary. Several standards were needed—one for each of several smaller groupings of sizes and classes—instead of the over-all figure used before. Then there is, of course, the case where a standard for a given cost is mistakenly based on the wrong operation altogether, which may happen when indirect labor is carelessly analyzed.

Errors of this sort are usually apparent when the standards are tested in application. It should be borne in mind, however, that the mere failure of actual costs to vary in the same proportions as standard costs is in itself no criticism of the standards. Perhaps the actuals are not being controlled to the extent that they should be, and the standard is merely performing its function of showing the possibilities for savings.

2. *Arithmetical Errors in Computing the Standard.*—Unfortunate occurrences of this sort require no discussion. They can be avoided only by double-checking all calculations.

3. *Failure to Distinguish between Fixed and Variable Costs.*—As pointed out in Chap. III, all standard costs may deliberately be considered completely variable. If this is done, certain variances will be largely due to the level of operations in the application period. But if it is decided to recognize the existence of fixed costs, misconceptions of just which costs are fixed will injure validity of the standard.

4. *Omission of a Portion of Cost That Should Compose the Standard.*—A comparison of standard allowances with detailed records of actual costs will usually show up any unjustifiable omissions.

5. *Failure to Collect P.S.H. Properly in the Period of Application.*—Clerks responsible for abstracting or tabulating p.s.h. by operations should be checked to be sure that they are not for any reason including standard hours earned from sources other than production (*e.g.*, from setups, size changes, reruns, etc.) in their take-offs. Otherwise the p.s.h. and hence the total allowable standard dollars will be inflated.

6. *Flow of Actual Costs Not Paralleling That of Standard.*—Briefly, the principal discrepancies of this sort are due to

a. Accounting changes contemplated in the standard but not yet made in practice. Standard costing subjects the accounts as well as the operations to a certain scrutiny and frequently results in minor shifts in charges for the sake of accuracy. It is necessary only to be sure that the changes are actually carried out. Otherwise it may be found, for example, that a certain indirect-labor occupation charged to one operation in the standard is charged to another in the actuals.

b. Failure to use established standard prices and sold-hour rates in the actuals.

c. Failure to offset abnormal actuals by the cumulative, or deferred, charges provided for in the standards.

This preview of the application of standards and their comparison with actuals leads to a fuller discussion of variance analysis in the succeeding chapters.

QUESTIONS

1. A certain plant has several cost centers subdivided into operations. The accounts used in each cost center are as follows:

Direct Labor.
Indirect Labor, Producers'.
Indirect Labor, Others.
Direct Materials.
Indirect Materials.
Fuel and Power.
Service Labor.
Service Materials.
General Factory Overhead.

You are required to draw up a sample set of forms on which may be recorded

a. The standard fixed and semifixed expenses of both manufacturing and service cost centers for various levels of capacity.

b. The standard unit amount of variable production or service expenses.

c. The standard product cost.

What backup sheets should be on file showing the development of the items in *a* and *b*? For each account state in detail the information that should appear on these sheets: quotas, hourly rates, efficiencies, standard prices and quantities, etc.

2. We know that standard costs can be used both for control and for inventory valuation. Which purpose can be achieved first in an installation? Why?

3. Why is it advisable to test the standards on a trial application before placing them in effect?

4. In a certain plant, all standard costs (except those for direct materials) were set up in terms of dollars per p.s.h. When they were tested by applying them to production in several consecutive months, it was found that the cost of fuel showed very erratic variances. It was then decided that the cost of fuel varied, not in accordance with p.s.h., but in proportion to tons of good material processed. Would there be any serious objection to using tons of good material processed as the denominator for this particular expense? How would the standard cost be cumulated for the cost-comparison sheet? For the standard product-cost card?

5. If in an application period, large variances occur between standard and actual costs on particular accounts for particular operations, is this prima-facie evidence of an erroneous standard?

CHAPTER XI

ACCOUNTING FOR STANDARD COSTS

Standard costs either are made an integral part of the accounting system or else are used merely as an exhibit for comparative purposes. As far as control is concerned, the two methods are equally advantageous. From an accounting standpoint the practice of incorporating the standards into the books has the following merits and drawbacks:

Merits:

1. It makes possible the use of a predetermined standard cost for each unit manufactured.
2. The existence of this predetermined cost obviates the need for keeping individual job-cost records. A savings in bookkeeping time results.
3. Transfers of Work in Process to Finished Goods can be made at standard cost times the number of units completed, when job costs have been abolished. This method makes it unnecessary to estimate how much Work in Process cost should remain in partially completed orders, a procedure otherwise essential when actual job costs are employed.
4. Standard costs are true and conservative costs for inventory values.
5. Tying operating standard-cost exhibits in with the company's books emphasizes the management's faith in the accuracy of those figures, which enhances their value for supervisory control.

Drawbacks:

1. Many executives prefer to see inventories valued at the actual amount of money spent or accrued on them.
2. Certain inconsistencies can develop between standard operational costs used as a source of entering, say, Standard Direct Labor in Process on the books, and the amount of Direct Labor included in the standard product price used for valuing inventories. This point will be covered later in this chapter.

3. Problems arise in disposing of variances between book actual and standard costs.

If standard costs are used only for exhibit purposes, paralleling but not participating in the established accounting procedures, none of the foregoing drawbacks occur, and operating performance can still be evaluated.

Standards Incorporated in the Accounts

The general procedure, when standards are incorporated in the books, is

1. To debit departmental expenses at actual cost.
2. To credit these accounts and debit Work in Process with the standard cost of productive operations performed.
3. To credit Work in Process and debit Finished Goods with the standard cost of products completed.
4. To credit the expense accounts with the remaining difference between actual and standard and debit this amount into Profit and Loss or on an apportioned basis to the various inventory accounts (if it is desired to restore the latter to an "actual" value). This may be done through intermediary variance accounts in order to spotlight the variances.

This series of transactions will be illustrated by the following example, considering only direct-labor cost for one operation:

Given:

Actual direct-labor cost of operation	$1,200
P.s.h. earned	1,000
Standard direct-labor cost per p.s.h.	$1.00
Number of units finished	100
Standard cost per finished unit (all operations to point of completion)	$5.00

Direct Labor Expense	$1,200	
Accrued Pay Roll		$1,200

To record cost of Direct Labor at actual.

Work in Process	$1,000	
Direct Labor Expense		$1,000

or

Work in Process	$1,000	
Direct Labor Standard Cost		$1,000

To charge Work in Process with the standard cost of 1,000 p.s.h. at $1.00 per p.s.h.

Finished Goods	$500	
Work in Process		$500

To transfer completed units to the Finished Goods inventory account (100 units at $5.00 each).

Direct Labor Variance	$200	
Direct Labor Expense		$200

or

Direct Labor Variance	$200	
Direct Labor Standard Cost	$1,000	
Direct Labor Expense		$1,200

To spotlight Direct Labor Variance by exhibiting it in a separate account.

Profit and Loss	$200	
Direct Labor Variance		$200

To dispose of Direct Labor Variance.

The last two steps may be combined by eliminating the Direct Labor Variance account.

Alternatively, it may be the management's desire to prorate the variance back into inventories. This not only results in inventories containing all actual cost, but also avoids the error of throwing all variance against profits from this month's sales, when actually a substantial portion of it may have been incurred on material still in process or in unsold finished goods. Assume that within the month

$1,000 (at standard) was added to Work in Process.
$500 (at standard) was added to Finished Goods.
$200 equals Direct Labor Variance.

Direct Labor Variance chargeable to Work in Process equals $200.

Direct Labor Variance chargeable to Finished Goods equals $\frac{\$500}{\$1,000}$ times $200, or $100.

Entries are

Work in Process	$1,000	
Direct Labor Standard Cost		$1,000

To enter the standard cost of Work in Process, which is equal to the p.s.h. times the standard cost per p.s.h.

Finished Goods	$500	
Work in Process		$500

To record transfer of completed Work in Process to Finished Goods.

Work in Process Variance	$200	
Direct Labor Variance		$200

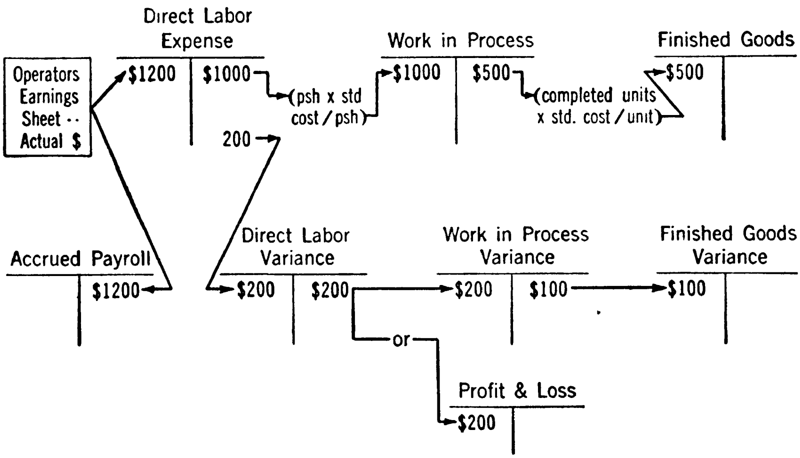
To transfer variance to an inventory account.

Finished Goods Variance..................	$100	
Work in Process Variance..............		$100

To transfer the variance applied to inventory, from Work in Process inventory to Finished Goods inventory, in the same ratio as the standard inventory amounts.

Although admittedly roundabout, this procedure does make an approach to accuracy if actual costs are desired on inventory accounts. It is only an approach because there is no guarantee that the particular in-process goods on which the variance occurred are actually those transferred to Finished Goods, to which a portion of the variance was applied. Even a job-order system, however, involves so many proratings of expense that it may safely be said that there is no such thing as 100 per cent accuracy. The best that can be hoped for is a consistent practice of charging costs where the management wants them to go, in line with good accounting policy.

The following chart illustrates the procedures shown in journal entries above.



FLOW OF DIRECT LABOR

Fig. 9

Needless to say, the Work in Process and Work in Process Variance accounts pick up charges from other accounts than Direct Labor, *e.g.*, Indirect Labor, Materials, Service Labor, Fuel and Power, etc.

Omission of the account Direct Labor Variance saves one step and causes no serious difficulties, for the variances, being the balance of the expense accounts after the removal of standard costs to Work in Process, can easily be picked off when the accounts are totaled. The customary procedure of exhibiting variances to the management, not as isolated items, but in conjunction with the actual and standard costs raises further question as to the necessity for a separate variance account in the ledger. Nevertheless, its use is helpful in coming to an understanding of the exact meaning of each cost transfer, especially for those not entirely familiar with the system.

Features of the Accounting Method

It has been stated that the use of standard costs in the accounts results in savings in bookkeeping time. That this is true is readily apparent when a job-order cost system is considered. Such a system requires that a record be kept of the time which each operator spends on each individual job. From this time his cost is computed and posted on a job-order cost sheet, to which all other costs are also posted either on a direct or on a prorata basis. If a given operator processes three jobs on his equipment in the course of the day, his time must be posted to three separate job orders. The same breakdown must be made of the time of every other man working on those jobs. Each order, when completed, must then be totaled; and furthermore, the hours charged to it must also be totaled when indirect expenses are applied on a per-hour basis. If, at the end of the month, a portion of the job is complete and has been transferred to Finished Stores, further computations are necessary in order to split out the cost of the completed material from that still in process so that the proper inventory entries can be made. Whether all this bookkeeping is done manually or mechanically, it requires a large amount of time and is accompanied by a strong possibility for errors. Yet unless standard costs (or possibly, estimated costs) are used, it provides the only means of determining inventory values.

With a standard-cost system, multitudinous entries are dispensed with by eliminating job records. Instead of being spread back against individual orders, each item of actual expense in the cost center is carried in one total to the end of the month. For each operation a total of p.s.h. is carried, which at the end of the month is multiplied by the standard cost per p.s.h. in order to obtain a total standard cost for comparison with the total operational actual cost.

This total standard cost is also the charge to Work in Process.

Credits to Work in Process are made simply by multiplying the number of completed units by the standard cost per finished unit. The need for estimating percentages of completion on individual orders is gone.

Job orders may be retained for purposes of production scheduling and control, and they may still be used on special jobs where the company desires to learn the relationship between actual cost and contract or selling price, but not for ordinary cost purposes.

True Cost

It may further be noted that the assigning of a constant standard price to particular finished commodities is by some authorities considered more accurate from a viewpoint of both accounting and economics than the occurrence of varying costs caused by factors of labor efficiency and plant capacity which have no bearing on the intrinsic value of the goods and which are more properly charged to Profit and Loss than to the products that happen to be scheduled at a given time.

These accountants argue somewhat as follows: The expenses of operating a manufacturing plant may be divided into the cost of producing goods and the cost of supporting idle facilities. When the plant operates at full capacity, a certain amount of overhead expense is necessary in order that goods may be produced. This expense is properly chargeable to those goods. When the plant operates at less than full capacity, some of these expenses continue unchanged. But only the fractional portion of them charged to each unit of output at full capacity should be charged to units at less than full capacity. The remaining fraction, which would have been charged to other goods required to make up 100 per cent capacity should now be considered a cost of unused manufacturing potential. Why, then, burden those goods which are made with this cost which is really not necessitated by them? Do not cost the goods with this unabsorbed overhead; divert it directly into Profit and Loss. It is not a cost of goods manufactured but a cost of goods not manufactured.

These arguments have an apparent validity. They assume that for every process, for every product, there is a true cost and that inventories should not be inflated by including in them those expenses which are not product costs but external costs of inefficiency and idle capacity; *i.e.*, conservative accounting, with its avoidance of unjustifiably high asset values, should shrink from any practice that increases inventory "values" because of poor plant practices. Since these practices may be especially prevalent in periods of low output, that is when conservatism is most desirable in order to prevent an unduly optimistic interpretation of asset figures. The goods are not worth more because of selling and operating inefficiencies. Therefore inventories should not be exhibited at so-called "actual cost" but instead at standard, and all variances should be placed in Profit and Loss. Otherwise, pricing policies based on costs may result in failure to meet competition.

Certain comments may be made on these arguments.

1. If we consider true asset costs to be those which eliminate costs of waste, inefficiency, and idle capacity, why not also exclude costs of outmoded processes or equipment? For example, if we operate plastics presses having dies into which molding powder is inserted by hand, this process costs more than if automatic-injection molding presses were used. If we heat-treat metal parts in a gas-fired furnace, there is a labor stand-by cost, a loss of material in the form of scale, and a loss of fuel in stack gases, radiation, and conduction, all of which could be eliminated by an electrical induction heating unit. In both cases the difference in cost is a loss due to relatively inefficient equipment. But our competitors may use the newest equipment. What then is the true cost? If it is said that the true cost should consider only the actual conditions in our own plant, it may be retorted that idle capacity, for example, is also a condition in our own plant and that in most cases the elimination of losses due to this factor is no easier than the elimination of those due to inadequate facilities.

2. Standard cost, until it has been attained, is a hypothetical cost. Inventory values based on it are hypothetical values. The extent to which such unrealized figures aid in gauging the financial position of a firm is open to question. That standards are useful in gauging operating performance does not mean that they are useful in assaying balance sheet values.

3. To state that costs of excess or idle capacity are not part of

the costs of goods made in periods of low operations is not entirely true. If the plant were shut down entirely, many of these costs would disappear. If it is kept open for the manufacture of a limited quantity of product, then that quantity should bear the costs of keeping the plant open.

4. The implication that standards should be used for setting prices, because they are true costs and therefore the ones really effective in competition, is especially misleading. In the first place prices are usually based on market conditions, demand, and the utility of the product. Even if a particular company has the entire initiative in setting prices, these prices must in the long run provide a margin over actual, not standard, costs, if profits are to be made. In a later chapter standard costs will be considered more fully in relation to prices, but it will here suffice to point out the limitations that exist, *viz.*, that standard costs, whether "true costs" or not, are a dangerous price basis. Furthermore, questions such as whether or not the setting of a certain price on a particular group of finished goods will enable the company to get rid of them and still recover the money tied up in them cannot be answered at all if the goods are carried at standard cost.

All in all, whether standard costs are true costs or not is so debatable that it is a matter of individual opinion as to how inventories are to be carried on the balance sheet. Undoubtedly the use of standard costs facilitates inventory accounting procedures. And if the actual value of inventories is desired, it can be arrived at by multiplying the standard cost of the goods in question by the ratio of actual to standard prevailing in the period in which they were produced.

Possible Errors in Method

When standards are included in the accounts and inventories are handled at standard cost, regardless of the final disposition of variances, differences can occur not only between standard and actual, but within the standards themselves. These do not prejudice the usefulness of the standards, but in the interests of accuracy they must be recognized. Otherwise, standard inventory values will be erroneous.

1. Nonstandard Operations.—The standard unit cost of a finished product is based on standard operations. This unit product cost is the summarization of the standard hours for each operation on the product times the standard-hour rate for that operation. The debit to Finished Goods, being based on this standard unit cost, assumes that the goods actually passed through these standard operations.

When the necessities of day-to-day shop scheduling require the use of nonstandard operations, the equality of total Work in Process standard costs and standard unit product costs is destroyed. Suppose that in a given month there is no initial work in process and that all products processed are converted into finished goods. If standard operations are followed, the credits to standard operational expense, debits and credits to Work in Process, and debits to Finished Goods will be equal. For example, consider the direct labor cost only for a single product.

Operation		Std. cost per p.s.h.	P.s.h. per piece	Std. cost per piece
No.	Description			
1	Face on milling machine	$1.00	0.0150	$0.01500
2	Drill ⅜-in. hole	0.75	0.0120	0.00900
3	Assemble bushing to hole	0.75	0.0002	0.00015
	Total			$0.02415

One thousand pieces are processed and transferred to Finished Goods. The Direct Labor expense account is therefore debited with whatever the actual cost of the operations may be at the time the expense is incurred. At the end of the month it is credited with the standard cost of the operations, calculated as follows:

Total p.s.h. earned × standard cost per p.s.h. = total standard cost

Operation 1.	1,000 pieces × 0.0150 p.s.h. per piece × $1.00 per p.s.h. =	$15.00
Operation 2.	1,000 pieces × 0.0120 p.s.h. per piece × $0.75 per p.s.h. =	9.00
Operation 3.	1,000 pieces × 0.0002 p.s.h. per piece × $0.75 per p.s.h. =	0.15
Total standard cost		$24.15

(It should be noted that the total p.s.h. earned is calculated separately in order to figure incentive earnings for machine operators).

The entry is

Work in Process	$24.15	
Direct Labor		$24.15

This leaves a balance in the Direct Labor account that represents the direct labor variance.

Finished Goods inventory is set up on the books by multiplying the number of pieces completed by the standard cost per piece. Since all pieces were completed, this is equal to 1,000 pieces × $0.02415 per piece, or $24.15. The entry is

Finished Goods	$24.15	
Work in Process		$24.15

Since standard operations were followed, and all goods were completed, Work in Process is left with no balance. But if because the milling machine, say, was busy with other work, Operation 1 had to be performed on a shaper, the case would be different, for the shaper represents a nonstandard operation for this product. Assume that the data on the shaper are as follows:

Operation		Std. cost per p.s.h.	P.s.h. per piece
No.	Description		
4	Face on shaper	$0.90	0.0250

Calculation of the standard cost is then:

Total p.s.h. earned × standard cost per p.s.h. = total standard cost

Operation 4.	1,000 pieces × 0.0250 p.s.h. per piece × $0.90 per p.s.h. =	$22.50
Operation 2.	1,000 pieces × 0.0120 p.s.h. per piece × $0.75 per p.s.h. =	9.00
Operation 3.	1,000 pieces × 0.0002 p.s.h. per piece × $0.75 per p.s.h. =	0.15
Total standard cost		$31.65

The entry now is

Work in Process	$31.65	
Direct Labor		$31.65

There will still be in the Direct Labor account a balance useful for control, since the actual cost for shaping has supplanted that for the milling which was not done, and efficiency of the operations used is what the standards are intended to gauge. But consider the next transaction. Finished Goods is still debited with the number of pieces times the standard price per piece. This standard price per piece, being based on standard practice, remains the same, regardless of what operations were actually used, for it would be neither practical nor advantageous to calculate standard unit costs for every possible combination of operations. Such a set of figures could indeed hardly be called *standard* product costs. Therefore the entry is still

Finished Goods............................	$24.15	
Work in Process......................		$24.15

Work in Process, having been debited with $31.65 and credited with $24.15, contains a residual balance of $7.50. This is a dangerously deceptive figure, for it seems to indicate that there is some work in process in the plant, whereas physically there is none. Actually, the $7.50 is a variance between the standard cost of the standard operation and the standard cost of the nonstandard operation.

Cases of this sort are quite common in shops having a variety of multipurpose equipment. They occur, for example, when a job can be performed on any of several different types of machine tool. In the preceding example, facing could have been performed on a milling machine, a shaper, a lathe, or a grinder. Again, the same job can be done on any of several sizes of equipment having different standard-hour rates. When die sets are interchangeable, a small metal stamping can be turned out on a bench press or on a large floor-mounted press. If when presses are tied up, a few of the parts are formed in the tin shop, there has been an even greater departure from standard operations.

Recognizing the variance in this simplified illustration presented no difficulty. But when work in process is transferred from department to department and carries over from month to month, the variance due to nonstandard operations remains concealed in bona fide work in process unless special measures are taken to disclose it. If these measures are not taken, there will be a cumulative growth of work in process that will exist only in the books.

There are two ways of isolating this variance. One is to apply standard costs on a product instead of on a purely operational basis. This means that total standard costs are cumulated according to actual operations performed, for the sake of comparing actual and standard performance on those operations in the regular manner. And at the same time the standard cost of each *standard* operation for each product is computed as that product goes through each step in shop processing. Only when nonstandard operations are performed will the results differ. This amounts to a job-order system in which standard costs of job orders are computed, not actual costs.

Thus the standard cost of actual operations is computed as shown in the example beginning on page 135 of this chapter, the calculations and entries of standard costs being made in totals at the end of the month. These figures are used to compute operating variances and are the credit to the various expense accounts. But they are not used as a debit to Work in Process. During the month an abstract is made from the daily time sheets of the quantities of each product going through each operation. For each product, the number of pieces is multiplied by the standard cost per piece of each standard operation that should be performed. These figures are used to debit Work in Process at the standard value. Any difference between the two totals is debited to a Nonstandard Operation Variance account. Using the figures in the preceding example, the process is as follows:

(*a*)	Work in Process	$24.15	
(*b*)	Nonstandard Operation Variance	7.50	
(*c*)	Direct Labor		$31.65

Line (*a*) is the sum of the individually calculated standard costs of standard operations that should have been performed on each product during the month to bring it to its present stage of completion over and above its status at the beginning of the month. Line (*c*) is the product of total p.s.h. earned times standard-hour rate, figured and totaled by operations, not products. Line (*b*) is the difference between lines (*c*) and (*a*). Line (*a*) is in practice calculated on the basis of total standard expenses for each product to its stage of completion, not for each isolated item such as Direct Labor. Line (*c*) is separately calculated for each expense.

This method entails about half as much work as a job-cost system of actuals. It is somewhat easier than the latter system, however, since although it requires consideration of each product made, it can be handled on the basis of total production on each product during the month rather than on the basis of daily entries and posting; *i.e.*, only the total number of pieces of each product going through each operation must be known; the actual costs incurred on each product on each operation need not be posted.

The second way of isolating the variance in question is to set up a system of timekeeping whereby shop time checkers are provided with process sheets listing standard operations for each product. When a nonstandard operation is performed, the clerk reports the production on a time card having a distinguishing mark, such as a color stripe. These cards are segregated by the pay-roll clerk and serve as a basis for calculating what the standard cost of the work would have been if the standard operation had been used. For convenience, the results of these calculations can be recorded daily on a form for totaling at the end of the month. An example of such a record is shown:

CALCULATION OF VARIANCE DUE TO NON - STANDARD OPERATIONS

CC No.______ __________19__

Actual Oper. Std. Cost					Std. Oper. Std. Cost			
Date	Oper. No.	Psh Earned	Std. Cost per Psh	Total Std. Cost	No. of Pieces	Std. Oper. Psh per Piece	Std. Oper. Std. Cost per Psh	Total Std. Cost
		(a)	(b)	(c) (a x b)	(d)	(e)	(f)	(g) (d x e x f)
Total					Total			
Non - Standard Operation Variance: col. (c) - col. (g) = ______								

FIG. 10

If the frequency of nonstandard operations is large, Columns (*e*) and (*f*) can be premultiplied for all products to provide a standard operational cost per piece, thus saving one column and one multiplication on the form. The standard operational costs per piece are recorded on cards in a product standard-cost file.

By reducing the calcluations to those products which actually did receive nonstandard work, this second method saves much clerical time. It can be used only when the shop time checkers are sufficiently wide-awake to report every nonstandard job as such.

It should be noted that the entire discussion of nonstandard operations so far has dealt only with those which are alternative to a standard operation. It does not refer to additional work required by the poor performance of standard operations.

2. Fixed *vs.* Variable Standards.—In previous chapters, the advantages of dividing standard costs into fixed and variable charges for each cost center were pointed out. However, under this system a grave disadvantage arises when standards are incorporated into the books.

As previously stated, the recognition of nonvariable expenses means that the total standard cost of each cost center is the sum of fixed standard charges plus variable standard charges which are as a rule proportionate to p.s.h. But standard product costs are computed at a given level of operations—usually expected or normal capacity. Hence (even when only standard operations occur) only at normal capacity can the total standard cost of operations equal the total standard cost by products going through those operations. At less than normal capacity, the total standard operational cost per p.s.h. becomes proportionately greater because it includes a greater relative proportion of fixed expense. Under these circumstances, Work in Process credits for a given volume of goods completed, based on standard costs by product, are less than Work in Process debits for the same goods if based on fixed and variable standard costs. A variance due to differences in capacity occurs. This variance can be eliminated by setting different standard product costs for different operation levels, which is obviously inadvisable.

Alternatively, it can be handled by

a. Setting a standard cost of all fixed and semifixed expenses at each operating level.

b. Calculating a standard-hour rate for those expenses, based on normal operations.

c. Setting forth separately in the monthly comparative statements the difference between the dollars in *a* and the standard dollars computed from the variable rate in *b*, as an allowed fixed standard cost.

d. Charging this separated, fixed standard cost to a capacity variance account rather than to Work in Process.

For example, for a given cost center, a table is prepared which shows the productive standard hours at various operating levels, the standard cost of fixed and semifixed expenses, and the unit cost of these expenses at normal capacity. The table is as follows:

TABLE OF FIXED AND SEMIFIXED EXPENSES

Cost Center No. 131 Prepared Dec. 16, 19__

P.s.h.		1,500	1,800	2,100	2,400	2,700	3,000		3,300	3,600
Per cent of normal		50	60	70	80	90	100		110	120
Account										
No.	Description	Total	Total	Total	Total	Total	Total	Per p.s.h.	Total	Total
1002	Indirect Labor	$150	$150	$150	$150	$150	$150	$0.050	$150	$150
1003	Supervisory and Clerical Salaries	250	250	300	300	300	300	0.100	300	300
1007	Repair and Maintenance Labor	170	170	170	170	170	170	0.057	170	170
1008	Repair and Maintenance Material	50	50	50	50	50	50	0.017	50	50
1009	Utilities	20	20	30	40	40	40	0.013	40	40
	Total. . . .	$640	$640	$700	$710	$710	$710	$0.237	$710	$710

This chart, it may be observed, displays only fixed and semifixed expenses. Other expenses, even for the same accounts, may quite possibly be variable and are handled separately. Thus, the cost of Repair and Maintenance Labor shown in the table is the minimum amount required to keep the cost center in good repair, regardless of the amount of production. Additional repair and maintenance labor occasioned by wear and tear on equipment, which increases in proportion to the amount of use of the equipment, is treated as a variable cost, *i.e.*, a cost per p.s.h.

Standard product costs include the unit value per p.s.h. of the fixed costs at 100 per cent normal capacity. Credits to Work in Process and debits to Finished Goods are, in turn, based on these standard product costs. Therefore, for consistency, all *debits* to

Work in Process must be standard costs that include the p.s.h. value of fixed expenses at the 100 per cent level.

But the corresponding credits to Expense, made at standard cost, include a greater or lesser standard cost per p.s.h. of fixed expenses than do the debits to Work in Process, unless operations are at the 100 per cent level. Hence, in order to achieve an equality of debits and credits, the difference must be sidetracked into a separate account, Capacity Variance.

To illustrate, suppose the standard unit product cost to be \$0.226. During the month 300 units are initiated and transferred from work in process to finished goods, nothing else being manufactured during the month. Three operations occur, with variable costs per p.s.h. as follows:

Operation No.	Variable Standard Cost per p.s.h.*
1	\$0.400
2	0.800
3	0.600

* In practice these costs would be broken down into costs per p.s.h. for each expense account for each operation. They are here shown as totals in order to focus attention on the problem being considered.

P.s.h. earned during the month are

Operation 1..........	1,000
Operation 2..........	700
Operation 3..........	400
Total..............	2,100

The variable standard cost of operating the Cost Center is first calculated.

Operation 1.....	1,000 p.s.h. × \$0.400 per p.s.h. =	\$400
Operation 2.....	700 p.s.h. × \$0.800 per p.s.h. =	560
Operation 3.....	400 p.s.h. × \$0.600 per p.s.h. =	240
Total variable..........................		\$1,200

To this must be added the standard fixed expense to which the supervisor is entitled. This is read from the table on page 148 to be \$700 at a 2,100-p.s.h. level. The total standard expense of the cost center is therefore \$1,200 plus \$700, or \$1,900. This will be used as the credit at standard cost to the controlling expense account, so that the variance between it and actual will reflect the supervisor's performance. This amount cannot also be debited to Work in Process, however, for Work in Process is necessarily valued at *standard cost based on 100 per cent capacity*—necessarily, since the *credits* to Work in Process will be calculated from standard product prices based on standard costs at the 100 per cent level. Hence there must be removed from the $1,900, before debiting, an amount equal to the difference between fixed expense at the 2,100-p.s.h. level and fixed expense based on the 100 per cent level unit costs. This difference is equal to

Fixed expense at actual level − fixed expense based on 100% level unit costs
$700 − [($0.237 from Table of Fixed and Semifixed Expenses, above) × 2,100 p.s.h.]
$700 − $498
= $202

That is, if fixed expenses were considered to be variable in the figures used for comparison with actual costs (as they are in figures used for standard product costs), they would be $202 less than the amount really used for comparison. Stated another way, they would amount to $498, which added to the truly variable expenses would give $1,698 as the value of the Work in Process debit.

The accounting entry is therefore

Work in Process	$1,698	
Capacity Variance	202	
Expense		$1,900

Work in Process Accuracy

The foregoing discussion has dealt with the procedures necessary for a completely accurate statement of the value (at standard) of Work in Process. We have seen that Work in Process may be cumulated in either of two ways:

1. It may be based on the standard cost of the p.s.h. earned. In this case, certain adjustments are necessary to remove the effect of nonstandard operations and of off-capacity operating levels.

2. It may be based on the standard product price of the various materials remaining unfinished at the end of the month. The quantity of these materials is determined either by keeping a running production record of the operations actually performed on each order or by taking a physical inventory at the end of the

month. In either case all products must be priced up to the point of completion that they have reached. Keeping these records of operations by product or taking monthly inventories is a nuisance job that, together with the subsequent pricing, should be avoided wherever possible.

Some thought should therefore be given to the degree of accuracy required of Work in Process values. If only an approximation is needed, we can employ Method 1 above without making any adjustments, provided operations are not too far from normal capacity. When the semiannual inventory is taken, any discrepancy appearing in the book value of Work in Process can then be removed by a single adjustment. That a short cut like this effects substantial savings in clerical time is obvious. Accordingly, we should not install methods of obtaining very accurate Work in Process inventories unless we are convinced that the resulting figures will actually be of assistance in the effective management of the business and that management will be less effective without them.

Exhibit Standards

If standard costs are not incorporated in the accounts, they are used for control in the form of exhibits. The calculation of standard dollars earned in the period is made exactly as previously described but is not made the basis of inventory values. For this reason no problems occur because of discrepancies between p.s.h. standards and product standards. If desired, the standard costs are entered in ledgers provided with double columns, one for actual costs and one for standard costs, or else they are entered only on the cost-comparison sheets. In either case, the existing accounting system need not be changed except to the extent of providing a complete segregation of operational costs as described in Chap. II.

The use of exhibit standards is most common during the period when standard costs are first being introduced to the plant. At this time, standards are usually prepared for one cost center at a time. As soon as a cost center is set up on standard, exhibits of cost comparisons are prepared for it immediately without waiting for the standardization of other cost centers. By the time that the program is completed, the entire organization is familiar with the meaning and purpose of standards. Also there has been opportunity for making whatever corrections in method have appeared to be necessary. The foundation has therefore been laid for the introduction of standards into the accounts, for the sake of achieving bookkeeping economies if for nothing else.

Summary

Standard costs may be used in the form of exhibits for control only, or they may be integrated into the accounts. When the latter procedure is followed, standard costs appear on the books as a credit to expense accounts and as a debit to inventory accounts. These entries are made in summary form at the end of the accounting period without the necessity of cumulating actual costs by product. Simplification of accounting procedures is the result. Care must be used to isolate variances due to different methods of expressing standards. Other variances (those between actual and standard) are either transferred to Profit and Loss or prorated against inventories. A further examination of these other variances occupies the immediately succeeding chapters.

QUESTIONS

1. What are the arguments for and against incorporating standard costs in the accounts?

2. Would it be possible to operate a standard-cost accounting system without the use of variance accounts? If this were done, where would the variances appear in the accounts?

3. Why is the prorating of variances to inventories only an approximation?

4. With a standard-cost system how are credits to the departmental expense accounts obtained? How are credits to Work in Process obtained?

5. With a standard-cost accounting system is there ever any need for recording actual costs on individual orders? State the reason for your answer.

6. What is meant by "cost of idle capacity"? Does this cost consist of fixed or variable expenses or both?

7. State an argument for charging at least a part of the cost of idle capacity to the products being manufactured, in a period of low activity.

8. State an argument for isolating the cost of idle capacity rather than charging it to goods manufactured.

9. What is meant by a "nonstandard" operation?

10. If work in process is cumulated by multiplying p.s.h. earned by standard cost per p.s.h., what will be the effect of performing nonstandard operations?

11. Describe another way of cumulating work in process than that mentioned in Question 10.

12. What does the amount of money in the Nonstandard Operation Variance account reveal to the management? Is this account ever likely to have a credit balance? State the reason for your answer.

13. When we speak of variable standard costs in this text, do we mean that the cost per p.s.h. varies?

14. Given

	Normal	This month
P.s.h. earned..................	5,000	4,000
Fixed standard cost............	\$800	\$800
Variable standard cost per p.s.h.	\$2	\$2
Total actual cost..............	....	\$9,000

Show calculations and journal entries to record the credit to the cost-center expense account, the variance controllable by the cost-center supervisor, the capacity variance, and the debit to Work in Process.

15. In what type of plant would the savings in bookkeeping costs resulting from valuing inventories at standard be negligible? Why?

CHAPTER XII

INTRODUCTION TO VARIANCE ANALYSIS

The difference in a given period between actual cost and standard cost, known as the "variance," tells management to what extent costs can be controlled. The variance itself is not a control, for costs are not controlled by compiling statistics about them. The control consists of the steps that management takes to regulate or limit costs. And the effectiveness of these steps is gauged by the degree to which actual costs approach standard; in other words, by the size of the variance.

But merely to know that a variance exists or to know its dollar value for a given account does not facilitate the exercise of control. Tell the works manager that the entire plant has an unfavorable variance of $30,000 this month in the account Direct Labor, and you tell him nothing. Suppose it is $30,000—what should he do about it? Is that good or bad?

For even though the standards are supposed to be attainable, they are not necessarily immediately attainable. We should have an unusually high caliber of supervision indeed if all cost-center heads could force the costs of their multifarious activities down to standard at once. Behind every variation from standard cost there is a reason in operating conditions—and very often an apparently good reason. Supervisors do not have high costs just for the pleasure of reading large figures. They have them because they do not realize that the costs are reducible, because they have not yet got around to reducing them, because they do not yet see how to reduce them, or because they have not been impressed with the necessity for specific reductions. To eliminate these mental impediments as well as the physical plant conditions that accompany them and the cost variances that reveal them is not a quick job. Nor is it to be done by saying "Here is a variance. Wipe it out next month." Variances can be reduced, but their existence is not in itself a sign of bad management.

Merely exhibiting to the works manager the aforementioned

$30,000 Direct Labor variance does not inform him of the significance of the variance. Without knowing the significance of the variance he cannot intelligently use the data. Therefore the dollar value of the variance must be related to other statements that tell the manager, first, where he stands now and, second, where he can move to.

Two methods are available for giving meaning to a variance. The variance may be compared with previous variances in the same account. Here there is the implication that the variance should show a trend toward diminution. Or the variance may be resolved into its components in such a way as to show wherein actual performance differed from standard to the extent of affecting costs. Either method may be used independently, but obviously they are best used together.

Comparison

Suppose that the comparative method is used. An account on the cost-comparison sheet then appears as follows:

Account		Total std. cost	Total actual cost	Variance	Variance last month
No.	Description				
1000	Direct Labor	$75,000	$105,000	$30,000	$23,000

Apparently performance this month is not so good as last month, for the variance has increased from $23,000 to $30,000. But perhaps the increase is really the result of a higher volume of operations. Perhaps the $23,000 variance last month occurred when there was more or less money in the standard-cost column. In order to make the comparison equitable, therefore, the figures are stated as a percentage of standard, so that they may be adjudged on the same basis every month.

Account		Total std. cost	Total actual cost	Variance		Variance last month, % of std.
No.	Description			Amount	% of std.	
1000	Direct Labor	$75,000	$105,000	$30,000	40	43

We can see that the variance has decreased from 43 per cent of standard last month to 40 per cent of standard this month—a desirable trend. Since a variance of 40 per cent has been demonstrated, there is no reason, apparently, for any greater figure appearing in the future. Rather, further reductions should be worked for. The organization is moving toward a goal.

This method of showing variances is readily grasped, requires but little computation time, and provides a vivid moving index of performance. These are distinct advantages.

Analysis

Desirable though the comparative method may be from the standpoint of simplicity, it does not exploit the full possibilities of a standard-cost system. With the statistical data on performance made available by standard costs, a much deeper insight into the health of plant operations may be gained. Failing to use this information is like buying an expensive jig borer and then using it for nothing but routine drill-press jobs.

The essential purpose of examining variances is not to realize that a variance exists or even to recognize the fact that it has changed from month to month but rather to learn what cost components caused it to change and, knowing what these factors are, to trace them to their original sources in plant operations. Good management, by understanding these grass-roots reasons for variance changes, learns to control them, *i.e.*, to modify them to its advantage, and so, eventually, to reduce the variance and thus bring actual cost one step closer to standard.

This general discussion can be illustrated by a simple and concrete example. Examination of a cost-comparison sheet for a hand-miller operation reveals that the variance between actual and standard labor cost has increased from 27 to 29 per cent in two successive periods. Why? Further investigation reveals that the actual costs of operators' paid-for delays were, in the two months, $200 and $290, respectively, as against standard costs of $150 and $175. Again, Why? Reference to the operators' time sheets shows that the principal cause of delays is waiting for material. We ask, Why must operators wait for material? And we learn that this delay occurs because of a recent shortage of trays on which in-process parts are racked. More trays should be provided.

Let us examine some features of this analysis. The foreman, of course, knew that not enough trays were on hand, but he did not realize that this deficiency was actually eating into his cost center's potential profits as measured in dollars. He therefore did not immediately correct the condition. If he had been asked to explain the variance from standard in the most recent month alone, he would probably have replied that the standard was impossibly tight. But his previous month's record demonstrated that he was capable of better performance. Hence it appeared that a more plausible explanation must be found. Cost data supplied the means of pinning the variance down to one particular cause—delays. One major source of delays was discovered, and finally and most important of all, a means was found to eliminate it.

True, a monthly tabulation of delays themselves would doubtless have revealed the same information. But this is just one of many expense items. The over-all picture is most clearly defined in terms of the common unit, actual dollars, and with the use of standard as a bench mark from which to measure those dollars. In this way all costs—those of materials, services, and utilities as well as of labor—are evaluated.

This case, being but an example, has been simplified. In practice it will be found that a multiplicity of causes contributes to every variance. How these causes are to be isolated will be explained in the following chapters.

What to Avoid

The presentation of variances must always be accompanied by an awareness of its ultimate use. It is easy for the statistical mentality to be beguiled into devious paths of analysis, which the lay mind cannot follow. And yet it must be remembered that all cost statements, comparisons, variances, and interpretations thereof become useful tools only in the hands of the operating executive who controls manufacturing processes. He can employ those tools only if he readily understands them. And with his mind occupied by problems of shipping dates, employee relations, equipment purchasing, quality control, shop maintenance, and many others, he does not have time to pick his way through a maze of cost-accounting elaborations. It is the standard-cost accountant's duty to give him vivid reports which high-light the essentials and point out particular cost deviations and possibilities for improvement.

To illustrate the dangers of too extensive analysis, it may be pointed out that the apparently simple item of variance in labor cost of machine operators may be resolved into the following components, to name a few:

Variance due to off-standard rates of pay.
Variance due to excess producing hours.
Variance due to excess delays.
Variance due to excess defective or spoiled material produced.
Variance due to excess setups.

Each of these is capable of being modulated into other keys such as

Cost variance due to excess delays with hourly rates at actual values.

Cost variance due to off-standard rates if producing and delay hours had been at standard.

These variances can be stated both in dollars and in ratios—ratios of variance to standard cost or to a historical-reference actual cost. Again, each variance can be identified, for simplicity, by an alphabetical code, as some authorities suggest.

With such refinements the standard-cost exhibits are removed into a universe so orderly that everything is accounted for and at the same time so complex and arithmetically remote from yesterday's jobs in the shop that nobody has time or ability to comprehend it. A standard-cost system that is perfected to this point is in danger of either being thrown out or ignored. But fortunately this condition is easy to avoid.

What to Aim At

Remembering the ultimate purpose of standard costs, insofar as the operating supervisor is concerned, is the best guarantee of obtaining useful information from those standards. The purpose of the standards is not to provide exercises in arithmetic or to supply a source of complex and abstract reports but rather to

1. Show the supervisor what his costs should have been.
2. Show how closely he came to meeting those costs.
3. Show whether his performance in this respect is improving.
4. Set up a means of explaining the variances so that the knowledge of their causes can be used as a weapon for their reduction.

In order to accomplish the purposes in Items 3 and 4 the analyst must do more than calculate the amount of the variance. He must compare that amount, either on a dollar or percentage basis, with previous performance, as explained on page 155. He must also state the reason for the variance.

In discovering the reasons for particular variances, a certain amount of discrimination must be used. It is a small plant indeed that does not have at least a dozen operations, on each of which there are several cost elements, which in turn may vary for sundry causes. To separate these causes out to their roots, though quite possible, results in such a mass of data that taking any action on it all is difficult. Therefore it is better to select for analysis from each operation only the outstanding or major cost variances at any one reporting time. The basis for the selection may be either the dollar value of the variance or the fact that it is showing an increase in growth from month to month. If any one cost element is fully resolved, the supervisor will find that he has quite enough to do to improve performance on that element without being bothered with a host of others. The next month another element can be selected for attention and action. Thus are economies effected, one step at a time.

As mentioned before, those variances which are singled out for dissection must be explained fully; otherwise the explanation is merely a restatement of the obvious. For example, a case is recalled of a cost-comparison sheet for a steam-generating plant that indicated a marked variance between the actual and standard cost of coal (both costs being predicated on standard prices). The attached commentary stated "Unfavorable variance due to above-standard consumption of coal." An explanation of this sort is, needless to say, so superficial as to be worthless. Only if it had been accompanied by further details as to why excess coal was used would it have been of value. Then the conditions responsible for the variance could have been attacked.

Frequency of Reports

The foregoing observations are intended to convey the idea that variances used for control are not just a series of accounting computations. Instead they are like the instruments on the panel board of a powerhouse, which signal any deviation from desired performance. At a given time, only a few may be worthy of particular attention.

A skilled analyst scans the monthly statements of a cost center. He selects one account the actual costs of which appear unduly out of line with standard. He then digs back into this account and discovers to what extent the deviation may be attributed to off-standard operating times, off-standard materials, off-standard operating practices, and so forth. So far, each of these deviations is expressed in dollars, since dollars are the universal measure of business results. But once the magnitude and cost of the deviation have been established in dollar values, other means may be used to reveal its outlines more clearly; for just as a good mechanic is familiar with many kinds of tools, so should a good standard-cost accountant be able to utilize many more devices than ledger records for his purposes.

Therefore a small cost-reduction campaign is instituted on the one item chosen for special analysis. This campaign is based on the rule that standards have been set up as being *attainable*. Its purpose is to facilitate the attaining of one specific standard. In order to fulfill this purpose, various special reports and investigations are employed, a number of which, such as production reports, man-hour controls, and materials-consumption records, will be described in the following chapters.

The customary preparation of monthly reports does not apply to this portion of the program. Ordinarily, summarizing costs more than once a month is inconvenient. For the purpose of controlling one particular cost, however, reports are issued for each day, each shift, or even each hour. "A modern cost system . . . must present headline news, not obituaries."[1] While the reports are still hot, they have more significance than when they are 30 days old, their causal background buried in the succession of intervening events. They can instantly be related to shop conditions. The effect of any remedial measures that are tried out can be seen quickly.

The advantage of this mode of cost reduction is that it works entirely with existing conditions and equipment. Not relying on extensive replacements or upheavals in the plant, it merely attempts to get the most out of what is on hand. Although revisions

[1] HADDEN, A. A., Standard Costs in a Paper Mill, *Paper Trade Journal*, Mar. 6, 1941.

in plant layout and facilities may be suggested by the study, they are extraneous to its assumptions and hence not essential to its success.

Summary

For each cost center a monthly statement is prepared showing both actual and standard costs. The variance between the two is displayed in comparison with previous variances. Outstanding disparities are broken down individually to determine their causes. The analysis is aided by the use of auxiliary reports prepared at close intervals to facilitate the observation of changes. Operations are then controlled in a manner that will effect a reduction in the variance. The whole procedure is carried out in such a way as to be readily understood by all supervisors concerned.

QUESTIONS

1. The supervisor of a cost center says: "I know what is going on in my department every day because I'm right there to see what happens. When something goes wrong, I know about it immediately, long before the accountants come around with their figures at the end of the month to tell me about it. All this variance analysis is just a lot of superfluous paper work to reveal the obvious, and I can't see why the company spends money on it." How would you answer his statement?

2. A standard-cost accountant says: "Every month I send each supervisor a statement showing the standard and actual costs for each expense account on each operation. The statement also shows the ratio of actual to standard for this month, for the year to date, and for last year. In addition I send him a statement showing him a breakdown of all variances into their sundry causes, such as excess delays, spoiled work, excess scrap, excess setups, excess maintenance hours, excess maintenance materials, etc., for each operation. I do not feel that the supervisors are making full use of this information. Perhaps they do not realize its value. At any rate, they glance over the reports, lay them aside, and go on about their duties. It is as though the data did not impress them. Yet I do not see how I could give them any better information than I am now giving them." What would you suggest for better results?

CHAPTER XIII

VARIANCES IN LABOR COSTS

In this chapter are described the techniques of explaining the differences between actual and standard cost that occur in any specific accounting period for direct labor, producers' indirect labor, and other indirect labor. Service-labor cost variances are examined in Chap. XV because the method of handling them differs from that for the ones in question. The analysis is predicated on an understanding of the standard-cost accounting procedures for labor. Since control is the object of the analysis, a consideration of allied aids to control is also important.

Throughout this chapter and those which follow, variances will be assumed to be an excess of actual cost over standard. In practice, this is not always so, particularly when "attainable" standards are used, but the method of analysis is the same in either case.

Direct-labor Variances

Variances in direct-labor cost are due to divergences from standard in either the price or the efficiency of labor.

Price Variances.—The standard direct-labor cost of an operation is based on the earning of a given number of p.s.h. per actual hour worked and on the use of employees who receive a given rate per hour for doing the work. As stated in Chap. V, the standard rate per hour is either the rate paid to operators of the minimum ability necessary to perform the operation or the average of hourly rates paid in the cost center. Ideally, the rate of pay received by a man is determined by the type of work that he does. In a plant operating on this policy the rate of pay goes with the job. A man doing a high-rated job receives high guaranteed hourly earnings. The same man doing a lower scaled job receives relatively low guaranteed hourly earnings. Thus the individual is paid in proportion to the requirements of the job. When he does the most demanding work, he receives the most income. Rates of pay per standard hour earned are scaled in the same proportion as guaranteed hourly rates. Hence, assuming incentive standards to be fairly set, bonus earned is, for a given rate of output, greater on higher rated jobs. A plan of this sort is fair both to the company and to the employees, for payment is always in proportion to value given. When it is used, there can be no variance between the standard and actual labor price of a job, for both are fixed.

In the eyes of many, however, such plans are not favored. It is pointed out that

1. No provision is made for merit or term-of-service increases to older employees. (But to this it may be answered that older employees will receive more money by qualifying themselves for higher rated jobs.)

2. Extremely accurate timekeeping is necessary in order to measure the time spent on different jobs carrying different rates of pay.

3. Unless employees work on the same job day in and day out, great care must be used in assigning jobs in order to avoid charges of discrimination.

Consequently, many firms, particularly small ones and those having a great variety of work for each employee, prefer to use individual rates based on the worker's general ability and length of service.

It is in this case that labor price variances occur. Theoretically, it is still possible to determine what rate *should* be paid for a given job. On this determination standard operational costs are set, and the thoughtful supervisor attempts to schedule employees in line with these requirements. He does not, for instance, place a \$1.25-an-hour machinist on a drill press that can be run by a \$0.80-an-hour machinist's helper. Nevertheless, the correct practice is not always adhered to for the following reasons:

1. There may simply happen to be a disproportionately large percentage of low-caliber jobs in the shop at a particular time.

2. Relatively new men may be working on high-caliber jobs, so that more expensive men must be assigned to whatever other jobs come along.

3. Certain men receiving a high rate because of length of service may not be capable of performing the more demanding jobs.

4. The foreman may merely be careless in assigning work, or he may assign easy jobs to his favorites.

Under these circumstances the actual cost of some operations will be in excess of standard cost, even though expected efficiency performance is attained.

Not only does the variance occur because of job assignments. It can also occur because the proportions of men at various rates are not in line with standard proportions. Assume that in a small cost center an average rate per hour is calculated as follows, to be used on all operations:

NORMAL AVERAGE RATE PER HOUR

No. of men	Guaranteed hourly rate	Rate per std. hr.	Total cost
6	$0.90	$1.20	$ 7.20
8	0.80	1.04	8.32
12	0.70	0.91	10.92
5	0.55	0.72	3.60
31			$30.04

Standard average rate per standard hour: $30.04 ÷ 31, or $0.97

The proportions of men shown above in various classes have presumably been decided on by the employment manager, industrial engineer, department head, and standard-cost accountant as a good representation of the requirements of the cost center at normal operations. However, whether because somebody is tempted to hire some good employees who can be attracted only by high rates, because raises are given in order to satisfy grievances or retain skilled men, or because some workers become eligible for seniority increases, the proportions rise to

ACTUAL AVERAGE RATE PER HOUR

No. of men	Guaranteed hourly rate	Rate per std. hr.	Total cost
8	$0.90	$1.20	$ 9.60
9	0.80	1.04	9.36
14	0.70	0.91	12.74
0	0.55	0.72	
31			$31.70

Actual average rate per standard hour: $31.70 ÷ 31, or $1.02

Even if the normal proportions of operations requiring various degrees of skill occur, even if men are assigned only to jobs for which they are best suited, even if everyone works at expected efficiency, actual cost will exceed standard, for some men are being overpaid with regard to the total needs of the department.

Determining the amount of this variance due to labor price is arithmetically simple. Suppose, for example, that workers are paid a piece rate expressed in standard hours with varying earnings per standard hour depending on the individual doing each particular job and that

P.s.h. earned	1,000
Standard average direct-labor cost per p.s.h.	\$0.97
Actual average direct-labor cost per p.s.h.	\$1.02

Then

Actual total direct-labor cost = 1,000 × \$1.02 =	\$1,020
Standard total direct-labor cost = 1,000 × \$0.97 =	970
Price variance in direct-labor cost =	\$ 50

Although arithmetically simple, practically this calculation is laborious. The example covers only one small cost center. In a company of any size the actual average cost per p.s.h. must be figured for each cost center on the basis of current labor rates. If in setting the standards the most desirable rate for each operation was used rather than an average rate for the cost center, it becomes necessary to calculate, for each operation, what the direct-labor cost would have been if the same number of p.s.h. had been earned but at the standard rate per standard hour. This amounts to a double calculation of the pay roll. The calculation would be unnecessary if no other factors contributed to direct-labor variance, for then labor price would be the only reason for variance. But unfortunately such factors frequently do occur. One of them is labor efficiency.

Efficiency Variances.—When employees receive a straight piece rate, however expressed, there can be no variance between actual and standard due to efficiency, for the per cent performance of the workers does not affect the dollars paid per piece, or per standard hour. The only variance is that due to labor price, which is, from an accounting standpoint, independent of performance. Only if the employee fails to make out—that is, to earn enough from production to realize his guaranteed rate—does a variance due to efficiency occur; this is discussed under Producers' Indirect Labor as Make-up Money.

But, as explained in Chap. V, when a differential type of incentive plan is used, the direct-labor cost per p.s.h. depends upon the efficiency (assuming that all operators receive the same rate per p.s.h. at 100 per cent performance). On page 57 of Chap. V is shown a table in which it is seen that, for the plan exemplified, Direct Labor cost at 100 per cent performance is \$1.000 per p.s.h., and that at 80 per cent performance, for instance, it is \$1.113 per p.s.h. Under this plan, therefore, a cost variance may occur due to efficiency. The calculation of variance in specific cases is illustrated by the following example for a single operation:

Standard base rate	\$0.45 per hour worked
Incentive rate	0.55 per standard hour earned
Earnings	(\$0.45 × hours worked) + (\$0.55 × standard hours earned)

In a given period,

$$\text{Actual hours worked} = 1{,}000$$
$$\text{Standard hours earned} = 800$$

$$\text{Actual cost} = (\$0.45 \times 1{,}000) + (\$0.55 \times 800) = \$890$$

But at standard performance, only 800 actual hours would have been required for 800 standard hours earned.

Therefore

$$\text{Std. cost} = (\$0.45 \times 800) + (\$0.55 \times 800) = \$800$$
$$\text{Efficiency variance} = \$890 - \$800 = \$90$$

Let us now consider an example where both price and efficiency variances occur. Two rules are remembered.

1. Price variance is that due to difference between standard and actual rates at the actual performance obtained.

2. Efficiency variance is that due solely to deviations from standard efficiency, assuming the standard labor rate to obtain at both actual and standard performance.

Assume facts to be the same as in the foregoing example. However, assume further that although the standard base rate is \$0.45 per hour worked, actual base rates paid to workers of varying length of service are as follows:

500 hr. at \$0.45 base rate
300 hr. at \$0.50 base rate
200 hr. at \$0.60 base rate
1,000 hr. total

The actual cost as computed daily and entered to Pay Roll, is summarized as follows:

500 actual hours × \$0.45 =	\$225	
300 actual hours × \$0.50 =	\$150	
200 actual hours × \$0.60 =	\$120	
	\$495	base-rate earnings
800 standard hours × \$0.55 =	\$440	incentive earnings
	\$935	total actual cost

At the given level of performance the cost, at standard base rate, would have been

$$(\$0.45 \times 1{,}000) + (\$0.55 \times 800) = \$890$$
$$\text{Price variance} = \$935 - \$890 = \$45$$

But even at the standard base rate the 800 p.s.h. should have been produced, not in 1,000, but in 800 actual hours.

Therefore the standard cost should have been

$$(\$0.45 \times 800) + (\$0.55 \times 800) = \$800$$
$$\text{Efficiency variance} = \$890 - \$800 = \$90$$

This can be checked as follows: From the table on page 57, the direct-labor cost per p.s.h. at 100 per cent performance is seen to be \$1.00. Therefore the standard direct-labor cost for 800 p.s.h. would be \$800. But the actual cost was \$935. Therefore the total variance is \$935 minus \$800, or \$135. The sum of the price and efficiency variances is \$45 plus \$90, or \$135. Hence the calculations are correct. They tell us that if employees receiving the standard rates had worked on the job at the level of performance which actually occurred, \$45 would have been saved and that if these workers had attained expected production of one standard hour per hour worked, a further savings of \$90 would have been obtained.

It should be remarked that in this example and all similar computations the actual and standard hours used are necessarily those devoted to direct-labor jobs, since that is the cost being figured. Actual hours spent on size changes, delays, etc., together with any standard hours earned therefrom are charged to Indirect Labor.

To reduce the foregoing example to a procedure, the method is as follows:

1. Obtain the total variance. This is the actual cost minus the product of p.s.h. and standard cost per p.s.h.
2. Substitute total productive actual hours and total p.s.h. in the earnings formula to obtain what the cost would be at actual performance and at standard rates.
3. Subtract the figure obtained in Item 2 from the total actual cost to obtain the price variance.
4. Subtract the standard cost from the figure obtained in Item 2 to obtain the efficiency variance.

Producers' Indirect-labor Variances

Variances from standard in Producers' Indirect Labor are due to many causes, depending on individual shop conditions. The most common ones are make-up money, delays, setups and changes, spoilage, defective material, and reruns.

Make-up Money Variance.—If a laborer, paid a piece rate of $1.00 per standard hour and a guaranteed rate of $0.70 per hour, earns only 5 standard hours in an eight-hour day, his earnings should be 5 standard hours times $1.00, or $5.00. Since he is actually paid his guaranteed rate of $5.60, his cost for the day includes $0.60 of make-up money.

Some accountants treat make-up money as Direct Labor, asserting that it is part of the cost of making the product and therefore should be charged to the product on which it occurs. Actually, it should be coded as Indirect Labor for the reason that no one particular product can rightly be charged with an expense that is attributable not to the nature of that product but rather to tight incentive standards, individual inefficiency, or material and equipment vagaries. None of these sources of expense can be allocated on a measurable basis to each unit of any particular product. Hence make-up money is Producers' Indirect Labor, to be allocated to all products passing through the cost center in which it occurs, as a reflection of the cost of operating that cost center. What, it may be said, of the operation or product on which make-up always occurs? Should it not be charged directly with this make-up? The answer is that such a job should be retime-studied. When make-up occurs repetitively, either the job is being done entirely wrong, or the incentive standard is unfair.

Since make-up money is never allowed for in standard costs, the variance due to it is equal to its actual amount. This can be determined most conveniently by assigning an expense-item number to it. In the daily computation of operators' earnings, the make-up is figured separately on the time card and posted directly to this expense item under the account Producers' Indirect Labor.

Delay Variance.—Since delays can never be abolished completely, an allowance is made in the standards for their normal occurrence, and their expected cost is prorated against p.s.h. When actual delays exceed the allowed amount, a variance occurs in this expense. The actual cost of delays is recorded by assigning an expense-item number to the cost. The amount of money paid to workers to compensate them for hours lost from production because of delays is figured separately on the time card and posted to this code number. The standard cost is equal to the p.s.h. earned times the standard delay cost per p.s.h. For example:

Standard delay cost per p.s.h.	$0.05
P.s.h. earned.	1,000
Actual delay cost.	$80
Standard delay cost.	$0.05 × 1,000 p.s.h. = $50
Delay variance.	$80 − $50 = $30

Since the standard labor cost of delays is based on an established standard labor rate per hour, the delay variance can be resolved into a component due to the payment of nonstandard rates for those hours which were delayed. Whether or not the time spent on this arithmetical excursion might better be spent on an inquiry into the causes of delays depends upon individual plant characteristics.

Setup Variance.—The variance between actual and standard cost of machine setups, size changes, etc., is sometimes included in the delay variance. Because it differs in reason, however, being attributable in part to the production-scheduling department, it deserves to be segregated from the delay variance, which arises from mechanical difficulties, material shortages, and related intradepartmental causes. This variance is found in exactly the same manner as the delay variance, being the difference between the dollars shown under the expense item for setups and the standard cost.

Spoiled- and Defective-material Variances.—In a job-order system, accounting for labor on spoiled (*i.e.*, unrecoverable) material, original work on defective (recoverable with additional work) material, and any incremental work required to bring defective material up to par presents a problem: whether to charge the cost to the particular good product that does get through, to prorate it to all products as indirect labor, or to charge it directly to Profit and Loss. In standard costs it is best considered as indirect labor. A standard cost per p.s.h. is established for an allowable minimum of such work and is coded as an expense item under the Indirect Labor account.

Recording the amount of money spent or accrued in this expense item requires a well-considered system of timekeeping. Obviously, standard hours earned on an operation subsequently found to have been faultily performed cannot be considered productive. If the article has been spoiled to the extent that it must be scrapped, none of the standard hours earned on the culpable operation are productive. In fact, good incentive-plan administration would require that the operator receive no standard hours for this work but only his guaranteed rate. It may be, however, that he can attribute the fault to the material, equipment, or other causes beyond his control. In any event, regardless of how the operator is paid, the standard hours thus earned should be excluded from the classification *productive* in building up total standard cost for the month.

But a further step must be taken. In addition to this last operation, there were preceding successful operations on which p.s.h. were rightfully earned. The standard cost computed from these p.s.h. has been credited to expense accounts and debited to standard Work in Process. It must now be removed from Work in Process, since the material is physically removed from that category. Otherwise Work in Process, a representation of the standard cost of goods unfinished, will contain a remaining balance when all these good products are eventually transferred to Finished Goods Inventory. The adjustment is made by multiplying the number of pieces scrapped by the precalculated standard cost per piece up through the last operation on which p.s.h. were earned, by crediting this amount to Work in Process, and by debiting it to Variance—Standard Cost of Spoiled Goods.

Example.—A turret-lathe operator turns 100 pieces (out of a lot of 1,000) 0.010 in. too small on the diameter before his mistake is discovered by the inspector. The remaining 900 are machined satisfactorily.

P.s.h. per piece on this operation	0.01
Standard cost per p.s.h.	$1.25
Standard product cost per piece up to this operation	$0.05

The operator is not paid for the bad pieces.

The entries are as follows:

Expense	xxx	
Pay Roll		xxx

To record whatever the actual cost of the operation was.

Work in Process	$11.25	
Expense (standard)		$11.25

To record the standard cost of 900 good pieces times 0.01 p.s.h. per piece times $1.25 per p.s.h.

Alternatively, the bad pieces may not have been discovered until later. In this case the standard cost of the 1,000 supposedly good pieces would have been calculated, since the standard hours from all of them would have been thrown in with all other p.s.h. on the operation. The entry would then have been

Work in Process	$12.50	
Expense (standard)		$12.50

To record the standard cost of 1,000 good pieces times 0.01 p.s.h. per piece times $1.25 per p.s.h.

Later, when the 100 bad pieces are found, the entry would be

Expense (standard)	$1.25	
Work in Process		$1.25

To remove the standard cost of 100 bad pieces times 0.01 p.s.h. per piece times $1.25 per p.s.h., which should not have originally been entered as Work in Process.

But p.s.h. have been earned on preceding operations. Their cost must be removed from Work in Process, although it is still a legitimate offset to actual expense, since those operations were performed correctly. The entry is

Variance—Standard Cost of Spoiled Goods	$5.00	
Work in Process		$5.00

To transfer from Work in Process the standard cost of 100 spoiled pieces on which a standard cost per piece of $0.05 had accumulated.

Conceivably, additional operations might be performed on spoiled work before it reaches an inspection point and is scrapped. They might even be done in other cost centers than the one in which the mistake occurred. The foremen of these cost centers should not be penalized for someone else's errors. Therefore the standard hours earned on succeeding operations are considered productive in computing the standard credit offsetting actual expense, but the standard product price of spoiled pieces is still removed from Work in Process.

In this case, if the spoilage occurs in the same month in which it is discovered, a composite entry is made.

(*a*)	Work in Process	xxx	
(*b*)	Variance—Standard Cost of Spoiled Goods	xxx	
(*c*)	Expense (standard)		xxx

Line (*a*). P.s.h. on good products × standard cost per p.s.h., or line (*c*) − line (*b*).

Line (*b*). Spoiled pieces × p.s.h. earned thereon × standard cost per p.s.h.

Line (*c*). Total p.s.h. × standard cost per p.s.h.

This entry covers the standard costs in the second cost center, which was not responsible for the spoilage. Another entry is made to remove the spoiled goods from Work in Process in the preceding cost centers.

The Variance—Standard Cost of Spoiled Goods is an intra-standard variance of the type described in the preceding chapter—one essential to the correct statement of inventories. Within the cost center responsible for the spoilage remains a variance between actual and allowed standard cost to the extent of the actual cost of the spoiling operation for which no standard cost is allowed. There are two methods of recognizing this.

1. When the spoilage is discovered in the same month in which it occurs. In this case it is necessary to "red-circle" the actual cost of the operation and code it to an appropriate expense item under Producers' Indirect Labor. This is accomplished by having copies of the inspectors' rejection reports sent to the cost clerk, so that they may be used to identify the actual cost shown on the time card as Producers' Indirect Labor—Spoilage.

2. When the spoilage is discovered in a month subsequent to its occurrence. In this case, the actual cost on the spoiled material has been charged to Direct Labor in the previous month, and a corresponding standard cost offsets it. The entries to adjust inventory are a debit to Variance—Standard Cost of Spoiled Goods and an equal credit to Work in Process. The question now arises of whether a deduction should be made from this month's standard operational cost to show a penalty for the spoiling previously

performed and not subtracted from standard. If the supervisor receives a bonus based on standard-cost performance, the unjustified allowance received previously should certainly be deducted this month. If he does not, the deduction may be shown for exhibit purposes on the cost-comparison sheet. In either case it is displayed separately in order not to affect the validity of comparisons between actual and standard for this month's operations.

Frequently products are found that can meet inspection requirements only when additional work is performed on them. For example, a machine operator may be expected to file the rough edges on parts during the period when they are being cut by automatic feed on the machine. He fails to do this, and they must later be filed as a separate operation. The additional cost of filing does not occur on every lot of these pieces that is run; so it is a Producers' Indirect Labor charge. In order to expedite production, the time-study man may set an incentive standard on the filing. Nevertheless, standard hours thus earned are not productive. If the filing is done in the cost center responsible for it, no standard-cost allowance is made. There is, therefore, a variance between total actual and standard costs equal to the actual cost of the additional work. If it is done in another cost center, say, the assembly department, the actual cost of the operation is still charged back to the cost center responsible, where it shows up as a variance.

In order to obtain a full picture of performance, then, the actual cost of this extra work should appear on the cost-comparison sheet of the cost center responsible for it, with no corresponding standard allowance, since the work is not necessary. It should also appear on the cost-comparison sheet of the cost center doing the work, with a corresponding standard allowance, to reveal the efficiency with which the work was performed. The total figures on the cost-comparison sheets need not tie in with the accounts, since the sheets and accounts have different purposes.

On some operations a certain amount of repetitive work is unavoidable—indeed it is desirable. For example, small parts may be tumbled in a machine in order that they may acquire an acceptable surface finish. An inspection after the tumbling reveals that some of them still retain surface scratches which have not been removed. These scratches must then be obliterated by means of buffing. Although the buffing is additional work not performed on every piece, a certain amount of buffing should be allowed for in the standard, because it is a necessary job. It can be avoided only by tumbling the parts so long that too much material would be removed from the majority of the pieces. Therefore the variance to be analyzed is that between actual cost of buffing and standard cost for an allowed percentage of these reruns. This is easily done if the actual payment for reruns to operators is coded and recorded separately.

Before leaving the subject of spoilage and defective material, it may be observed that the adjustments to work-in-process standard costs described on the preceding pages apply not only to labor costs but also to the standard costs of material and other expenses included in the standard product prices and standard hour costs on which work in process values are based.

Timekeeping Procedures.—Variances so far discussed are of two types.

1. Those due to the occurrence of an actual cost in excess of an allowed standard cost, *e.g.*, direct labor.

2. Those due to the occurrence of an actual cost that is not allowed for at standard, *e.g.*, make-up money.

As has been stated, the analysis of these variances is facilitated by a time-and-production recording system which isolates certain elements of actual costs for comparison with the standard. Such a system also pin-points actual costs that are not allowed for at all in the standard. This is achieved in several ways.

One method is to use "prefabricated" time cards. At the time when an order is scheduled for a given operation, the production-scheduling department issues to the cost center concerned a set of time cards that have already been filled out with the quantity of pieces, the operation number, and the standard time allowance or piece rate for the job. As the work is completed, the operator's clock number and elapsed time are entered on the cards, and they are forwarded to the pay-roll clerk. If the operator is also to receive payment for lost time, excess setups or changes, or additional work on defective product, this is recorded on separate time cards identified by a color band. The incoming cards are sorted according to clock numbers; the quantities are verified with inspection reports of good product completed; and individual earnings are computed. They are then resorted according to operation and expense item. Cards having a color band represent producers' indirect labor. Plain cards represent direct labor. The amounts on the various cards are then totaled and posted to the various expense items. Productive standard hours are abstracted and totaled for use in computing standard operational cost.

This system has the following advantages:

1. Time cards for various operations can be duplicated in quantities in advance. When an operation is scheduled, it is necessary only to pull the appropriate time cards from the file, enter the scheduled quantities, and issue them to the shop. In this way a saving in clerical time is effected.

2. Since p.s.h. can be reported only on uncolored cards the issuance of which is controlled, it is impossible for any inaccuracies to occur as a result of the inadvertent inclusion of nonproductive standard hours with productive.

3. The separation of costs on different cards facilitates totaling by expense item for posting.

4. A control is achieved that prevents payment for any nonscheduled operations without approval of the production-scheduling department. This means that additional operations required on defective work cannot erroneously be reported as productive, since special time cards must be issued for them.

In some plants scheduled quantities are so large that they extend over the closing of a pay period. Again, the production-scheduling department may not schedule closely by operations. In these cases the foregoing system is not practicable. Time and production are then best reported on a single time card with expense-item numbers printed in to facilitate subsequent posting. One card may be used for each job, or one card for the operator's entire production for a stated period of time.

Such time cards are set up with identified spaces for the entry of earnings attributable to the various types of expense.

An example of such a card is shown on page 176.

A study of this card reveals that the earnings from original pieces produced (or direct labor), reruns, delays, setups, and make-up, are shown in separate blocks. Each block is keyed with the expense-item number to which it applies. In this example, Make-up Money is listed on the chart of accounts as Expense Item 80. Therefore this number appears in the section of the card devoted to Make-up Money. At convenient intervals the

OPERATOR'S EARNINGS CARD

CC No 102 Operation No. 8 Date 7-21-19 Shift 7-3
Operator M. Phillips Clock No. 1532 Rate per Std. Hr. $0.80

Part. No.	Work Done	Pieces Produced	Std. Hrs. per 100 Pieces	Std. Hrs. Earned	Actual Hours Worked	Earnings		Expense Item No.
		GOOD PRODUCT						75
7200	Blank & Pierce	1200	0.333	4.00	5.0	$3.20		
		DEFECTIVE PRODUCT						75
	REASON:							
		SPOILED PRODUCT						76
7205	Pierce	250	0.275	0.69	2.0	0.55		
	REASON Was Given Superseded Print. Pierced ¼" Hole Instead of 3/16"							
		RERUNS						77
		DELAYS						78
	Wait for Inspector to Get Revised Print				0.5	0.30		
		SETUPS & CHANGES						79
	Change from	7200 to	7205	0.33	0.5	0.26		
		TOTAL			8.0	$4.31		
		GUARANTEED RATE		$0.60				
		AMOUNT PAID				$4.80		
		MAKEUP MONEY				$0.49		80

Fig. 11

cards are grouped by operations, and the earnings thereon are selectively added to obtain total dollars in each expense item. When compared at the end of the month with standard allowances, these totals supply the information required on variances by operation.

On cost-comparison sheets it is not customary to show costs broken down any finer than by operation and account number, the costs by account number for each operation being the totals of the individual expense-item costs comprehended by that account. The individual expense-item totals are exhibited only when the comparison of account totals reveals variances of a magnitude that warrants further investigation.

Since p.s.h. also appear for purposes of earnings computation, these can also be totaled from the cards. In the example shown, the p.s.h. are the standard hours shown under Good Product, *viz.*, 4.00. From this card the number of spoiled pieces can also be abstracted for use in adjusting the Work in Process account. If defective pieces had been produced, they would have been listed in the block so designated, and the standard hours equivalent to them would have been calculated. Whether or not they would have been paid for at full rate would depend on the reasons for the defect. Additional work required to make them usable would be listed in the Reruns block.

When mechanical tabulating systems are used, cards are punched from the information shown on the illustrated time card. Alternatively, the information can be entered originally on tabulating cards, and earnings computed mechanically. When this is done, many more cards must be used. The possibility of error then increases, for there is no guarantee against the various labor costs being keyed with erroneous expense-item numbers through the carelessness of clerks.

Other Indirect-labor Variances

Variances in the account Other Indirect Labor are due to deviations from standard in labor price, labor hours, or level of operations. Other causes also exist in particular installations, but these are the ones most commonly occurring.

Price Variances.—As for direct labor, so for indirect labor do off-standard hourly rates of pay effect a variance in cost. The independent calculation of the variance due to this cause is similar to that described on pages 162*ff*. The standard rates per hour are multiplied by the actual hours of indirect labor. The difference between the actual cost and this figure is the variance due to off-standard rates of pay.

Indirect-labor Hours Variance.—The analysis of variance due to use of excess indirect-labor hours is divided into two parts: excess in fixed hours and excess in variable hours.

1. *Excess in Fixed Hours.*—Assume that at all levels of operating capacity in a given cost center, one setup man is allowed. The cost of this man is a fixed cost; the same standard allowance is

made regardless of the amount of production. If, then, two setup men are used, the actual cost of this indirect labor exceeds standard. A variance due to excess fixed expense occurs.

Determining the exact cost of excess hours requires a tabulation of actual hours *vs.* standard allowed hours in the fixed classification and a translation of these hours into dollars at the standard hourly rates. An example follows for a particular cost center:

VARIANCE DUE TO EXCESS FIXED HOURS

Cost Center No. 170 January, 19__

Occupation	Actual hr.	Allowed hr.	Difference	Std. rate per hr.	Variance
Setup man......	176	176	0	$1.00	
Chip wheeler....	200	176	24	0.60	$14.40
Tool grinder.....	176	176	0	0.75	
Material handlers	392	352	40	0.60	24.00
Total variance due to excess hours..					$38.40

Observe that this variance is calculated on the basis of standard hourly rates. This is done because the actual rates have already been allowed for in computing the labor price variance.

2. *Excess in Variable Hours.*—When indirect laborers are on an incentive plan based on their own output, their standard cost is tied in with p.s.h. by expressing the relation between that output and some operation performed on the product. When indirect laborers are not on an incentive plan of this sort, their standard cost is related to p.s.h. by allowing a certain number of indirect labor hours per p.s.h. of some operation. In either case, indirect labor requirements are considered as varying in direct proportion to the number of p.s.h. earned. When they do not so fluctuate in an actual production period, a variance occurs.

The variance may be due to any of the following causes:

a. When variable indirect laborers are on an incentive plan of their own, they may work at greater or less than standard efficiency. For example, in manufacturing butt-weld pipe, strips of heated steel are drawn from a furnace through a forming die. Tongs are used to grip the steel, and because of the adverse working conditions they deteriorate rapidly. Two blacksmiths are engaged in making and repairing tongs. They are paid a base rate plus a bonus rate per pair of tongs made or repaired. By calculating the life of a pair of tongs in terms of productive standard pipe-welding hours, the cost of these smiths is reduced to a p.s.h. basis. If the blacksmiths work at less than expected efficiency, more hours are required per pair of tongs, and the indirect-labor cost increases over standard.

Variances due to off-standard efficiency of indirect laborers are detected only by an analysis of performance under their own incentive plan, comparing actual hours worked with standard hours allowed for work done.

b. Excess indirect-labor hours may be caused by the fact that there is more than the standard amount of work for indirect laborers to do.

In the preceding example, the smiths may work at standard efficiency. Yet if the tongs are abused by productive workers, the smiths must spend more time on repairs. Thus more hours of indirect labor are required. Similarly, failure to provide chip breakers on lathe-turning tools may result in increased difficulty in disposing of scrap and a consequent variance in indirect labor hours for such work. Conditions of this sort are controllable by foremen. They can be detected only by research into individual cases.

c. When indirect-labor hours are keyed to the p.s.h. of an operation, a decline in the efficiency of that operation results in correspondingly few p.s.h. on which indirect labor is allowed. As a result, fewer indirect labor hours may be allowed for than were actually used. If, for example, lathes are working on reruns not allowed for at standard performance, chip wheelers will still be used to handle turnings. But no p.s.h. will be earned; hence there will be no basis for a standard indirect-labor cost; and actual will exceed standard.

The effect of deviations of this sort on indirect-labor variances can be found by comparing the standard indirect-labor cost at actual operating performance with the standard indirect-labor cost at standard operating performance for the same level of production.

d. Foremen may fail to recognize that certain indirect-labor occupations are to be considered as variable. The difficulty of selling the "variability concept" has been mentioned before. Supervisors who are new to the idea find difficulty in putting it into practice. They hesitate to assign men to unaccustomed jobs. They hesitate to transfer them to other departments if there is no work. They still need to be educated to the fact that if they do not economize on costs, competitors' foremen will do so and that the competitors' foremen will eventually be working for the company that makes profits.

Accordingly, excess indirect-labor hours may result, not from worker inefficiency, from too much work, or from inefficient productive operations, but from supervisory inefficiency in scheduling men.

Procedure.—To resolve indirect-labor variances into the detailed components mentioned above demands so much work that is ordinarily done only in exceptional cases. The most complete procedure to follow is to

1. Obtain the total variance. This is the actual cost minus the sum of fixed costs and the product of p.s.h. times standard indirect-labor cost per p.s.h.
2. Multiply actual hours times standard rates per hour to find what the cost would be at actual performance and at standard rates.
3. Subtract Item 2 from the total actual cost to obtain the price variance.
4. Subtract the standard cost from Item 2 to obtain the variance due to excess hours.
5. Find the difference between allowed cost of "fixed" occupations and the cost of actual hours at standard rates of "fixed" occupations. This is the variance due to excess hours of "fixed" labor.
6. Subtract Item 5 from Item 4. The remainder is the variance due to excess hours of "variable" labor.
7. Break down Item 6 into excess hours due to poor performance under indirect-labor incentive plans, excess hours due to more than the standard amount of output required of indirect-labor incentive plans, excess hours due to low p.s.h., and excess hours due to the use of too many men.

Ordinarily, only Item 1 is carried out for all cost centers and operations. The other steps are reserved for special investigations of particular phases of cost cutting.

Special Reports

Standard-cost variances reveal wasteful practices in terms of dollars. Supervisors, when apprised of variances and their primary causes, can best take steps to reduce them when they are also told of specific deviations from standard practice. This information is provided by special auxiliary reports that reveal unfavorable situations in the use of labor from a cost standpoint. Several examples of such managerial tools are illustrated in the following pages.

Quota Reports.—Large companies employing many people on hundreds of occupations must protect themselves from an inflation of the labor force, particularly on indirect occupations. Just as a series of checks is provided to ensure that pay envelopes are delivered to the correct people in the correct amount, so must a safeguard be set up to ensure that no more than the requisite number of people is employed on particular jobs. This is accomplished by establishing maximum quotas of men for each occupation. Fewer than the maximum number may be used, depending on the level of operations, but more cannot be employed without special authorization of some plant executive. The system operates as follows:

1. Industrial engineers determine the permissible quota of men for each job.
2. A copy of the quota is maintained in the pay-roll department.
3. Daily job cards are checked to be sure that they conform with the quota.
4. When more men work on a job than the quota calls for, a report of the excess is sent to the works manager for approval before payment is made.

The quotas are listed on wage-scale sheets as on page 182.

The quota system is most useful for controlling "nonproductive" occupations, although when cost centers are operating at capacity, it is also an aid in controlling "productive" occupations.

Man-hour Controls.—Man-hour controls are an extension of the quota system. They consist of a periodic report that exhibits

1. The number of man-hours of various occupations that should be used per p.s.h. earned on the same or related occupations.
2. The total man-hours allowable for the total p.s.h. earned.
3. The actual man-hours used.
4. The difference between actual and allowed man-hours.

Cost Center No. 193		WAGE SCALE SHEET		Effective Jan. 1, 19__	
Occupation		Guaranteed rate per hr.	Rate per std. hr.	Quota (max. no. of employees)	Remarks
No.	Title				
1200	Subforeman	$1.00	....	1	
1201	Inspector	0.83	....	2	
1202	Material cutter	0.50	$0.66	3	
1203	Stockman	0.60	....	1	
1204	Sewing-machine operator	0.48	0.64	15	One per machine
1205	Trimmer	0.45	0.60	15	One per machine (maximum)
1206	Sweeper	0.45	....	1	
1207	Clerk	0.60	....	1	
1208	Grommeter	0.48	0.64	2	One per machine
1209	Trucker	0.45	....	1	

The report of quota excesses is as follows:

Cost Center No....		REPORT OF QUOTA EXCESSES			Jan. 15, 19
Occupation		Quota	Actual	Excess	Reason for excess
No.	Title				
101	Sweeper	1	2	1	Light work for injured employee
105	Rigger helper	3	6	3	Erecting new press
120	Clerk	1	2	1	Training new man
123	Burr remover	2	3	1	Excess burrs due to new die
124	Laborer	1	2	1	Needed to handle material received in strip rather than coil stock
					Approved________________Works Manager

An example is shown on page 183.

When man-hour controls are predicated on the standard performances used for developing standard costs, they provide a quick verification of variances due to excess hours. In addition they provide a comprehensive picture of labor effectiveness, since man-hours are useful to the company only to the extent that they result in p.s.h., which are the measure of salable product made.

MAN-HOUR CONTROL REPORT

Cost Center No. 175 Feb. 20, 19__

Occupation	Man-hr. per p.s.h.	P.s.h. earned on occupation	Total p.s.h. earned	Allowed man-hr.	Actual man-hr.	Difference, man-hr.
J & L Lathe...	0.90	J & L Lathe	1,800	1,620	1,600	+ 20
Cin. Miller....	0.95	Cin. Miller	200	190	160	+ 30
Swager........	0.80	Swager	150	120	150	– 30
Setup Man....	0.10	Lathes	1,800	180	200	– 20
Supervisory and Clerical	0.10	All incentive jobs	5,000	500	510	– 10
Laborers......	0.05	All incentive jobs	5,000	250	300	– 50
Total........	....	....	......	6,000	6,520	– 520

Excess man-hours on the chart shown are an indication that labor time is not being utilized to its fullest possibilities for production. Man-hour control charts also control variable occupations more closely than do quotas.

If desired, man-hour controls can be combined with quotas by use of a chart that keys variable occupations to p.s.h. and lists fixed occupations by quotas separately.

Labor-rate Reports.—The trend in hourly labor costs is effectively demonstrated by a labor-rate report, which is also useful in analyzing labor price variances. In plants where employees are on individual rather than occupational rates, the labor-rate

LABOR-RATE REPORT

Month of February, 19__

Cost center No.	Man-hr.		Earnings at guaranteed rates		Average rate per hr.		% variation of actual from std.
	Actual	Std.	Actual	Std.	Actual	Std.	
101	1,000	1,200	$ 600	$ 750	$0.600	$0.625	– 4.0
102	7,200	9,000	4,800	6,000	0.667	0.667	0
103	6,000	6,000	4,000	4,500	0.667	0.750	– 11.1
104	10,000	9,000	7,000	6,000	0.700	0.667	+ 4.9
Total	24,200	25,200	$16,400	$17,250	$0.678	$0.685	– 1.0

report is a useful guide in employment and upgrading practices, for it quickly reveals undesirable upward or downward swings in the average rate of pay per hour (at guaranteed rates). Needless to say, an upward swing can be justified only by general economic conditions or by improved quality or quantity of production resulting from the gradual acquisition of more highly skilled men.

An example is shown on page 183.

Subdivisions of this report are also developed for particular cost centers, showing the hours and rates either by occupations, by labor classes, or on a percentage distribution basis.

Performance Reports.—Performance on incentive jobs is presented periodically, preferably at the end of each pay period thus:

1. A comparative record of the relative ability of various employees. When the chart is posted publicly, it encourages workers to strive for better performance in order to make a good showing.
2. A barometer of the foreman's ability to provide his men with the means of attaining good performance.
3. A partial indicator of the general trend of time-study men in setting tight or loose rates.

INCENTIVE PERFORMANCE REPORT

Cost Center No. 170 Pay ending Feb. 14, 19....

Employee	Actual hr. on production	P.s.h. earned	Per cent performance
John Doerr........	70	80	114.3
Patrick Kuessner...	75	85	113.3
Arthur Trout......	64	72	112.5
Joseph Pinelli......	60	60	100.0
Harry Horsky.....	48	40	83.3
Total...........	1,500	1,600	106.7

Incentive Coverage Reports.—Incentive plans are one of the best tools for cutting costs, but the tool must be kept sharp; *i.e.*, the maximum possible number of operations should be placed on incentive in order that foremen may have the maximum possible assistance in furthering high output, high operator earnings, and low costs. Incentive coverage reports show the effectiveness of the time-study men in furthering this end.

An example is shown.

INCENTIVE COVERAGE REPORT

Pay ending Feb. 14, 19__

Cost center	Actual man-hr. worked	Actual man-hr. on incentive *	% coverage
Machine Shop	3,500	3,200	91.4
Tin Shop	1,500	1,300	86.7
Carpenter Shop	800	600	75.0
Paint Shop	200	200	100.0
Punch Presses	1,000	1,000	100.0
Small Assembly	2,500	2,500	100.0
Final Assembly	1,500	1,450	96.7
Maintenance	600	....	0
Shipping	800	....	0
Total	12,400	10,250	82.7

* Includes delays and changes.

In addition to the obvious benefits derived from additional incentive coverage, there is also the necessity of avoiding the condition where individual employees work part time on incentive and part time on day rate; for when this occurs, workers are tempted to falsify their time reports in order to inflate their earnings. This they do by reporting relatively more hours on day rate and relatively fewer on incentive work in order to add excess day-rate payment to their bonus earnings. The condition is better avoided by obtaining complete coverage than by adding to the force of timekeepers.

Delay Reports.—Delay reports exhibit a breakdown of actual man-hours for the purpose of revealing the magnitude of delays. Excessive delays, whatever the cause, are an outstanding sign of impotent supervision. This report is usually prepared only for incentive occupations.

An example follows on page 186.

Further control is provided by breaking the report down into operations. A separate sheet is prepared for each cost center, with operations listed in the first column and producing and delay hours for each operation shown in the extension columns.

The reports illustrated may be issued daily, weekly, by pay period, or monthly. Properly assembled, they are invaluable to

DELAY REPORT

Feb. 15, 19__

Cost Center No.	Total man-hr. on incentive	Prod. man-hr.		Delay man-hr.							
				Maintenance		No material		Other		Total	
		Amt.	%	Amt.	%	Amt.	%	Amt.	%	Amt.	%
101	3,200	2,900	90.6	200	6.2	50	1.6	50	1.6	300	9.4
102	1,300	1,200	92.3	25	1.9	25	1.9	50	3.9	100	7.7
103	600	550	91.7	20	3.3	30	5.0	....	...	50	8.3
107	200	180	90.0	10	5.0	....	....	10	5.0	20	10.0
108	1,000	800	80.0	50	5.0	100	10.0	50	5.0	200	20.0
109	2,500	2,000	80.0	75	3.0	300	12.0	125	5.0	500	20.0
Total	8,800	7,630	86.7	380	4.3	505	5.8	285	3.2	1,170	13.3

the standard-cost accountant for diagnosing variances and to operating supervisors for learning the sources of variances in order to minimize them.

Summary

Variances between the actual and standard cost of direct labor, producers' indirect labor, and other indirect labor are attributable either to off-standard rates of pay or to off-standard hours. Hours may vary from standard because of poor efficiency; because of excess setups, delays, and reruns; and because of too many man-hours being used for particular jobs. These various causes are separated one from the other by analyzing the relationship between actual and standard hours and expressing this relationship in dollars. Provision is made for eliminating variances due to spoilage and reruns from the Work in Process accounts. Auxiliary reports are prepared to illuminate the variances that accounting methods reveal.

QUESTIONS

1. A jobbing machine shop employs 110 men. The hourly rate of each man is determined on the basis of his skill, years of service, and versatility at operating various machines. Since the orders in process are seldom sufficient to occupy all machines, it is frequently necessary to shift men from one machine tool to another. Ordinarily, drill presses are operated by the lower paid men, but sometimes scheduling difficulties necessitate putting a higher paid man on this work. The same situation may occur on other machine groups. Each man's earnings are equal to standard hours earned times his individual rate per standard hour. Outline a procedure for obtaining the labor price variance.

2. In the foregoing example, could an efficiency variance occur in the Direct Labor account?

3. Under what type of incentive plan can an efficiency variance occur?

4. On a certain operation, which is on incentive, the hourly earnings are equal to

$$\text{Base rate [0.60 plus (0.60} \times \text{per cent performance)]}$$

where

$$\text{per cent performance} = \frac{\text{std. hr. earned}}{\text{actual hr. worked}}$$

The standard base rate for the operation is $0.75. Standard performance is set at 100 per cent.

In a particular month, actual earnings are $900.00 Standard hours earned are 900. Actual hours worked are 1,000.

a. What would be the standard cost per standard hour (based on 100 per cent performance)?

b. What is the price variance?

c. What is the efficiency variance?

5. It is discovered that in 50 castings a hole has been drilled at an angle of 30 deg. instead of 60 deg. The castings cannot be recovered. Their standard product cost through the last operation before the drilling of the hole is $1.78. Show the journal entry necessary.

6. In another lot of the same castings, it is discovered that the same hole, although drilled at the correct angle, is $\frac{1}{16}$ in. too small; an extra operation is necessary to drill it out to the correct diameter. The extra operation requires one standard hour per 100 pieces, at a standard cost of $1.25 per standard hour. What debit or credit to Work in Process is entailed by this additional operation? Are the standard hours earned on the redrilling productive? Why should any standard hours at all be paid for this operation? If the redrilling was done in another cost center than that responsible for the faulty work, might the standard hours earned for the extra work be considered productive and, if so, for what reason? State one reason why a cost center might accept parts from preceding departments without first inspecting them.

7. Name four causes of variances in the hours of Indirect Labor—Others.

CHAPTER XIV

VARIANCES IN MATERIALS COST

Variances in materials cost consist of deviations from either standard prices or standard quantities. This chapter describes the standard-cost accounting procedures for materials in order to show the point in the bookkeeping process at which the variances appear, the interpretation of the variances, the requisitioning methods that facilitate variance analysis, and various special reports that assist management in devising ways to reduce variances.

Accounting Procedure

Use of Standard Prices.—In its charge to expense, materials accounting differs somewhat from labor accounting. In the latter, the expense accounts are debited with the actual quantity of labor at its *actual* price. (The price of labor used to accomplish a given result frequently depends on the foreman.) But materials, once they leave stores, are debited at the actual quantity and *standard* price. The primary reason for this, as explained before, is that cost-center supervisors control quantities consumed but do not as a rule have any influence on price, which is determined by purchasing circumstances. Therefore, in order to restrict cost-center variances to controllable ones where possible, the price variation is eliminated before materials reach operations, so that only a quantity deviation remains.

Another reason for charging materials at standard prices obtains when goods manufactured within the plant are returned to stores to be held for future requisitioning for further processing or assembly. These goods, when manufactured, are valued at their standard cost. They enter stores at this value. Hence they can be issued only at this value unless the most complicated adjustments are to be employed. When this portion of the stores inventory is issued at a standard figure, consistency dictates the necessity of issuing purchased articles also at a standard price;

otherwise there will be a confusion of variances on the various types of material used by each cost center.

For these reasons, the "actual" cost of materials in the cost-center accounts is really the product of the actual quantity and the standard price.

Stores Valuation.—Although they are *issued* at a standard price, materials may be carried in stores at either the actual purchase price (plus freight-in and mark-on for storing cost, if desired) or at standard price (also including such mark-ons, if desired). Each of the two methods will be explained, and a discussion of their relative merits will follow.

Stores at Actual.—When stores are carried at actual cost, the journal entries are as follows:

	Stores	$10,000	
	Vouchers Payable		$10,000
	To record actual cost of purchases.		
(*a*)	Materials Expense	$1,000	
(*b*)	Materials Price Variance	100	
(*c*)	Stores		$1,100
	To record the issuance of materials from stores.		

Line (*a*) is the actual number of pieces issued, at the standard price. Line (*c*) is the actual number of pieces issued, at the actual price. Line (*b*), the difference between (*c*) and (*a*), is the variance caused by the difference between the actual and standard prices of the materials issued.

The preceding transactions summarize the following steps:

1. When a given lot of materials is purchased, the quantity, unit price, and total cost are entered on the subsidiary stores ledger cards.

2. When a portion of the materials on hand is issued to the factory, it is priced at the actual unit cost. This may be based on the first-in-first-out method, averages method, etc. An entry is made on the subsidiary stores ledger card to show the remaining balance in quantity and dollars, and the actual price is entered on the requisition.

3. At the same time the volume of materials is also multiplied by the standard price per unit. This product is also entered on the requisition.

4. This procedure is followed for every requisition. An increase or decrease in stores balances during the period may result

in fluctuating actual unit costs on the ledger cards, so that Calculation 2 must be performed for each requisition.

5. The total of the actual costs shown on the requisitions is the basis for a credit to stores. So far as actual costs are concerned, this procedure is the same as that followed when standard prices are not used at all. The use of standard prices merely adds one more computation.

6. The total of the standard costs shown on the requisitions is the basis for a debit to the Materials Expense accounts of the various cost centers.

When this system is used, stores inventory is carried at actual prices. Cost centers, however, are charged with actual quantities of material at standard prices. As a result, variance due to price is segregated at the time when materials are issued to the cost centers.

Stores at Standard.—When stores are carried at standard cost, the journal entries are made as follows:

(*a*)	Stores	$9,000	
(*b*)	Materials Price Variance	1,000	
(*c*)	Vouchers Payable		$10,000

To record the purchase of materials.

Line (*a*) is the cost of the actual quantity of materials at standard prices. Line (*c*) is the purchase price of the materials. Line (*b*), the difference between (*c*) and (*a*), is the variance caused by the difference between the actual and standard price of the materials purchased.

Materials Expense	$1,000	
Stores		$1,000

To record the issuance of materials from stores at the standard price.

The above transactions summarize the following steps:

1. When a given lot of materials is purchased, the quantity on the invoice is multiplied by the standard unit price. The invoice amount itself serves as the basis for a credit to Vouchers Payable. The standard amount serves as a debit to the controlling Stores account.

2. The purchased quantity (verified by receiving slips) is entered on the subsidiary stores ledger card. This card has the standard price entered at the top, and the various columns carry only quantities. For example, see Fig. 12.

A	6	102	Piece	$0.450	100	75	Crank Lever	30103
Storeroom	Aisle	Bin	Unit	Std. Price	Order Point	Min. Order Quantity	Part Name	Part No.

Date	Ordered	Received	Disbursed	Balance	Date	Ordered	Received	Disbursed	Balance
2-7		18		168					
2-10			30	138					
2-15			5	133					
2-23	75 ✓		25	108					
2-27			25	83					
3-2		75		158					

Fig. 12

3. When a portion of the materials on hand is issued, the product of the quantity and standard price is entered on the requisition.

4. The total of the dollars on the requisitions is the basis for a credit to Stores and a debit to Materials Expense.

When this system is used, stores inventory is carried at standard prices. Cost centers are charged with actual quantities of material at standard prices. Any variance due to price is segregated at the time when materials are purchased.

Actual *vs.* Standard Stores Inventory.—What are the relative merits of the two modes of carrying stores inventory? To answer this question, we must consider the effects of each method.

1. The most evident fact is that carrying stores at standard greatly expedites pricing requisitions. When the inventory is carried at actual, each requisition must be individually priced, for the actual per-unit values fluctuate from time to time, depending upon the conditions under which the material was purchased. In fact, two prices must be entered on each requisition: the standard price and the actual price.

On the other hand, this work is unnecessary when the inventory is listed at standard prices. For a given article, the standard price is always the same. If numerous requisitions for that article occur during the month, they can be sorted and priced at one time. If a mechanical tabulating system is used, the pricing can be handled by the machines. Not infrequently, additional time can be saved by setting up a file in which quantities of prewritten requisitions (turned out on a duplicating machine) are indexed by part number. Each requisition bears the part number, part name, storeroom designation, and standard price. For items used in only one department of the plant, the cost center to which the material is to be charged can also be printed in. When goods are to be drawn from stock, a requisition for the required material is removed from the file, and the quantity and total cost (at the standard price) are entered. Only two entries are necessary. But even further savings can be made. Assembly operations frequently require the withdrawal from stores of a number of parts—so many of each for one assembly. Stores-at-actual-value systems require the entry and extension of the actual price of each part, since the prices vary from time to time. But when standard prices are used in stores, the requisition may be in the form of a bill of material, with the standard price of all items thereon entered as a total. This total times the number of assemblies required is the only pricing needed for all items taken from stores in one lot.

All in all, standard prices facilitate the "prewriting" and "pre-pricing" of requisitions and, by combining numerous items on one form, save much time. That clerical and arithmetical errors are greatly reduced by the elimination of unnecessary writing and figuring is obvious.

Although the elimination of double-pricing of requisitions saves time at this point, it must be remembered that purchase orders in a stores-at-standard system require double pricing whereas in a stores-at-actual system they do not; *i.e.*, in the former, actual and standard prices are both figured for each purchase order. In the latter they are both figured for each requisition. But a net saving in time still characterizes the former, not only because purchase orders are nearly always less numerous than requisitions but also because entries on stores ledger cards are minimized, as explained in the next section.

2. The use of standard prices diminishes the duties connected

with stores ledger cards. One standard price being shown at the top of each ledger card, the use of actual prices in the columns is eliminated. The receipt and issuance of materials no longer requires the calculation of a new average unit price and of the dollar value of inventory balances. The complications involved in assigning the correct price to stores returns are avoided. Instead, only quantities are added or deducted in the columns for each transaction. Thus, entries are reduced by at least 50 per cent, and arithmetical dollar calculations are entirely eliminated from the cards. Here again the possibility of mistakes is practically washed out.

3. With regard to the variance itself, the first method reveals it when materials are used. The second method reveals it when they are purchased. If this variance has any meaning at all insofar as prices, as distinguished from handling charges, are concerned, it is as a gauge of purchasing performance. As explained before, it must even then be interpreted with caution. But if it *is* to be considered, then it should be considered when it occurs, at the time of purchase. If the purchasing department is to be expected to meet standard prices, then the cost of not meeting them should be available as soon as possible in order that corrective steps may be taken. The effective utilization of purchase-price variances therefore requires that stores be carried at standard in order that these variances may be known in their total amount as soon as possible.

4. Elimination of actual prices from the stores ledger cards does away with a valuable source of information on prices of particular products. Often members of the purchasing or cost departments desire to know what a given article costs or how the trend of prices on that commodity is running. The purchasing department frequently needs this information when placing orders, and the cost department sometimes needs it in order to be sure that estimates on large jobs are correct or to ascertain the extent of expected variance on particular jobs as distinguished from the average. It is also required periodically as a basis for revising standard prices. Such information cannot be obtained from ledger cards when stores are carried at standard, as only quantities appear thereon. It must therefore be recorded either in an auxiliary card file of part numbers in which purchase dates, quantities, and actual cost are listed or else in a special column under Receipts

on the ledger card. It is still unnecessary, however, to maintain a running average of prices or of the actual value of material in stock.

5. Carrying stores at standard worries some accountants, who feel that to show inventories at "artificial" values is a misstatement of fact. The pros and cons of this question have already been briefly discussed in Chap. XI. Here it will suffice to point out that if Work in Process and Finished Goods inventories are carried at standard, there is usually no reason why the practice should not be extended to purchased materials.

In one case, however, a serious difficulty accompanies the listing of stores at standard. As long as the actual prices exceed standard prices, the variance is negative and can safely be carried to Profit and Loss. But what if the situation is reversed and a sudden drop in markets results in a positive variance, materials being purchased at less than standard prices? Can the inventories be shown at a standard value that is in excess of their actual cost? If they are not displayed in conjunction with a variance, this will occur. The ancient rule of "cost or market, whichever is lower" will be violated. That portion of the goods which remains unprocessed will be apparently overvalued, whereas an unrealized gain resulting from the variance will creep into Profit and Loss. The difficulty can be avoided only by instantly revising the standards—not always an advisable procedure—or by showing the variance as an adjustment to inventory values.

6. When stores are carried at standard, a revision of the standard prices requires a recalculation of the entire inventory value. Although this is a time-consuming job when it occurs, it should not happen frequently. And even then, it is less arduous than the day-to-day application of prices required in a stores-at-actual system.

7. The fact that semifinished goods returned to stores prior to subsequent processing are necessarily individually valued at standard price has already been mentioned as an argument for carrying all stores at standard for the sake of consistency.

To sum up, it is found that carrying stores at standard prices results in reduced clerical work, a more timely knowledge of price variances, and a consistent treatment of all inventories. At the same time it violates the cost-or-market rule, fails to provide ready details on individual commodity purchase prices, and distorts "true" inventory values. But all these disadvantages can be overcome. It is therefore recommended that standards, if they are to be incorporated into the accounting system, be employed in valuing stores inventory.

Flow of Charges.—Either of two methods can be used for getting materials costs into Work in Process.

1. When goods are issued from stores, the expense account Materials for the cost center receiving them is debited with the actual quantity times the standard price, and Stores is credited with the same amount. When materials are transferred from a preceding cost center where they were processed, the Work in Process account of the preceding cost center is credited with the actual quantity at the standard value and the receiving cost center's Materials account is debited with an equal amount. These materials are utilized within the cost center on some definite operation. The performance of this operation is the signal for crediting the cost center's Materials account with the standard quantity per unit of good product turned out times the standard price and for debiting Work in Process for that cost center with an equal sum. Variances can ordinarily occur only as a result of more materials having been issued than the pieces produced on the operation call for.

Example.—1,000 pieces are issued to Cost Center 101 at a standard price of $1.00 per piece. Seven hundred of the pieces have been processed by the end of the month, with no spoilage loss. Entries are

Materials Expense, Cost Center 101.........	$1,000	
Stores..............................		$1,000

To record issuance of 1,000 pieces at $1.00 each.

Work in Process.........................	$700	
Materials Expense, Cost Center 101.....		$700

To record the fact that 700 pieces have been processed, their standard materials price being $1.00 each.

There now remains in the Materials Expense account a variance between actual and standard cost of $300, due to the existence of a quantity of issued but unprocessed materials. In this example we know the reason for the entire variance. But if spoilage had occurred, we should not know how much of the variance represented unprocessed materials and how much represented materials that had been issued but, having been spoiled, did not get into

Work in Process via the standard allowance. Only by making a physical count of the materials remaining unprocessed on the floor could we learn how much *was* processed for comparison with the standard allowance for materials processed.

2. In the second method, materials, when issued from stores, are charged straight to Work in Process. Then as losses due to spoilage, etc., occur, their amount is charged to a cost-center Materials Variance Expense account. It is unnecessary to compute a standard cost of materials as operations are performed, since the entire actual charge minus losses is taken as the standard cost.

This brief explanation will be expanded in the following sections.

Comparison of Methods.—Under the second method, all materials issued from stores are charged to Work in Process, as is the standard cost (excluding materials) of all p.s.h. earned. But if any materials are spoiled in processing, they must then be removed from this account; otherwise the apparent balance of Work in Process will contain the standard dollar value of goods that are no longer really in process. This deduction is accomplished by crediting Work in Process for the standard cost of materials lost through shrinkage, theft, or defective operations. At the same time, the expense account of the cost center responsible for the loss is debited. It will be noted that this procedure eliminates the use of standard materials costs by quantities for operations (since Work in Process is charged with all materials rather than with the amount allowed on each good operation).

The advantages of this method are that it reduces calculations of standard operational materials costs, reduces the number of accounts on the books, and obviates the need for adjusting Work in Process for the amount of materials received by a cost center but not yet worked on. Its chief disadvantage is the difficulty of detecting losses at the end of each accounting period. When material is rejected by an inspector, the volume of loss is known, and its standard cost is readily deductible from Work in Process. But when materials are stolen, when they shrink in volume or weight, when they disappear in floor sweepings, or when they are scrapped by operators and disposed of before the inspector sees them, there is usually no record of the amount of loss. True, the amount can eventually be learned by comparing the number of articles completed with the number originally called for on the order. But this loss cannot be assigned to the period in which it occurs unless the cost center receives and completes the material in the same period. In industries where the processing period extends over several months or is continuous, only physical inventories reveal the amount of loss.

The two methods are illustrated in the diagrams below.

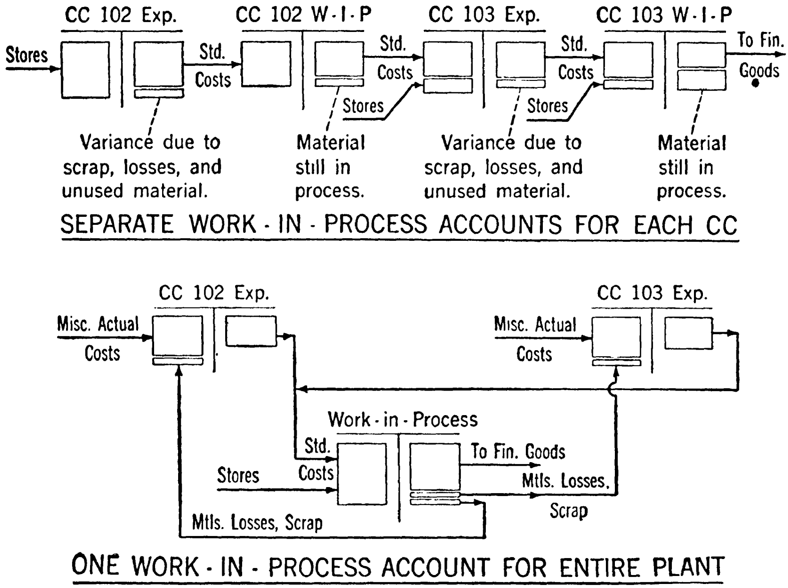


Fig. 13

When the first method is used, the problem is to determine how much material is in the cost center as an expense but not yet processed. When the second method is used, the problem is to determine the exact amount of losses. Methods for handling either problem are described in the succeeding sections on variance analysis.

Variance Analysis

Variances in the cost of materials are attributable either to price or to quantity. The former is obviously due to the purchase of materials at other than the standard price. When a mark-on is added to the purchase price to cover the cost of the purchasing or stores departments, another source of price variances is introduced: one between the actual and standard amounts of expense involved in the mark-on. Quantity variations are caused by material being lost through spoilage, shrinkage, theft, or excess scrap. Depending on the accounting method used, another variance may occur as a result of materials being issued but not processed.

Price Variance.—Methods of isolating the price variance have already been described. If a portion of the standard price includes an allowance for the costs connected with buying and storing materials, the variance in this portion can be separately considered. Such allowances are, as a rule, applied on the basis of dollar value of materials bought or issued. They are not universally used, for the costs in question can also be distributed as a part of the general overhead expense, *e.g.*, on the basis of p.s.h.

If stores are carried at standard, the standard allowance for these mark-on charges is equal to the standard dollars' worth of material purchased times the standard cost of purchasing and storing per dollar. A comparison of this figure with the recorded actual costs of purchasing and storing discloses the variance. It will be observed that the procedure is very similar to the analysis of Other Indirect Labor, for the charges involved are frequently of a fixed or semivariable nature; *i.e.*, a variance occurs due to the level of operations or of materials inventories. As a result, the standard mark-on, being necessarily on a fixed per-dollar basis, will in total differ from actual costs both because of the volume of materials handled and because of deviations from the allowed cost at a given volume. Hence there is a variance between the standard mark-on (based on normal volume) as applied to goods and the allowed expense for buying and storing at the actual volume, and there is a further variance between the allowed expense and the actual expense. If materials are carried at actual, the analysis is similar.

Spoilage Variance.—Determining the variance due to spoilage losses depends in method upon whether materials as issued are charged to cost-center Materials Expense accounts or to Work in Process. Before discussing the two possibilities, we must remember that the detection of spoilage may occur in several ways.

1. An inspection may be performed at each operation, resulting in an accurate count of the good material produced and of the amount of material spoiled at that operation.

2. An inspection may be performed after several operations, re-

sulting in a count of good pieces produced at that point. If complete records are kept of the causes of rejects, spoilage may be assigned back to the operation responsible for it.

3. In Item 2, additional pieces may be spoiled and laid aside without further processing, so that they do not reach the inspection point. If the materials are relatively large in size, these spoiled pieces can be counted, measured, or weighed.

4. Again, in Item 2, the spoiled pieces may be removed from processing before reaching a tally point but may be tossed into a scrap bin by the operator, remelted, broken up, or otherwise disposed of so that they lose their identity. These spoiled materials cannot be directly measured in amount. Whether or not the loss can be detected at all in this case depends upon the manner of production scheduling. For if production is not scheduled and followed on orders calling for specific quantities, the ascertaining of deficiencies cannot be made accurately except on the basis of averages over extended periods of time.

For example, suppose that a blanket order is placed for the processing of certain materials in a cost center, covering a period of several months. Materials are requisitioned as needed to keep the operation going and are charged to Materials Expense or Work in Process. Not until the order is complete is it possible to learn, by comparing total good product with total materials issued, how much was scrapped, unless the scrap is actually counted as it occurs. This system of production scheduling and materials accounting, although not ideal in many respects, is not infrequent.

If, on the other hand, an order is placed for the production of a specified number of good pieces within a relatively short period of time, then if the requisite number is to be produced, any scrap must be replaced by the withdrawal of additional materials from stores, and a complete accounting of scrap losses is quickly obtained.

It is apparent that which of these four possibilities obtains has a marked influence on the method of determining spoilage variance.

1. *When Materials Are Charged to Materials Expense.*—When materials are charged to cost-center Materials Expense accounts and the Work in Process inventory is constructed on the basis of standard hours earned and good pieces turned out at each operation, the spoilage variance is arrived at either directly or inferentially. If spoiled material is counted, the loss due to spoilage is the product of the count times the standard price of the material

as received by the cost center (the cost of work performed on it within the cost center being considered as a labor variance, as explained in Chap. XIII). If desired, the cost of the spoilage is set up in a separate account by crediting Materials Expense and debiting the account Spoilage Variance for the amount of the loss. If spoiled material is not physically counted, its cost can be arrived at only by deducting all other determinable variances from the total materials variance, so that it must necessarily be the balance.

2. *When Materials Are Charged to Work in Process.*—When materials are charged, as issued, to Work in Process, any spoilage that occurs must be deducted from this account; otherwise the Work in Process balance will exceed its physical volume equivalent. This deduction must be based on a direct count of spoilage, for there is in this method no comparison of standard and actual materials quantities from which a variance may be deducted; *i.e.*, the Work in Process represents, not the standard price of materials in semifinished good product turned out, but the actual amount of materials (at standard price) issued. It contains materials that have been partially processed as well as materials that have been issued but not yet processed at all. Hence the charging of materials to Work in Process as issued is not practical if there is any possibility of spoilage being concealed.

On punch-press operations, for example, the large volume of production, together with the admixture of spoiled pieces with the skeletons of metal left after stamping, precludes the possibility of determining exactly how much lost material should be attributed to spoilage. In this case if materials are charged immediately to Work in Process, the only alternative is to forget spoilage altogether and be satisfied with an over-all variance due to material losses in the form of total weighed or measured scrap.

Assuming, however, that the spoiled materials *are* counted, the journal entries consist of a credit to Work in Process for the amount of loss and a debit to Spoilage Variance.

Scrap Variance.—Scrap variance occurs when more or less than the standard amount of scrap material accompanies the production of good material. In the cutting of shoe-upper leathers, for example, lack of skill in placing the die at various places on the hide results in more than the standard allowed amount of wasted leather.

The handling of scrap cost is similar to that for spoilage. The amount of scrap is weighed, measured, or counted and is multiplied by the standard scrap price. Or it is assumed to be a portion of the difference between the actual materials expense and the work in process obtained through pricing on completed operations.

In either case the actual quantity of scrap at the standard price, compared with the standard quantity of scrap at the standard price, is the source of the variance. Determining the standard quantity of scrap requires a knowledge of the number of pieces completed, since only as production occurs should the scrap in question occur. Once the standard cost of scrap is learned, the journal entries can be made.

Case 1. Materials Charged to Materials Expense.—When materials are originally charged to Expense, the Work in Process inventory is constructed on the basis of the standard materials price of pieces subjected to operations, which includes a standard allowance for scrap credits. The entry, assuming the scrap to have no value, is

Work in Process..........................	$1,000	
Materials Expense....................		$1,000

To record the standard cost of materials undergoing operations.

This entry really could have been expanded to

Work in Process..........................	$1,000	
Materials Expense (standard amount for product)........................		$900
Materials Expense (standard amount lost in scrap).......................		$100

To find out whether the standard cost of scrap has been exceeded, it is necessary to multiply the amount of scrap by the original standard unit price of the material of which it is composed and to compare the result with the standard scrap allowance for the amount of good product realized. This calculation is facilitated by having a schedule of standard scrap allowances for each product. The difference between actual and standard is transferred to a Scrap Variance account, as follows:

Scrap Variance................................	$20	
Materials Expense........................		$20

To transfer excessive scrap from Materials Expense to a variance account.

Case 2. *Materials Charged to Work in Process.*—When materials are originally charged to Work in Process, the standard cost of scrap losses must remain in that account, for it is included in the standard price of Finished Goods which will eventually be used as a credit to Work in Process. Therefore, only the difference between the standard and actual amount of scrap is removed from Work in Process. Using the same figures as before, the entry is

Scrap Variance..................................	$20	
Work in Process.............................		$20

To record excess scrap losses.

The amounts are found as in Case 1, by comparing actual and computed standard volumes and costs of scrap.

When scrap is not considered valueless but is returned to stores for sale or reuse, the cost of scrap losses diminishes, and a debit to Stores enters the picture. The development of journal entries for this situation is left to the reader.

Shrinkage Variance.—In certain industries materials shrink in volume or weight during processing. Portions of them evaporate, oxidize, are abraded, or are lost through floor sweepings or dust exhausts. Occasionally they are stolen, and the result, if not the cause, is the same as for shrinkage. Also, they may be wasted simply by using more than is necessary, as for example, when an article is given a needlessly heavy plating.

The amount of loss due to these reasons can be determined only by comparing the quantity of goods originally placed in process with the amount eventually obtained in the product after all other determinable losses have been deducted.

Variance Due to Unprocessed Material.—Suppose that when materials are charged from Stores to Materials Expense, a certain quantity of goods issued to a cost center has not been processed at the close of the accounting period. They have been received by the cost center; they are on the floor; but they have not yet had any work performed on them. Hence they have not yet been credited to Expense and debited to Work in Process. They should not be so credited and debited, for in this system only the good products of an operation are debited to Work in Process, and it is not yet known how much of these materials will be lost in various ways. Nevertheless, they constitute an inventory and should be shown as such. Not to show them would be to inflate the cost center's Materials Expense and distort the controllable variances.

In order to take care of this situation, the amount of materials on hand but not worked on in the cost center is at the end of the period credited to Materials Expense and debited to an account entitled Stores Issued, Variance Due to Unprocessed Materials, or some other appropriate designation. This is an inventory account which must be viewed in conjunction with Stores and Work in Process. It does not occur when materials are charged directly to Work in Process, for then both unprocessed and in-process materials are lumped together.

Summary of Entries.—The preceding discussion of entries and variances can be summarized as follows:

When Materials Are Charged to Expense:

Materials Expense Account:

Debit, for actual quantities issued, at standard price.
Credit:
For Work in Process, number of good pieces times standard price per piece.

For unprocessed material, determined by count For scrap variance, determined by count For spoilage, determined by count For shrinkage, balance after other deductions	or lumped together if uncountable separately.

When Materials Are Charged to Work in Process:

Work in Process Account:

Debit, for quantity of materials issued, at standard price.
Credit:
For Finished Goods, determined by count.
For scrap variance, determined by count.
For spoilage variance, determined by count.
For shrinkage, undeterminable until specific orders are completed, when it is found by differences.

Before leaving the subject it may be repeated that charging all materials to Work in Process avoids the necessity of inventorying unprocessed goods at the end of the period but on the other hand demands an accurate knowledge of all losses. In process or other industries where material is not put through on relatively small production orders and no check can be obtained on losses by subtracting the final from initial quantities on orders, it is not practicable unless a method of obtaining running average yields is used.

Requisitioning.—That standard prices facilitate the use of streamlined requisitions has already been pointed out. One other method, useful for but not essential to a standard-cost system, also deserves description. This is the use of "standout" requisitions for extra materials.

Their use is illustrated by an example.

An order is initiated in the plant. It calls for a specified quantity of product. Prewritten requisitions are delivered to the stores department from the production-scheduling department, calling for the computed amount of material needed to complete the order. These requisitions cover sufficient material to provide for standard spoilage, shrinkage, and scrap losses. As the order progresses, the foreman finds that because of excessive losses, additional material must be requisitioned from the storeroom. At this point the calculation of variances is facilitated if the additional materials can be isolated on the books, for in them lies the difference between standard and actual performance. This segregation is accomplished by color marking or special coding all requisitions for extra materials, so that they can later be easily sorted. These standout requisitions are the only ones for direct materials that are honored over the foreman's signature. All others must be issued by the production-scheduling department, and they are written only for the standard quantity of materials needed to complete the scheduled number of pieces on the order.

This method double-checks the validity of materials variances computed by other means, but whether or not it can be used depends upon ordering practices in the individual plant. For if it is permissible to complete a production order with less than the originally stipulated quantity, the various losses will result in a reduction of the order rather than in a request for extra materials, and no standout requisitions will be executed.

Special Procedures

The possible methods of using and accounting for materials are so numerous that the foregoing pages have covered only general practices. In each plant modifying features exist that require special treatment. A few of these are

Departmental Stores.—Not infrequently materials are purchased and delivered directly to a department without passing through stores. They may then be used as required, without supporting requisitions. In this case the determination of the actual amount of materials put into production can be made only through memorandum requisitions or by means of repeated physical counts.

Continuous Processes.—A continuous process provides no convenient starting or stopping times for the measurement of consumption, output, and losses. Hence the relationship between these must be based on averages. For example, blast furnaces operate 24 hr. a day, and materials are charged fairly continuously, the metal being tapped, or cast, intermittently. During any period, the losses can be closely approximated by subtracting output from input, but this is still only an approximation because of the large quantity of material within the furnace at any one time.

By-products.—The accounting treatment for by-products is amply covered in general cost-accounting texts. In standard costs the question of determining standard quantities of by-products as well as standard values arises. As a result, a further variance account is introduced to cover differences between the actual and standard quantities of by-product in relation to actual quantities of primary product turned out. A related type of variance occurs in some industries where raw materials must be split into various grades for incorporation into finished products bringing varying selling prices. For example, in fruit canning, various degrees of quality in the finished product are turned out, some selling at higher prices than others. Failure to obtain the standard proportions of each grade from the raw fruit initially received results in a variance due to poor sorting or handling. [1]

Confidential Costs.—In order to avoid too common knowledge of product costs, some companies prefer not to issue cost-comparison sheets on which all costs appear. Accordingly, the cost of materials is shown on these sheets not in terms of total materials used but rather in terms of losses only. Thus the foreman can compare his actual losses with standard allowable losses, but the remaining bulk of costs of good material is not revealed.

[1] BARR, RALPH H., The Use of Standard Costs in the Canning Industry, *N.A.C.A. Bulletin*, July 1, 1941.

Indirect Material

Once a complete understanding of standard-cost accounting for direct materials is attained, the procedures for indirect materials need little description. It will suffice to list the causes of variance, which are

1. Spoilage of the indirect materials themselves.
2. Losses of indirect materials on direct materials that are spoiled.
3. Shrinkage, theft, etc.
4. Inefficiency of direct occupations that use indirect materials, so that the amount of indirect materials used rises out of proportion to standard hours earned.

Special Reports

As an aid to supervisors, various detailed reports are prepared relating to materials consumption. So specialized are materials requirements that particular illustrations are of little value. Some of the more common reports are

1. *Spoilage Report.*—A listing of pieces put into production, pieces spoiled, and the cost of the spoiled material.
2. *Scrap Report.*—A listing of the volume, weight, or quantity of material processed, together with the actual and standard amounts of scrap resulting. Actual and standard scrap prices are also included.
3. *Yield Report.*—A listing, usually prepared in process industries, of the total amount of material put into production, the itemized losses due to various causes, and the net good product obtained. Actual and standard quantities, actual and standard costs, and actual and standard percentages for each item are displayed.
4. *Price Report.*—A listing, either as a total or for individual commodity classifications, comparing actual with standard purchase prices. Price trends are revealed by plotting the information periodically in graph form, so that the continuous relationship between actual and standard may be observed for the purpose of either changing buying practices or revising standards.
5. *Inventory Report.*—A statement of the amount of unprocessed material and work in process in each cost center, to be used as a guide for maintaining these inventories at a minimum.

The carrying of excessive floor inventories not only ties up money but also increases the possibility of spoilage and shrinkage.

Disposition of Variances

As with labor variances, so with material variances—they either are carried to Profit and Loss or are prorated over inventories, a portion of them thus finding their way into Profit and Loss via Cost of Goods Sold.

How materials price variance is prorated depends upon the manner of costing Stores. If Stores is carried at standard, the variance occurring at the purchase time may be shown on the balance sheet as an adjustment to the standard dollars in stores, as a means of indicating the actual cost of stores. Needless to say, this adjustment, or variance, is applied only to the controlling account; it is not applied to each commodity in the subsidiary ledger. Were no materials issued during the accounting period, allocating the variance solely to Stores would be quite satisfactory. The transfer of goods to Work in Process, however, necessitates the removal of a corresponding amount of Price Variance to Work in Process also in order to avoid a pyramiding variance from month to month on the Stores account. This is best accomplished by

1. Finding the ratio of the variance account balance to the average Stores-at-standard balance.
2. Multiplying the ratio by the standard cost of materials issued.
3. Crediting Price Variance and debiting Work in Process Variance with this amount.

Being based on averages, this method is only a good guess at where the variance should really go. Actually the specific materials on which the variance occurred may not be issued for months, or they may move out of stores immediately. One exception occurs: When materials are purchased for direct delivery to operating departments, the purchase orders may be held separate and the variance on these particular commodities applied directly to Work in Process.

If stores are carried at actual, the price variance is not revealed until materials are issued. Therefore it is applied in its entirety to Work in Process.

Credits to Work in Process accompanied by debits to Finished

Goods require further proratings of the variances. And as finished goods are sold, a portion of the variances enters the Cost of Goods Sold account. Hence the consistent prorating of variances must be based on a consideration of the changes in the balance of all inventory accounts. The entire treatment may be applied to materials as a whole or to separate classes of materials.

Summary

Standard prices may be applied to materials either when they are placed in stores or when they are issued. Although both methods have advantages, the former is more in line with standard-cost philosophy as well as being more convenient clerically. Materials are issued from stores either to a Materials Expense account or to Work in Process. The price variance is in any case withheld before they are charged to the cost center. Subsequent variances are due to off-standard quantity usage and may be analyzed into the various forms of loss that occasion them. All variances may be prorated to inventories or carried directly to Profit and Loss.

As with labor costs, more must be done than merely to state the amount of the variances. The causes must be investigated. The knowledge that spoilage variance is above standard is in itself useless unless it spurs somebody to discover, say, that the spoilage was high because certain materials were below specifications. And while operating foremen may have known that the materials were below specifications, an exact statement of the cost of this occurrence places the management in a position to decide the extent of action justified to correct the condition.

QUESTIONS

1. What is the primary reason for issuing materials to operations at standard prices?

2. A manufacturer of coin machines purchases large quantities of small springs from an outside supplier. The supplier's engineers cooperate with the purchaser's engineers in choosing springs of the correct design and materials properties for particular applications.

A manufacturer of foodstuffs purchases cereal grains both from primary producers and in the open market where speculative buying is a price factor.

A small manufacturer of kitchen equipment advertises that its products are made from a certain trade-marked corrosion-resistant metal. This metal is produced by only one company. It comprises the bulk of materials purchased.

For each of these cases, state whether or not you would hold the purchasing department responsible for price variations. State the factors to be considered in arriving at your answer.

3. Outline the entries required for the purchase and issuance of materials in a stores-at-actual system; in a stores-at-standard system.

4. Outline the advantages and disadvantages of both systems considered in Question 3.

5. Discuss the relative advantages of charging issued materials to Work in Process or to Cost Center expense accounts. Might they be charged to a Cost Center Work in Process account? Which of the former two methods would this resemble? Why?

6. Is it necessary to weigh or measure the material losses themselves in order to arrive at the materials quantity variance?

7. A blast furnace is operated continuously. Ore, coke, and limestone are charged into the top of the furnace according to a fixed schedule, and several times a day a cast of pig iron is taken from the bottom of the furnace. Outline a method of accounting for materials that reveals quantity variance. After operating for a year, the furnace is taken out of production. Charging stops, and ensuing casts merely remove the relatively large bulk of iron remaining in the furnace. What effect would this have on the variance for the month in which operations stopped?

8. In a certain company, the standard price of materials in stores is composed of the standard purchase price of the materials plus 5 per cent for standard receiving and storing expenses. Outline a method for ascertaining the variance due to excess receiving and storing expenses. Under what circumstances might this variance be a credit?

9. A soup canner finds that 850 lb. of vegetables having a standard price of $0.05 per pound have been spoiled by overcooking. Show journal entries required if the materials were charged to (*a*) Cost Center Materials Expense, (*b*) Work in Process.

10. A manufacturer of small electrical products produces most of his materials for stock. Orders are issued to the plant to replenish stock as necessary, but they need not be filled to the exact quantity specified. Would the use of "excess-material requisitions" be justified? Why or why not?

CHAPTER XV

VARIANCES IN SERVICE AND OVERHEAD COSTS

Direct expenses, being seldom fixed or semifixed, present only minor problems when compared with such indirect items as services and overhead. In dealing with the latter two quantities conflicts are encountered that can easily distort the interpretation of variances. What some of these are has been intimated already. To clarify the extent to which they limit the usefulness of variance analysis, they will now be more fully considered. First it is necessary to make a brief comparison of two ways of charging service costs to operating departments.

Actual Charges

Service-labor costs are incurred in the cost center supervising that labor. They are charged to the cost center for whose benefit that labor is used. Thus, two "actuals" exist: the service cost center's actual, which is the expense incurred in that cost center, and the consuming cost center's actual, which is based on actual service units received at the fixed sold-hour rate.

The total of the actuals for all service, or incurring, cost centers is (with the exception of included distributed amounts) matched on the general accounting records by either cash disbursements or liabilities. The total of the consuming, or charged, cost center's actuals is a credit to the service cost center, computed by multiplying a standard selling rate for the latter cost center by the number of units of service sold. Thus, what is "standard" for the incurring department is "actual" for the charged department. This relationship is illustrated on page 211.

Study of the diagram reveals that the service cost center's standard represents what the cost should be for the number of service units sold. The consuming cost center's standard represents what the cost should be if the right number of service units (at the standard price) had been used for the number of p.s.h. earned.

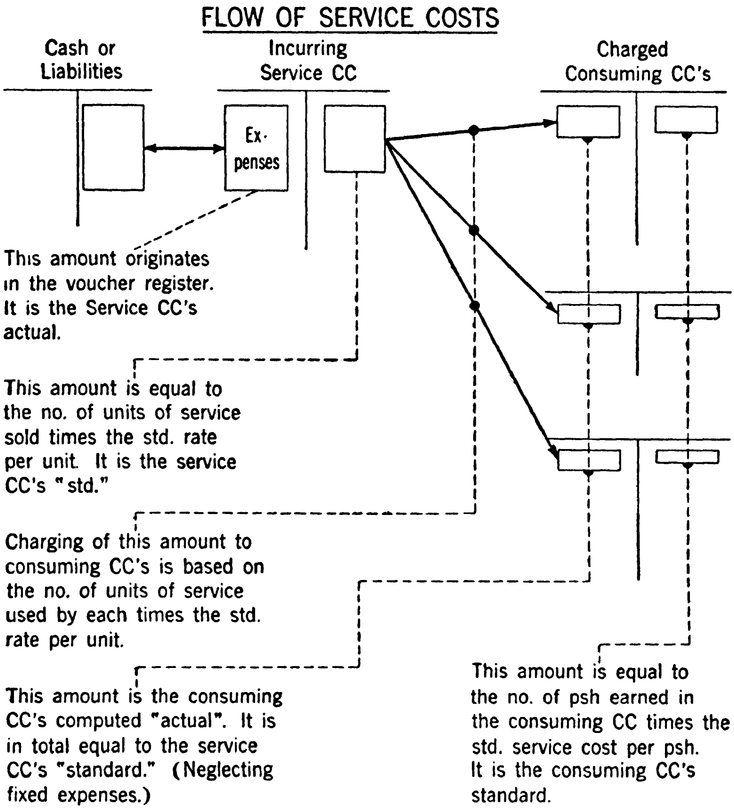


FIG. 14

The supervisor of the service cost center is, as a rule, solely responsible for variance between the actual cost of his cost center and what the cost should have been for the number of service units sold. The supervisor of the charged cost center is, as a rule, jointly responsible with the supervisor of the service cost center for the number of service units consumed.

For example, the pipe-fitting department in a large factory sells man-hours of pipe fitters' labor to various operating departments. This labor is sold at a standard rate per sold hour which includes a standard allowance for tools, supplies, supervision, etc. The pipe-fitter foreman is responsible for any difference between the actual cost of his department and the standard cost (total sold hours times standard sold-hour rate). The foreman of any operating department is responsible for any difference between the number of pipe fitters' hours allowed for a given amount of production and the number actually used, since good care of the equipment will reduce the amount of maintenance necessary. But he shares this responsibility with the pipe-fitter foreman, who controls the amount of time that pipe fitters charge to a job when they *are* needed as well as the quality of the job itself and hence the frequency with which it recurs.

Alternative Treatment

An alternative treatment of service distribution is to base the credit to service cost centers and the corresponding debit to consuming cost centers, not on the number of service units sold, but rather on some key measure in the latter cost center. Thus, instead of charging the consuming cost center with the number of purchased pipe-fitter hours at the standard sold-hour rate, we would charge it with a cost equal to, say, the actual machine hours in the consuming cost center times a fixed service charge.

This method has several disadvantages. In the first place, "actual" for the consuming cost center bears no relation to the amount of service really used. In fact, it is difficult to say whether or not the cost center's actual is not really a sort of standard, since it allows a fixed cost of service per machine hour. Also, the distinction between price and quantity variance is suppressed.

No doubt this method is sometimes used in standard costs because of a confusion with the burden application rates used in job-order systems. Of course it is easier to employ, since no record need be kept of the actual quantities of service units used by each consuming cost center. But it does not contribute to the fundamental purposes of standard costs: analysis and control.

For example, suppose that a burden application rate of \$0.50 per machine hour is used in a producing cost center and that in a given month 1,000 standard hours are produced in 1,100 actual hours. The "actual" service charge to the cost center is then equal to the burden application rate times the actual machine hours, or

$$\$0.50 \times 1{,}100 = \$550$$

The standard service cost is the burden rate times the standard hours earned, or

$$\$0.50 \times 1{,}000 = \$500$$

The variance is $550 minus $500, or $50. If the foreman of the consuming cost center is told that he is responsible for this variance, he can truthfully reply that the variance has no meaning as a measure of his performance. This is so because the $550 represents not what was really spent for services for his cost center but rather what somebody in the accounting department says *might* have been spent if the burden application rate were 100 per cent accurate insofar as this particular producing department is concerned. Moreover, the variance represents merely an inefficiency of the machines and is not a measure of any excess burden cost at all.

The "actual" charge in this case is thus merely a figure assigned for accounting purposes. In a job-order system, application rates are necessary in order to cost burden to product. But in a standard-cost system, with its emphasis on cost-center costs, there is no reason why expenses cannot be charged to the cost center on the basis of true figures. The use of burden application rates should, therefore, be dispensed with when a standard-cost system is installed.

Dual Responsibility

One of the easily overlooked features of service-cost analysis has now become apparent. In examining variances in the service cost centers, it is not enough to compare debits (or expenses) with credits (which might be called "income from sales of service"). Such a comparison neglects the additional responsibility for the number of service units sold. A comparative cost exhibit for service cost centers therefore looks somewhat like that shown on page 227.

An additional column to show total variance could be used, but it is not advisable, since the introduction of total columns, although making a clear picture, encourages readers of the report to glance at over-all figures when they should be studying the component details.

Price Variance

The variance between the standard and actual cost of service labor *used* occurs entirely within the incurring cost center. It is the residual balance of the service cost center's control account after all journal entries have been made crediting that actual and debiting consuming actuals with the sold-hour cost of service-labor hours.

If the plant does not operate on the complete-variability theory, this balance can be resolved into two components. The first is the price variance due to off-normal operations. This is computed in a manner similar to that used for departmental indirect labor. At the time when the sold-hour rates are originally established, a table is prepared showing man-hours of service labor for various percentages of normal within the service cost center as well as the fixed and variable costs at each level. For example:

COMPUTATION OF SOLD-HOUR RATE AND CAPACITY VARIANCES

Service Cost Center No. 221

Account		Type	Sold man-hr. per month				
No.	Description		1,600	2,000	2,400 (normal)	2,800	3,200
			Standard cost				
1002	Labor	Variable	$1,280	$1,600	$1,920	$2,240	$2,560
1003	Supervisory Salaries	Fixed	225	225	225	225	225
1004	Clerical Wages	Semifixed	......	120	120	120	180
1006	Indirect Materials	Variable	200	250	300	350	400
1009	Fuel and Power	Semifixed	15	15	20	20	20
Total			$1,720	$2,210	$2,585	$2,955	$3,385

$$\text{Sold-hour rate} = \frac{\$2{,}585}{2{,}400} = \$1.077$$

From this table it is obvious that even if all expenses are held to the standard amount, variances will occur if more or less than the normal number of man-hours are sold. If 2,000 man-hours are sold, the credit to the cost center will be 2,000 times $1.077, or $2,154. But the allowed cost is $2,210 at this level. Hence there is an off-capacity variance of $56, which is attributable to the existence of fixed expenses and the use of a constant sold-hour rate. It may be asked, Why not eliminate this book variance by using different sold-hour rates at different levels? This cannot be done because standard product costs, the basis for inventory valuation, include service costs, and those service costs must therefore always be applied consistently.

The total allowed cost figures shown for various levels are sometimes known as "budget expense." This confusion of budget with standard should be discouraged.

Given, then, a price variance for a service cost center, the off-capacity variance is first ascertained by referring to the table to find the allowed cost for the actual man-hours sold and subtracting from the figure obtained (by interpolation of variable expenses if necessary) the total sold-hour cost for the month. This variance, being the result of the standard-cost setup, is not considered controllable. Obviously, to suggest that the foreman reduce it is to suggest that he sell more service units, which is not a desirable endeavor. Only by increasing plant operations to a point that justifies the use of more service hours can this variance be rightly eliminated.

The difference between the allowed cost for the number of man-hours sold and the actual cost of operating the service cost center is a price variance that the foreman *can* control by cutting expenses. When it is unduly large it may be further broken down into elements of expense in order to determine whether it is due to high labor rates, excessive clerical cost, waste of fuels and power, or abnormal supplies consumption. (Supplies are, of course, charged to the service cost center at standard prices.)

Sample journal entries are

Service Cost Center Expense..............	$2,300	
Vouchers Payable....................		$2,300

To record the incurring of various actual expenses in the service cost center.

Consuming Cost Center Service Expense.....	$2,154	
Service Cost Center Expense...........		$2,154

To record the sale of 2,000 service man-hours at $1.077 per man-hour to consuming cost centers.

Service Off-capacity Variance..............	$56	
Service Cost Center Expense...........		$56

To record variance due to sale of less man-hours than normal sold-hour rate was based on. Variance = $2,210 (from preceding table) − $2,154 = $56.

Service Expense Variance..................	$90	
Service Cost Center Expense...........		$90

To transfer to a variance account the excess of service cost center actual expenses over allowed expenses of $2,210.

The accounting procedure is much the same, whether the units sold are man-hours, B.t.u., square feet of floor cleaned, or gallons of filtered water. In the case of utilities, the costs involved are frequently so large that a breakdown of items of expense must be made, supplemented by statistical records of materials consumption when necessary.

Services purchased from outside vendors are subject to variance, just as those supplied from within the plant are. The analysis of these price variances is similar to that of stores purchase-price variances.

The preceding discussion has revealed a second of the points that must be remembered in service-cost variance analysis, *viz.*, that off-capacity variance (or "budget-excess variance" as it is sometimes called) must be eliminated before a true picture can be obtained of the variance for which a supervisor can be held responsible.

Quantity Variance

For every p.s.h. earned in a producing cost center, a fixed standard service cost is allowed. This cost is stated in dollars per p.s.h., which could also be expressed as "standard sold service hours times sold-hour rate" per p.s.h. Since the actual charge for services to the producing cost center is equal to the service hours *actually* sold times the same sold-hour rate, any difference between actual and standard service cost for the producing cost center is due to a variation from the allowed number of sold hours.

This variation may be due to several factors.

1. *Excess Amount of Service Required.*—In the case of repair and maintenance labor, for example, misuse of operating equipment may result in excess service requirements for that equipment. Or excess service for equipment may result from accelerated deterioration due to age. Conversely, new equipment may require abnormal service during the initial breaking-in period.

2. *Inefficiency of Service Laborers.*—Taking again the example of repair and maintenance service, the actual number and type of repair jobs may not increase, but the men working on those jobs may operate slowly or inefficiently or may be poorly scheduled, so that more sold hours occur than are necessary. This condition is especially prevalent during low operations, when service workers tend to stretch out their jobs rather than appear conspicuously idle.

3. *Performance of Service Work during Partial Shutdown Periods.*—When this happens, there are, because of the shutdown, few

p.s.h. on which a standard allowed service charge can be earned. The situation is perfectly legitimate. It can be recognized through the standards only by means of a reserve account for spreading the cost over an operating period.

4. *Shift in the Proportion of Services.*—Because of market difficulties or emergencies, it may be necessary to manufacture within the plant or patch up repair parts that are customarily purchased. If the plant cost for these parts is greater than the purchase price, the result will be a favorable variance in service materials and a greater unfavorable variance in service labor.

5. *Operating Inefficiency.*—Service costs, being proportioned to p.s.h., are assumed to vary with productivity of operations. If, however, an abnormal amount of nonproductive operations (output of spoiled materials or salvage work on defective materials, for which no p.s.h. are earned) is performed, service costs will be incurred while there is a deficiency of p.s.h. and hence of standard service allowance. This variance properly reflects part of the cost of these wasteful, nonproductive operations.

6. *Poor Quality of Service.*—If services are not performed adequately when rendered, their frequency and hence the number of sold units increase over standard. Consider the sold service inspection. If inspection is carelessly performed, a reinspection is necessary, and the cost of this service increases. In the case of service materials, such as repair and maintenance parts, the use of poor-quality materials results in more frequent need of them and hence in an increase in cost.

Variances in utilities service costs are discussed in a subsequent section of this chapter.

It will be seen from the above list of causes that variations from the standard quantity of service are attributable to the supervisors of both service and operating cost centers.

Journal entries required are

Consuming Cost Center Expense............	$2,154	
Service Cost Center Expense...........		$2,154

To record the sale of 2,000 service man-hours at $1.077 to consuming cost centers. (This is the same entry shown on page 215.)

Work in Process.........................	$2,000	
Consuming Cost Center Expense........		$2,000

To record standard service cost earned and charged to Work in Process: 2,000 p.s.h. × $1.00 standard service cost per p.s.h.

Service Quantity Variance..................	$154	
Consuming Cost Center Expense........		$154

To transfer balance in consuming cost center to a variance account.

Consideration of the possible causes of this quantity variance indicates that only by an investigation of actual shop occurrences can the ultimate reasons for the variance be learned. They are not apparent in the accounts.

Relationship between Variances

The relationship between the different variances for service costs is illustrated in the following diagram, in which the height of the blocks represents the relative amounts of money in each charge or credit.

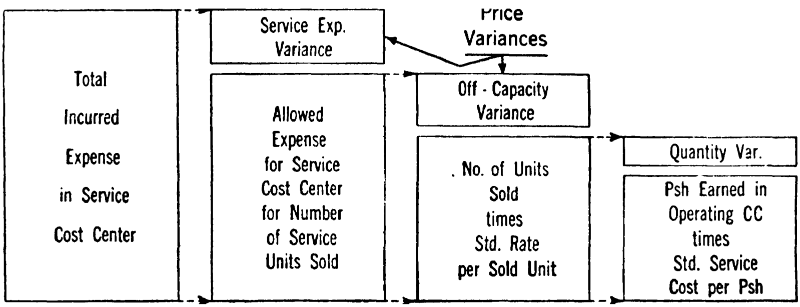


FIG. 15

Utilities Variance

As pointed out in a prior chapter, services can consist of materials, labor, or utilities. Utilities being a rather special type of service, the following points should be remembered in dealing with them:

1. Utilities can be accurately charged to consuming cost centers only when they are metered as they enter each cost center. This cannot always be done, because meters are not always available at every required location. For example, we may not have any means of measuring the quantity of compressed air delivered to each cost center. By means of readings from a revolution counter on the compressor, the total actual quantity of air delivered can be calculated; and it has been shown how measurement of cylinders and jets on the air-consuming facilities discloses how much *should be* used. But how much is really used on each facility or

in each cost center or how much is dissipated in line losses cannot readily be determined.

Therefore, since the number of units sold to each consumer cannot always be measured, the charge to consumers is sometimes predicated on a book distribution of the total units produced. This distribution is based on the actual or standard hours, revolutions, pieces, or tons produced or some other index of consumption on production facilities, of which the utilities used may be a function. Since it is not always, however, a true measure, the responsibility of the supervisor of the consuming cost center for variances in utilities consumption must frequently be viewed with reservations. The supervisor of the service-selling cost center is, of course, still responsible for the measured total produced.

2. When utilities used by various departments are actually measured, the quantity used at the point of consumption frequently differs from that produced. Line losses cause the disparity. It is customary to charge these line losses to the purveyor of the service; *i.e.*, their excess over the amount allowed for in the sold-unit rate remains in his cost as a component of the price variance.

3. The sharing of responsibility for utilities losses is frequently complex. For example, consider the case of steam piped throughout the plant for use in processes. It may be wasted, with a resulting variance, because of poor valve, joint, and piping installations (pipe fitters' responsibility); carelessness in its use (operating supervisors' responsibility); or poor quality, causing condensation (power supervisors' responsibility). Merely to determine that a quantity variance exists is not sufficient for control; knowledge of physical characteristics of the plant is necessary to assign responsibility for it to the proper authority.

4. Some utilities, such as steam, electric power, and treated water, can be either purchased from outside the plant or manufactured inside. Moreover, even when produced within the plant, they may issue from any of several possible pieces of equipment, each having a different cost—as when several electric generators are available, not all being used simultaneously. It is then advisable to base the standard intraplant selling rate of the service on the most economical method of production. In this way the producer of the service is penalized when power is purchased from

outside vendors or when he operates obsolescent or stand-by equipment. How the variance due to this cause can be set up in the accounts is left to the reader.

Because of these special features, the analysis of variances in the costs of utilities should be undertaken only with a full knowledge of plant practices in production and use of this service.

Nonstandard Equipment

Standard service expenses being accumulated within the consuming department on the basis of p.s.h. earned, it follows that the use of nonstandard equipment will result in the earning of a standard burden cost not in line with that contemplated in the standard product price. For example, suppose that in a heat-treating department there are two furnaces, either of which may be used for hardening a given product. One of the furnaces, being smaller and newer, is more efficient in the use of gas than the other. According to standard procedure, the part in question should be treated in the latter furnace. Because of congestion in the shop, it is, however, treated on occasion in the larger and more expensive furnace. Then because standard hours are earned on the large furnace, a standard gas cost is cumulated on those hours, and this standard cost becomes a part of the charge to Work in Process. But the standard product price of the part, the basis for future credits when the material passes from work in process to finished goods, contains the lesser standard gas cost of the smaller furnace. Therefore Work in Process will contain a balance equal to the difference between the number of pieces processed times the standard gas cost per p.s.h. per piece for the large furnace and that for the small one.

It will be seen by now that this problem—the existence of a variance due to the use of nonstandard operations—is identical with that described in the chapter on Variances in Labor Costs. The solution, then, is the same as outlined in that chapter.

Sample Problem

To illustrate the procedures for handling service costs and variances, an example is presented. In this case we shall assume a factory in which there are, for simplicity, two producing cost centers—*A* and *B*—in each of which there are two operations. We shall suppose that there are two service departments—a millwright department and a pumping station which supplies water separately metered to departments A and B. First we shall review the construction of standards for the service cost centers.

MILLWRIGHT COST CENTER

COMPUTATION OF SOLD-HOUR RATE AND CAPACITY VARIANCES

Account	Sold man-hr. per month			
	500	750	1,000 (normal)	1,250
	Standard cost			
Shared Supervision..........	$ 60	$120	$ 120	$ 120
Labor....................	450	675	900	1,125
Supplies..................	50	75	100	125
Fuels and Power (for shop)..	30	45	45	50
Total..................	$590	$915	$1,165	$1,420

$$\text{Sold-hour rate} = \frac{\$1,165}{1,000} = \underline{\underline{\$1.165}}$$

FIG. 16

PUMPING STATION COST CENTER

COMPUTATION OF SOLD-UNIT RATE AND CAPACITY VARIANCES

Account	M Gal. sold per month			
	10,000	20,000	30,000 (normal)	40,000
	Standard cost			
Shared Supervision	$ 50	$ 65	$ 65	$ 65
Labor...........	175	175	175	175
Supplies..........	15	20	25	30
Electric Power....	40	50	60	70
Millwrights.......	93	117	140	163
Total..........	$373	$427	$465	$503

$$\text{Sold-unit rate} = \frac{\$465}{30,000} = \$0.0155 \text{ per thousand gallons}$$

FIG. 17

Observe that in the computation of the sold-gallon rate for water from the pumping station, there is included a cost of another service: millwrights. This service cost is included at the estimated number of hours required times the sold-hour rate of $1.165. Normal distribution of services and costs thereof is as follows:

Cost center	Oper. No.	Normal p.s.h.	Millwrights			Pumping Station			Total std. service cost per p.s.h.
			Std. sold hr. per p.s.h.	Std. cost per p.s.h.*	Normal std. cost	Sold M gal. per p.s.h.	Std. cost per p.s.h.*	Normal std. cost	
		(*a*)		(*b*)	(*a* × *b*)		(*c*)	(*a* × *c*)	
A	1	1,000	0.230	$0.268	$268	12.95	$0.201	$201	$0.469
	2	800	0.188	0.219	175	......	....	.. ..	0.219
B	1	1,500	0.200	0.233	350	11.35	0.176	264	0.409
	2	1,200	0.166	0.193	232	......	....	....	0.193
		Normal M gal.		Std. cost per M gal.					
Pumping station		30,000		$0.0047	140				
Total...		......	......	....	$1,165	......	......	$465	

* Sold rate times sold units.

Fig. 18

In review it may be said that the procedure in the original development of the data so far was as follows:

1. Normal monthly capacities, in p.s.h., were determined for each operation in cost centers *A* and *B*.

2. Standard service requirements per p.s.h. were established for each operation. These requirements were expressed in sold man-hours for millwrights and in sold thousand gallons for water.

3. The total services to be sold by each service cost center were then found by a summation of the information in Item 2.

4. For this normal quantity of services, as well as for other quantities, a standard cost of each item of expense was set, from which a rate per sold unit of service could be deduced.

5. These rates, applied to the sold quantities used by each cost center (as found in Item 2), give the standard service cost per p.s.h.

6. As a check, the standard service cost per p.s.h. times the normal p.s.h., should (and does) equal the total standard cost of producing that service. Thus the figures shown in the total line

in Fig. 18 will also be found in the normal totals in Figs. 16 and 17, respectively.

In our problem, the p.s.h. earned in the current month were as follows:

Department	Operation	P.s.h.
A	1	900
	2	700
B	1	1,400
	2	1,000

Services sold were

Department	Operation	Millwright man-hr.
A	1	300
	2	140
B	1	300
	2	80
Pumping station	....	85
Total........	....	905

Department	Operation	Water, M gal.
A	1	13,000
B	1	18,000
Total........	....	31,000

Total actual expenses of the service cost centers were as follows:

Millwrights...............	$1,100
Pumping station..........	410

Required.—Show calculations, journal entries, and ledger entries to record all transactions with respect to the service costs and variances.

Solution.—Initial journal entries are

(1)	Millwright Cost Center Expense............	$1,100	
	Pumping Station Cost Center Expense.......	410	
	Vouchers Payable Pay Roll Reserves, etc.		1,510
	To record expenses incurred.		

(2)	Cost Center *A*	$513	
	Cost Center *B*	443	
	Pumping Station Cost Center Expense	99	
	Millwright Cost Center Expense		$1,055

To record sale of Millwright hours as follows:

440 hr. to Cost Center *A* at $1.165 per hr.	$ 513
380 hr. to Cost Center *B* at $1.165 per hr.	443
85 hr. to Pumping Station at $1.165 per hr.	99
Total	$1,055

(3)	Cost Center *A*	$202	
	Cost Center *B*	279	
	Pumping Station Cost Center Expense		$481

To record sale of water as follows:

13,000 M gal. to Cost Center *A* at $0.0155 per M gal.	$202
18,000 M gal. to Cost Center *B* at $0.0155 per M gal.	279
Total	$481

(4)	Work in Process	$1,341	
	Cost Center *A*		$575
	Cost Center *B*		766

To record the standard cost for services, calculated as follows:

Cost Center *A*, Operation 1. 900 p.s.h. at $0.469	$422	
Cost Center *A*, Operation 2. 700 p.s.h. at $0.219	153	$ 575
Cost Center *B*, Operation 1. 1,400 p.s.h. at $0.409	573	
Cost Center *B*, Operation 2. 1,000 p.s.h. at $0.193	193	766
		$1,341

(NOTE: Production Department labor and materials, also chargeable to Work in Process, are not included in this example.)

(5)	Off-capacity Variance	$15	
	Millwright Cost Center Expense		$15

To record variance due to the fact that only 905 millwright man-hours were sold, whereas sold-hour rate is based on 1,000 man-hours. Calculated as follows:

Allowed cost for 1,000 sold man-hours	$1,165
Allowed cost for 750 sold man-hours	915
Difference	$ 250

$$\frac{905 - 750}{1{,}000 - 750} \times \$250 = \$155$$

$\$915 + \$155 = \$1{,}070$ allowed cost obtained by interpolating in Fig. 16 for 905 sold hours.

Allowed cost − sold cost = variance
$1,070 − $1,055 = $15

(6)	Service Expense Variance	$30	
	Millwright Cost Center Expense		$30

To record variance due to Millwright Cost Center costing more to operate than is allowable for the number of hours sold.

Actual cost − allowed cost = variance
$1,100 − $1,070 = $30

(7)	Pumping Station Cost Center Expense	$12	
	Off-capacity Variance		$12

To record variance due to the fact that 31,000 M gal. of water were sold, whereas sold-gallon rate is based on 30,000 M gal. Calculated as follows:

Allowed cost for 40,000 M gal	$503
Allowed cost for 30,000 M gal	465
Difference	$ 38

$$\frac{31{,}000 - 30{,}000}{40{,}000 - 30{,}000} \times \$38 = \$4$$

$465 + $4 = $469 allowed cost obtained by interpolating in Fig. 17 for 31,000 M gal.

Allowed cost − sold cost = variance
$469 − $481 = − $12

(Observe that here, where the variance is favorable, the debit of $12 to Pumping Station Cost Center Expense does not represent an increase in the expense, but rather an offset to the sold-cost figure of $481.)

(8)	Service Cost Center Expense Variance	$40	
	Pumping Station Cost Center Expense		$40

To record variance due to Pumping Station Cost Center costing more to operate than is allowable for the number of M gallons sold.

Actual cost − allowed cost = variance
$509 − $469 = $40

(9)	Service Quantity Variance	$140	
	Cost Center *A*		$140

To record variance due to use of excess services in Cost Center *A*.

Actual cost − standard cost = variance
($513 + $202) − $575 = $140

(10)	Cost Center *B*	$44	
	Service Quantity Variance		$44

To record variance due to use of less than standard amount of services in Cost Center *B*.

Actual cost	−	standard cost	=	variance
($443 + $279)	−	$766	=	− $44

In reviewing the variances, it is observed that the quantity variance of $140 in cost center *A* is extremely high, being approximately 24 per cent of the allowed cost of $575. It should therefore be analyzed further. This is done by breaking down the total standard service cost per p.s.h. into its components for millwrights and water, respectively, and comparing the standard and sold costs of these commodities.

Millwrights:

Cost Center *A*, Operation 1. 900 p.s.h. × $0.268	$241
Cost Center *A*, Operation 2. 700 p.s.h. × $0.219	153
Total standard cost for Millwrights, Cost Center *A*	$394
Actual sold cost for Millwrights, Cost Center *A*	513
Quantity variance, Millwrights, Cost Center *A*	$119

Pumping Station:

Cost Center *A*, Operation 1. 900 p.s.h. × $0.201	$181	Std. Water Cost
Actual sold water cost	202	
Quantity variance, Water, Cost Center *A*	$ 21	

Total quantity variance = $119 for Millwrights plus $21 for Water = $140

The majority of the variance is thus seen to stem from the use of excess millwright hours. It is therefore advisable to check the shop to learn what reason can be assigned to this occurrence.

The variances for the service cost centers are exhibited in a report on page 227.

This chart reveals an interesting feature. Insofar as Millwrights are concerned, the correct judgment of that cost center's performance must be based on the total number of hours sold. Therefore the quantity variance includes the variance caused by the use of more or less than the standard number of millwright hours by both operating cost centers and the pumping station. At the same time, the quantity variance on hours sold to the pumping station is included in the expense variance of the latter cost center. For this reason, two lines are shown for Millwrights. The first contains a standard cost including the standard cost of Millwrights per thousand gallons of water times the standard

COST COMPARISON FOR SERVICE COST CENTERS

July 31, 19__

Cost center	No. units sold	Actual expense	Allowed expense	Sold cost	Std. cost	Off-capacity variance	Expense variance	Quantity variance
		(*a*)	(*b*)	(*c*)	(*d*)	(*b*) − (*c*)	(*a*) − (*b*)	(*c*) − (*d*)
Millwrights	905 hr.	$1,100	$1,070	$1,055* 956†	$1,059* 914†	$15	$30	− $ 4* 42†
Pumping Station..	31,000 M gal.	509	469	481	427	− 12	40	54
Total...	......	$1,609	$1,539	$1,536* 1,437†	$1,486* 1,341†	$3	$70	$50* 96†

* Based on sales to all cost centers.
† Based on sales to operating cost centers only.

number of gallons per p.s.h. in each operating cost center. The second line does not include this figure, containing only standard costs of millwright services for operating cost centers. The quantity variance on this line—$42—when added to the $54 for the pumping station gives the total of $96 previously set up through journal entries in the Quantity Variance account. The difference of $46 between the two quantity variances for millwrights is a favorable (or credit) variance due to the use of less than the standard number of millwright hours in the pumping station. This can be verified as follows:

Total M gallons sold	31,000
Standard Millwright cost per M gallons	× $0.0047
Total standard Millwright cost for Pumping Station	$145.70
Actual Millwright cost for Pumping Station	99.00
Quantity variance	$ 46.70*

* Due to use of less than standard number of Millwright hours in Pumping Station.

The $46 thus obtained is equal to the difference between the two alternative quantity variances for Millwrights. It should be remembered that when one service cost center buys services from another, its own price variance includes a quantity variance for the second cost center. Careful thinking is necessary to avoid an inflation of total variance due to this overlapping.

T Accounts

Millwright CC Expense

(1) $1,100	$1,055 (2)
	15 (5)
	30 (6)
$1,100	$1,100

Pumping Station CC Expense

(1) $410	$481 (3)
(2) 99	40 (8)
(7) 12	
$521	$521

Vouchers Payable, etc.

	$1,510 (1)

Cost Center *A*

(2) $513	$575 (4)
(3) 202	140 (9)
$715	$715

Cost Center *B*

(2) $443	$766 (4)
(3) 279	
(10) 44	
$766	$766

Work in Process

(4) $1,341	

Off-capacity Variance

(5) $15	$12 (7)

Service Cost Center Expense Variance

(6) $30	
(8) 40	

Service Quantity Variance

(9) $140	$44 (10)

Summary

Expenses incurred by service cost centers are charged to those cost centers. These cost centers are then credited with the product of sold service units times standard sold-unit rate. This product is at the same time charged to the consuming cost centers. Consuming cost centers are credited (and Work in Process is debited) with p.s.h. earned on production times the standard service cost per p.s.h. In this way variances can be set up to exhibit the cost excesses or savings effected by the service cost-center supervisors on their expenses and the cost excesses or savings effected by operating cost-center supervisors jointly with service cost-center supervisors on quantity of service consumed. Alternative methods of charging operating cost centers with service costs in proportion to actual or standard man- or machine-hours in those cost centers are undesirable because they fail to proportion the charge to the actual quantity of service consumed.

QUESTIONS

1. How is the actual service labor charge to manufacturing cost centers constructed? What is the offsetting credit to this charge?

2. What day-to-day records must be kept in order to obtain this charge?

3. If a standard time were set for every service job performed, as is done in some plants, how would the charge to manufacturing cost centers be arrived at? What additional variance, not discussed in the text, might then be shown in the service cost center?

4. Why do we say that the supervisor in charge of a certain group of service workers is not solely responsible for the number of their hours charged to various other cost centers?

5. What is meant by service price variance?

6. How is the service expense variance obtained?

7. How is the service off-capacity variance obtained?

8. How is the service quantity variance obtained?

9. Should the supervisor of a service cost center be encouraged to reduce the amount of his off-capacity variance if it shows up as a debit every month? State the reason for your answer. If he were encouraged to reduce it by selling more service hours, what other variance would be affected and in what way?

10. In a hypothetical plant there are two electric-generating units, one of which is a stand-by in case of emergency. The standard cost of power on the regular unit is \$0.005 per kilowatt-hour; that on the stand-by unit is \$0.007 per kilowatt-hour. Power is consumed on three productive operations as follows (at standard):

Operation	Kw.-hr. per P.S.H.
1	20
2	10
3	30

In a given month the p.s.h. earned and the actual power consumption are as follows:

Operation No.	P.s.h. earned	Kw.-hr. consumed
1	550	13,000
2	700	7,300
3	200	6,500

In the course of the month the regular generating unit breaks down, and the stand-by unit operates for the balance of the month, producing 30 per cent of the total power output. Actual costs of producing power are \$175.

Required:

a. Standard cost of power per p.s.h. on each operation.

b. Journal entries to show all transactions involved in the sale of the power to the consuming cost centers. Also show that portion of the debit to Work in Process which would stem from power expense and the corresponding credit.

c. What is the amount of the price variance? What portion of it is attributable to the operation of the relatively more expensive stand-by equipment?

d. What is the amount of the consumption variance?

e. The supervisor of the power cost center asks why he should not be allowed to sell power at two different rates, depending upon the unit on which it is produced. What two reasons would you give him for not doing so?

11. In a certain plant the data for the only two service cost centers are as follows:

Cost center	Sold man-hr. per month			
			(Normal)	
Millwrights	500	750	1,000	1,250
Electricians	400	600	800	1,000
	Standard monthly expense			
Millwrights	$600	$800	$1,000	$1,200
Electricians	540	720	900	1,080

The data for the only three production operations are

Operation No.	Normal p.s.h.	Standard service hr. required per p.s.h.	
		Millwrights	Electricians
1	1,200	0.250	0.150
2	900	0.333	0.333
3	1,600	0.250	0.200

In the month in question, the following p.s.h. are earned:

Operation	P.S.H.
1	1,000
2	800
3	1,400

Services sold were

Operation No.	Millwright hr.	Electrician hr.
1	280	150
2	300	300
3	300	300

Actual expenses of the Millwright cost center were $1,100; those of the Electrician cost center were $890.

Required:

a. Calculate sold-hour rates.
b. Calculate standard service costs per p.s.h.
c. Show journal entries for all transactions involving service labor costs.
d. Post the journal entries to T accounts.
e. Show a summary of variances.

CHAPTER XVI

BUDGETS

Earlier in this volume it was pointed out that budgets and standards are not the same thing. Having different purposes, they are set up and used in different ways. Yet a relationship exists between them. Without embarking on a complete description of budget procedures, this chapter will point out some of the ways in which standard costs can be utilized to shape up and reinforce budgets for operations.

Difference between Standard and Budget

The first distinction between standards and budgets is one of purpose. Budgets are statements of expected cost. At the *beginning* of the period for which they are prepared they are used to forecast requirements of finance, man power, and other variables related to production and sales. *During* that period they are used as a comparison to be sure that actual costs are not exceeding expectations—that the business is "staying on the track." Standards, on the other hand, do not necessarily show what costs may be expected to be but rather what they might be if certain highly desirable performances are attained. For this reason they cannot be used alone for forecasting.

The second distinction is one of emphasis. A budget emphasizes cost levels that should not be exceeded. If they are exceeded, then the whole foundation upon which profits are predicated is jeopardized. But a standard emphasizes the levels to which costs should be reduced. If these levels are reached, profits are increased. In a healthy business, costs never exceed budget; they do approach standard.

A third distinction is one of completeness. Budgets are customarily set for all departments in the company, from sales to manufacturing. But standards are frequently set only for the manufacturing divisions and can, indeed, be confined to controllable costs in a limited number of cost centers, although this is not a recommended practice. Furthermore, budgets customarily include both income and expense, whereas standards are more frequently set for expenses or costs only.

A fourth distinction is one of analysis and breakdown. If costs are within the budget, well and good. There is no danger signal; it is not necessary to investigate the reasons for the savings. But when actual costs differ in any marked degree from standard, the nature and cause of the variance are thoroughly investigated so that steps may be taken to reduce its amount. Knowing why actual cost differs from standard enables us to go after economies. Knowing why it differs from budget, if it is less, merely tells us of good performances already obtained—if it is more, it tells us of a highly perilous situation.

These distinctions may be summarized by saying that a budget is a marker for keeping out of trouble whereas a standard is a compass that points the way to improvements.

Similarities between Standard and Budget

Although standards and budgets have certain differences in purpose, emphasis, completeness, and degree of analysis, they nevertheless possess similarities. These resemblances, in fact, are of such a nature that the existence of standard costs greatly facilitates budget preparation.

Both budgets and standards attempt to predetermine expenses. Both consider departmental expenses according to accounts. Both assume that costs are controllable along fixed lines of supervision and responsibility. Both require the issuance of periodic comparative cost reports. Both require the measurement of costs as related to some other variable, such as pieces, standard hours, etc.

Budget Preliminaries

In setting up a budget for a coming period, it is necessary to know the quantities of each product that are expected to be made during that period. This information is ascertained from a forecast prepared by the sales department. For each product a listing is available of the materials and operations required. This listing provides the information needed to calculate total expected materials costs, as well as the expected cost of labor. The latter is obtained by adding up the total labor costs on all products undergoing the same operation. These totals are then grouped not only by operation but by cost center or department and according to classes of expense: direct labor and indirect labor. Overhead or service costs are also figured, either by applying cost rates to the previously obtained totals or by cross-adding these costs as listed on the product cards. The ultimate result is a budget of expenses for the whole plant, which is subdivided into expenses for each cost center. The details of this procedure will now be examined.

The Sales Forecast

The sales forecast corresponds in form to the exhibit of normal monthly production described in Chap. III. It consists of a tabulation of the products expected to be sold, with the quantities of each. If a flexible budget is being prepared, multiples of the quantities are shown for various levels of production. The difference between this forecast and the exhibit of normal monthly capacity lies in the fact that the former is a statement of expected actual production for a particular period whereas the latter is an average of perhaps several successive periods which, taken together, represent a level of optimum profitable operations for the plant.

Budget Standard Hours

From reference to standard product cost cards, p.s.h. for each operation on each product are next tabulated. Multiplication of these figures by the budgeted quantity of products gives the total budgeted p.s.h. for each operation. Again, it is seen that this process is similar to that followed in developing normal p.s.h. for calculating prorated fixed costs per p.s.h. in standards construction. The only distinction is that the product distribution differs from normal or even from percentages of normal, being an expected actual. An example of the calculation of budgeted p.s.h. is shown on page 235.

Observe that the occurrence of Part 21032 on two different assemblies necessitates its being listed twice. If the product is relatively stable, with little change in operations from month to month except in budgeted quantities, the tabulation can be run off on a duplicator, so that only quantities and totals need be filled in for various budget levels.

Budgeted Productive Standard Hours for January, 19—

Product No.		Cost center	102						103			
		Operation	1		2		3		1		2	
Assembly	Components	Quantity	Each	Total	Each	Total	Each	Total	Each	Total	Each	Total
21030	....	6,000	.....	.....	.....	.....	.....	.....	.....	.....	0.089	534
	21032	6,000	0.003	18	0.001	6	0.068	408	0.103	618		
	21033	12,000	.....	.....	.....	.....	0.022	264				
	21034	6,000	0.071	426	0.004	24	0.022	132				
	21035	24,000	.....	.....	.....	.....	0.015	360				
21040	....	3,000	.....	.....	.....	.....	.....	.....	.....	.....	0.077	231
	21042	3,000	0.051	153	.....	.....	0.062	186				
	21044	3,000	0.028	84								
	21032	3,000	0.003	9	0.001	3	0.068	204	0.103	309		
	21045	6,000	0.002	12	0.004	24	0.009	54				
21060	....	5,000	0.012	60	0.015	75	0.008	40	0.018	90		
21070	....	12,000	.....	.....	.....	.....	.....	.....	.....	.....	0.113	1,356
	21072	12,000	0.101	1,212	0.008	96	0.123	1,476				
	21077	72,000	0.007	504	.....	.....	0.003	216				
Total	....	......	.....	2,478	.....	228	.....	3,340	.....	1,017	.....	2,121

Budgeted Expense

Knowing the budgeted p.s.h. in each cost center, on each operation, it is next required to determine the budgeted expense. This is done by applying to the p.s.h. the standard cost per p.s.h. and then modifying that cost so that it represents not the cost at best attainable efficiency but rather the cost that may actually be expected to occur.

Obviously, the best guide to future costs is past costs. The cost-comparison sheets for preceding periods provide a ratio between actual and standard cost that, if multiplied by the standard cost for budgeted production, will give us a figure that might be expected to prevail, other factors remaining unchanged. The following steps are therefore taken:

1. Ratio between past actual and standard costs is ascertained. This *must* be shown by accounts. It *should* be shown by accounts for each cost center. It *may* be shown by accounts for each operation, which is the most accurate method, although requiring more work.

2. For each operation, the budgeted p.s.h. are multiplied by

the standard cost per p.s.h. for each account. This gives a total standard cost for budgeted production.

3. The total standard cost obtained in Item 2 is multiplied by the corresponding ratio developed in Item 1. This gives the total budgeted cost for each account for each operation. Costs for operations can be cross-totaled to give a cost-center budget cost.

The example on page 237 shows the preceding steps as they would be used for a cost center in which the ratio between actual and standard is not broken down by operations.

Additional Considerations

The treatment outlined in the preceding section has been somewhat simplified. In practice it must be modified for two reasons.

1. To assume that past ratios of actual to standard will prevail in the future is to ignore a prime purpose of standard costs: effecting savings. It would be more fair and realistic to expect the ratios to be reduced with the passage of time. By how much they may be expected to diminish in the future may be learned from an examination of the trend in recent months. At any rate, it should be remembered that the past ratios are only a guide.

2. Because the ratio of actual to standard is influenced by the level of operations, past ratios are truly applicable only to budgeted production at approximately the same level. Where the budgeted level is substantially different from that for which ratios were obtained, the effect of off-capacity variance must be weighed. The best solution to this problem is to figure the ratios for fixed and variable items of expense separately. The calculation then shows the standard and budget costs of fixed expenses, and the standard and budget costs of variable expenses, the two being subsequently totaled.

Checking the Budget

When total budgeted expenses have been built up, they are compared with budgeted income from forecasted sales and other sources. It is thus possible to learn what profits may be expected.

Although the budgeted expense has been based to some extent on past ratios, it does not necessarily follow that the profit margin will be the same as in the past. For one thing, the level of operations may be different, as has been explained, resulting in greater or less absorption of fixed expenses. Also, the proportions of

Step 1:

COST-COMPARISON SHEET

Cost Center No. 102 Year Ending Dec. 31, 19 _

Account		Actual cost	Std. cost	Variance	Ratio, actual/std.	
No.	Description				This year	Last year
1000	Direct Labor	$100,000	$80,000	$20,000	1.25	1.27
1002	Indirect Labor	60,000	50,000	10,000	1.20	1.22
1005	Direct Materials	75,000	60,000	15,000	1.25	1.26
1006	Indirect Materials	15,000	12,000	3,000	1.25	1.26
1007	Repair and Maintenance, Labor	15,000	12,000	3,000	1.25	1.29
1008	Repair and Maintenance, Materials	8,000	6,000	2,000	1.33	1.32
1009	Fuel and Power	8,000	7,500	500	1.07	1.06
1010	Plant Overhead	100,000	100,000	0	1.00	1.00
Total....................		$381.000	$327.500	$53.500	1.16	1.18

Step 2—Budgeted p.s.h., Operation 1 = 2,478 (from chart on page 235).

Step 3:

CALCULATION OF BUDGET COST

Cost Center No. 102 January, 19__

Account		Ratio, actual/std.	Operation 1 P.s.h. = 2,478		Operations 2, 3, etc.	Total budget
No.	Description		Std. cost	Budget cost		
1000	Direct Labor	1.25	$2,300	$2,875		
1002	Indirect Labor	1.20	1,800	2,160		
1005	Direct Materials	1.25	3,500	4,375		
1006	Indirect Materials	1.25	380	475		
1007	Repair and Maintenance, Labor	1.25	300	375		
1008	Repair and Maintenance, Materials	1.33	180	240		
1009	Fuel and Power	1.07	300	321		
1010	Plant Overhead	1.00	2,000	2,000		
Total..................		....	$10,760	$12,821		

various products manufactured may have altered in such a way as to give more weight to relatively unprofitable items, or vice versa.

For these reasons one or more of the following steps may have to be considered:

1. The sales department may have to revise the volume of sales that it is going after.
2. The sales department may have to shift the balance between various products that it expects to sell, so as to emphasize the more profitable items.
3. The manufacturing departments may have to take more drastic steps to cut costs—by obtaining materials at a lower cost, reducing rates of pay, or improving operating efficiency.
4. The firm may have to resign itself to operating at a loss for the period.

The Static Budget

The previous description has covered what is known as a static budget; *i.e.*, sales and projected expenses are set up for the coming year and are used as a comparison with actual expenses. When the bulk of the business is obtained on a contractual basis or can be estimated within close limits, this system is satisfactory. Since sales closely approximate the budget, the deviations of expense from budget are an index of how closely the expected profits and financial requirements can be met.

If the business is subject to seasonal fluctuations, this is reflected in setting up the budget. Sales are allocated to the various months of the year, as are budgeted expenses. But if the budget cost for any given month is set in advance, regardless of what the actual level of operations turns out to be in that month, the budget is still a static one; it is not changed to suit each fluctuation from expected output that occurs.

The Flexible Budget

As explained, the static budget is satisfactory for certain types of business. When, however, the volume of production may vary markedly from what has been forecast, the usefulness of the budget can be improved by splitting it into two parts—income and expense—and calculating budget expenses separately. Sales performance is still revealed by comparing actual with budgeted income.

For purposes of factory control, however, it is desirable to compare actual costs, not with the budgeted cost for an unrealized sales volume but with the budgeted cost for the amount of production actually turned out. Only in this way can the supervisor's responsibility for keeping expenses within allowable limits be brought out.

Construction of a variable budget of this type is identical with that of a static budget, except that the budget cost is calculated each month on the basis of p.s.h. actually earned rather than being set up in advance for a theoretical number of p.s.h. This calculation is for use in measuring performance only. Top management still requires an expense budget set in advance of operations (*i.e.*, a static one for the expected output) in order to determine financial requirements. Management also needs the budget to measure the deviations from expected expense (and hence from proposed financial requirements) that accompany variations from the expected production level; *i.e.*, if commitments are to be made, they must be made on the basis of knowledge furnished by a fixed budget. If, later, the budget must be varied because of changing conditions, we must still know what the original budget was in order to measure the effect on our commitments.

With a variable system the management is interested in

1. A static or fixed budget with which to anticipate future income, expense, and financial requirements.

2. A variable budget which shows the maximum costs that supervisors should incur for the production actually attained in any month.

3. A comparison between actual sales and those set up on the static budget, to measure sales-department performance.

4. A comparison between actual costs and those set up in the variable budget, to measure manufacturing performance.

5. A comparison between the static (or predetermined) budget for a given month and the variable budget, to measure the amount of change attributable to deviations from the originally budgeted level of operations. This is a deviation for which manufacturing supervisors are not responsible unless they have been unable to fill all orders booked.

6. A comparison between actual costs and those set up in the

static budget, to measure the trend with regard to the necessity for revising financial commitments.

Expense-only Budgets

A budgetary control system applied only to manufacturing operations is exceptionally easy to operate once standards are installed. Such a system is, if desired, used for forecasting, but it is primarily utilized for the control of current manufacturing costs. For this it requires the addition of two extra columns to the cost-comparison sheet: one for Budget Cost and one for Variance from Budget. Each month when the sheet is prepared, the actual costs are listed, the standard costs are calculated for the number of p.s.h. earned, and the budget cost is computed as a percentage of standard cost (which may or may not be the actual ratio of some past period). Differences between budget and actual and between actual and standard are exhibited. The foreman is thus provided with a "go-no-go" gauge for costs; he knows that he must not exceed budget and that he should approach standard.

For further information on budgetary control, the reader should consult standard texts on the subject, bearing in mind the relationship between budgets and standard costs.

Summary

Budgets differ from standards chiefly in that they establish maximum permissible costs whereas standards establish desirable minimum costs. They are similar to standard costs in their methods of approach and measurement. If standard costs are known, budgeted costs can be derived from them by the application of ratios. Either static or variable budgets can be set up in this manner. They can be used for controlling all phases of the business enterprise.

QUESTIONS

1. A certain firm, in preparing its budget for the coming year, follows these steps:

a. For each account in each cost center, the monthly expense for the last 24 months is plotted against direct labor hours.

b. Through the points thus obtained, a line is drawn. This line shows the way in which the particular expense varies with production.

c. Another line is then drawn in whose ordinates are approximately 95 per cent of the values of the first, or "actual," line. This second line represents the budget expense for any chosen amount of production. From it a budget cost per direct labor hour can be deduced at any production level.

What, if any, similarities does this budget cost have to a standard cost? Would you recommend the use of budgets thus derived for estimating financial requirements for a future period, assuming the future production volume to be known with some degree of certainty? State the reason for your answer. How does this budget cost differ from a standard cost? Is it the type of budget described in the text?

2. Neglecting the effect of changes in design or methods, which would require more frequent revisions, a budget cost per p.s.h. or a standard cost per p.s.h.? Why?

3. The sales manager of your firm, which manufactures farm equipment, says that he has only the roughest idea of the exact volume of various items that may be sold in the coming year. Naturally he is going to do everything that he can to achieve a high sales volume, but not until orders begin coming in from dealers can he know what that volume will be. Furthermore, he feels that questions of finance and manufacturing control, important though they may be, are slightly out of his province and that he should not be asked to go out on a limb in order to participate in them. If you feel that he is temperamentally or statistically unequipped to help you, how would you go about arriving at a budgeted sales volume for the coming year?

4. Of what value is a static budget?

5. Of what value is a flexible budget?

6. How does a static budget differ from a flexible budget?

7. A plant manager says: "As far as cost control goes, I don't see that it makes much difference what system I use. The value of any system lies not in the figures that it presents but in the fact that it makes my supervisors cost conscious. It is useful for just so long, and then they get used to it and fall into a rut. Then it's time for something new. I think it's a good idea to use a budget system for a while and then after a few years switch over to standard costs. Maybe after a few years of that, I might start throwing man-hour controls and yield reports at the boys. That way I jog up their thinking every so often and start them out all over again to go after savings. A little bit of novelty all the time, a new way of looking at things—that's what keeps them from going stale. Whatever type of control system is being used at the moment is just a device to keep supervisors on their toes. As long as the system produces results right now, I don't care how its data compare with those of five years ago." Do you agree or disagree? State your reasons.

CHAPTER XVII

SUPERVISORS' INCENTIVE PLANS

Incentive plans for supervisors are nothing new. Some of the older forms of plans for hourly workers provided devices whereby foremen participated in savings effected in labor hours. Others arrived at a composite bonus, based on wage-incentive performance together with measures of idle time, scrapped materials, unfinished work in process, safety performance, and similar factors that management deemed indicative of supervisory merit. Again, some firms have operated schemes for rewarding supervisors in proportion to net profits of the plant as a whole.

These plans vary widely in merit. Those are best which comprehend the greatest number of controllable costs. Obviously the ones that are based solely on wage-incentive performance are less desirable because of their limited coverage. And the profit-sharing plans, because the reward is so unrelated to the individual's efforts, are little more than devices for increasing earnings when the company makes money.

For these reasons progressive management, endeavoring to develop the highest degree of capability in its supervisors, is finding in standard costs the most comprehensive basis for incentive plans.

Incentive-plan Objectives

The objectives of a supervisors' incentive plan are similar to those for hourly workers' plans. They are

1. To encourage improved performance by paying money for it. Management's representatives are just like the workers under them; they will, if properly selected, turn in a satisfactory job under ordinary conditions. But without a stimulus they will seldom realize their best potentialities. In some cases this stimulus is provided by ambition, the desire to excel, or the expectation of promotion. But these are characteristics of individuals and do not affect all men equally. The one appeal to which nearly all employees do respond regardless of their status is a financial one.

Failure to offer this appeal not only deprives the company of possible profits but robs the supervisors of the opportunities for self-betterment that the men under them receive.

2. To provide employees with a knowledge of what is expected of them. A man who is put to work shoveling coal does not know how much he is expected to shovel unless somebody tells him. The information has more meaning to him when he is also told how much he receives for shoveling a given amount. So it is with department heads. They cannot know their full purpose in the plant unless management informs them. And the extent of their responsibility becomes most vivid when they realize that it is paralleled by a variation in their earnings. An incentive plan is the most effective way that there is to tell a supervisor what management wants him to do.

3. To reward in proportion to merit. Not only do incentive plans stimulate good performance; they also afford a means of paying men in proportion to accomplishment. In this way they eliminate the inequities that occur when a flat salary is paid month in and month out regardless of individual achievement at particular times.

4. To supply management with a yardstick for measuring the relative performance of individuals. Like wage workers, supervisors vary in individual ability. The workers' ability is readily apparent in terms of daily output. But that of supervisors is difficult to appraise. Too often the foreman with a "sales" personality can give an impression of competence that is not borne out by the facts when they become available. Furthermore, high productive output is in itself no criterion of excellence unless it is considered together with costs, which are of equal importance to profits. A good incentive plan correlates the maximum number of controllable items in such a way that the success of supervisors in controlling those factors is illuminated. And by doing this it reveals which men come closest to fulfilling the company's requirements for effective operations.

Incentive-plan Requirements

In meeting the aforementioned objectives, an incentive plan should fulfill certain requirements. Unless it does, it will fail of its purpose. These requirements are just as applicable to supervisors' plans as to any others, and in deciding the value of plans based on standard costs, they should be kept in mind. They are the following:

1. The plan should be understandable. Supervisors should be able to grasp the details of its calculation. They should be aware of the factual data on which it is based and, given these data, be able to verify their bonus by figuring it themselves. No one can possibly be motivated by an incentive unless he understands the relationship between efforts and results.

2. The reward should be proportionate to achievement. The proportion need not be direct, for it is sometimes advisable to pay more than the average rate of bonus at certain portions of the performance curve in order to encourage getting into high-yield performance. But the bonus should be so scaled that over-all improvement is matched by an increase in incentive earnings.

3. The plan should be fair. It should be operated according to predefined rules. It should be administered impartially. The data on which it is based should flow from official company records. Month-to-month bonus earnings should never be determined by the opinions of top executives as to what constitutes good performance at any one time.

4. The plan should not be just a device to increase earnings. Supervisors should realize that they earn bonuses only by contributing to the company's welfare, that they must work for what they get out of the plan, and that they will not be rewarded for the efforts of other managerial employees.

5. The plan should be comprehensive. It should include all measurable items that the supervisor can control. It should reward him for the increased responsibility of high-capacity operations. It should omit no feature of his job that affects profits. Conversely, it should include no factors beyond his control.

6. The bonus should be paid soon after it is earned. Speedy calculation and payment of incentive earnings is a sure way to emphasize the relationship between performance and reward.

Dollars as the Test

Dollar values are the objective measuring stick of supervisory accomplishment. If, as was suggested in Chap. II, the cost center can be regarded as a "factory within the factory," then that cost center's entire value to the company can be evaluated in terms of what it spends for what it produces. It produces either productive standard hours or sold services, and a standard money value is assignable to both. If its expenditures are grossly in excess of that money value, the cost center is not doing its share in supporting the company structure; it is eating into profits that other cost centers help to earn.

Now there are many other indexes of accomplishment, some of which have been mentioned: wage-roll incentive-plan efficiency, lost-time percentages, scrap ratios, breakdown reports. To the foreman these are helpful as a guide to improved job details. But to the company they are of interest only as they affect profits; *i.e.*, only when they are translated into money do they become comparable and assume significance. We cannot really adjudge the importance to the company of a 3 per cent excess-materials usage until we know just what that excess cost the company. If the cost is slight, perhaps it might well be neglected until more expensive inefficiencies have been treated. And so it is that a supervisory plan based on dollars is one that is most in line with the company's major objective of making money. It makes the supervisor think in the same terms as the general manager.

Moreover, it also weighs dissimilar items so that they may be compared. It places labor performance on the same plane as materials-usage performance, dollars saved in either being of equal value to the company.

Certain factors, it is true, are not immediately reflected or are not accurately measurable in dollars. For example, the ultimate cost of broken delivery promises is not readily ascertainable, and yet supervisors should be encouraged to get production out as rapidly as possible. Failure of a foreman to meet schedule dates is, however (when not originally the fault of the planning department), usually accompanied by excessive lost time or defective workmanship which is mirrored in costs as well as in late deliveries. So there is an indirect control of the cost of this item.

Other items that supervisors may be expected to influence are volume of work in process, grievances, accidents, and labor turnover. But the exact assignment of responsibility for any of these factors is difficult. Some of them are as much functions of company policy or top supervision as they are of the foreman. Others can be measured in monetary terms only by rules so arbitrary that they will never win full acceptance by the men to whom the rules are applied.

Use of Standard Costs

Standard costs and supervisors' incentive plans go hand in hand. If the plans are most useful when based on dollar values, then standard costs supply those values. Because of the extensive analysis that accompanies standards establishing, there is a clear-cut definition of which costs are controllable by each foreman, which are uncontrollable, and which are controllable jointly with some other supervisor. The cumulation of actual costs in parallel with this segregation is facilitated by the use of the cost centers and account numbers that are instituted for the operation of standard costs. In short, the system as a whole provides information on how much each foreman spends as well as on how much he should spend.

At the same time, standard costs, to be of the greatest practical value, need the aid of incentive plans. Although the conscientious department head always strives to reduce variances and to attain standard, it is not so with all. It is too easy for a supervisor to become accustomed to explaining variances rather than correcting them. Unless he is perpetually heckled, threatened, and cajoled by the plant manager, he comes to accept the cost variances as permanent and immutable fixtures of his department. Obviously the introduction of an incentive plan eradicates this attitude by spurring him to reduce variances in order to earn a bonus.

Not only is there this mutual reaction, but also incentive plans based on standard costs meet the objectives listed at the beginning of this chapter.

1. They encourage improved performance by paying money for it.

2. They provide employees with a knowledge of what is expected. This is done by the cost-comparison sheets, which tell supervisors what management believes costs should be for particular operations.

3. They reward in proportion to merit. The supervisor who has the best cost record has the best bonus for his level of pay.

4. They enable management to measure the relative performance of individuals. Standard-cost data make such a comparison possible even without an incentive plan. But without an incentive, the comparison is inconclusive, for it is not based on best possible efforts of the individuals involved. A bonus tends to

develop in the men affected supervisory qualities that might otherwise lie dormant.

The Human Angle

Recent years have witnessed a strange diminishment in the status of the foremen and department heads of many companies. Formerly little monarchs of their realms, these men wielded extensive power. They planned and scheduled operations. They hired, trained, disciplined, or discharged their employees. They ordered materials as they saw fit. They were solely responsible for the maintenance and repair of their equipment. Top management vested in them almost full authority for the running of their departments.

How different is their status now! Many of their former responsibilities—scheduling, hiring, requisitioning, etc.,—have been sliced away and grafted on to staff departments. The result has been increased efficiency, but it has undeniably reduced the foreman's stature.

Simultaneously, the growth of unions has advanced to the point where many supervisors either are timorous or are simply not permitted to take disciplinary action on their own initiative. Small wonder that they sometimes question if they are little more than clerks!

This feeling of inferiority may be enhanced by another fact. Many companies, anxious to avoid union grievances as well as to obtain maximum output by satisfying workers' demands, are, willingly or not, carefully toeing the line in dealing with labor—defining policies, assuming contractual obligations, practicing strict fairness—yet unfortunately they do not always follow these practices with respect to supervisors. The latter, being ambitious, having more to lose than the average worker, desiring to win management's regard rather than its suspicion, and knowing that they will never be promoted by a management that fears their power, have been reluctant to unionize except in a few industries. Consequently, they have had to endure more arbitrary treatment than the men under them, simply because their employers were not forced to treat them otherwise. The effects have not always been apparent in foremen's attitudes or expressed in their statements, but they have still existed in less obvious forms that inevitably reduced profit potentialities. You cannot get the best from a man by neglecting him.

A system of rewards based on a scientific standard-cost system can do much to correct this supervisory consciousness of indifference and injustice. This is so because the system, once installed, operates almost automatically, without regard to individuals. It is essentially fair. It delineates the supervisor's responsibilities in terms of the dollars that he is employed to spend or save. It advises management of his achievements and rewards him in proportion. And it gives him a sense of participation which elevates his value both to himself and the company.

How such a system operates is described in the following chapter.

QUESTIONS

1. A certain company sets aside a fixed percentage of net profits to be distributed as a bonus to supervisors. Discuss this practice from the standpoint of fairness to individual supervisors, strength of incentive offered, and value to the company. Which would have more effect on bonus payments, the business cycle or individual performance? At what point on the business cycle is a strong incentive most needed?

2. A plant manager says: "I don't believe in bonus plans for foremen. Why should I have to bribe them to do what they were hired for in the first place? They are already being paid a good salary to do their job in the best way they know how. Furthermore, when you pay a foreman a bonus, you lower his prestige by putting him in the same class as the people who work for him. All in all, I think the best guarantee of good foremanship is the innate character and drive of the individual himself. If he doesn't have the stuff to do a top job without appeals to his pocketbook, he shouldn't be a foreman at all." How would you reply to this argument?

3. Name four reasons for installing an incentive plan for plant supervisors.

4. In order to eliminate wide month-to-month fluctuations in supervisory incentive earnings, a large manufacturer of steel sheets determines the monthly bonus to be paid by averaging performance for the last 6 months rather than by using this month's performance alone. What is the weakness of this method?

5. Because it is impossible to assign exact responsibility for steel defects, which comprise a large proportion of controllable costs, the same manufacturer bases individual bonuses not on individual cost performance but on that of the plant as a whole; *i.e.*, in a given month every participating supervisor earns the same percent bonus. Granting that the practice may be necessary in this case, would you recommend its use generally? State the reason for your answer.

6. A manufacturer for the printing trade established a supervisory incentive plan in which the bonus earned was governed by performance on five factors, weighted as follows:

	Per Cent
a. Direct labor	25
b. Indirect labor	25
c. Variable expense	25
d. Factory errors and defective materials	19
e. Safety	6

If a supervisor attained 100 per cent of expected performance on any one factor, he received that percentage of his maximum possible bonus which is specified above for that factor. For lesser performances, he received a correspondingly smaller portion of the maximum allowable percentage for the factor involved. Is this a fair plan? Why or why not?

7. Why are standard costs a good basis for supervisors' incentive plans?

8. A British writer lists the following benefits of foremen's incentive plans:

a. Greater interest among foremen.
b. Higher output.
c. Reduced labor and material costs.
d. Greater speed of production and better service.
e. Better quality.
f. Minimizing of labor turnover.
g. Improved working conditions.
h. Better reception of improvements and suggestions.
i. Closer cooperation between management and men.[1]

Briefly state just how a foremen's incentive plan achieves each of these ends.

[1] Burns Morton, F. J., Incentives for Foremen, *Engineering*, May 23, 1941.

CHAPTER XVIII

APPLICATION OF SUPERVISORS' INCENTIVE PLANS

Several types of supervisors' incentive plans are described in this chapter. In the application of any of them it is usually desirable to employ a device that conceals earnings from the clerks applying the plan, as the remuneration of supervisors is usually confidential. This is easily done by expressing earnings in terms of "bonus points." Using the cost data available, clerks calculate the number of bonus points earned by a supervisor. The cashier then refers to a table of dollar values per bonus point (which differ from one supervisor to another depending on the salary level) to determine how much incentive money to pay out.

Simple Percentage Plans

The most obvious type of plan is one employing the familiar ratio of "standard to actual." Each month a per cent performance is calculated as follows for each cost center:

$$\text{Per cent performance} = \frac{\text{total controllable std. cost}}{\text{total controllable actual cost}} \times 100$$

The cost figures are taken from the monthly cost-comparison sheet. A typical earnings formula is

$$\text{Bonus} = (\text{per cent performance} - 75 \text{ per cent}) \times \text{salary}$$

This formula assumes that the supervisor should attain at least 75 per cent performance before earning bonus. If he meets standard, *i.e.*, hits 100 per cent performance, he earns a bonus equal to 25 per cent of his salary.

For example:

(*a*) Standard cost = \$40,000
Actual cost = \$50,000

$$\text{Per cent performance} = \frac{\$40{,}000}{\$50{,}000} \times 100 = 80 \text{ per cent}$$

$$\begin{aligned}\text{Bonus} &= (80 \text{ per cent} - 75 \text{ per cent}) \times \text{salary}\\ &= 5 \text{ per cent} \times \text{salary}\end{aligned}$$

(*b*)

$$\text{Standard cost} = \$50{,}000$$
$$\text{Actual cost} = \$50{,}000$$
$$\text{Per cent performance} = \frac{\$50{,}000}{\$50{,}000} \times 100 = 100 \text{ per cent}$$
$$\text{Bonus} = (100 \text{ per cent} - 75 \text{ per cent}) \times \text{salary}$$
$$= 25 \text{ per cent} \times \text{salary}$$

A foreman who cannot attain at least 75 per cent performance is scarcely deserving of any bonus. On the other hand, a well-run plant may already be operating at an average of 85 or 90 per cent performance. In this case the formula should be modified for two reasons.

1. There is nothing to be gained by paying bonus money for accomplishments already achieved without it. The purpose of the bonus is to reward for *additional* effort.

2. The spread of 10 or 15 per cent bonus between present performance and 100 per cent performance is a meager stimulus.

Accordingly the formula is modified by introducing a sliding scale of bonus proportioned to per cent performance. The break-even point is chosen in accordance with average present performance in the plant. The relationship between performance and bonus is expressed in Fig. 19.

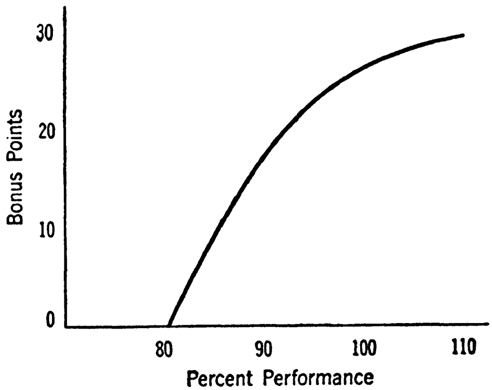


Fig. 19

Per cent performance having been calculated from cost data, the bonus points earned are read from the graph. Incentive earnings are then paid on the basis of the preestablished dollar value per bonus point. It may be observed that this particular curve is so constructed that

1. No bonus is paid until 80 per cent performance is attained.

2. A relatively large amount of bonus is earned between 80 and 90 per cent performance. Thus supervisors just being placed on incentive have an opportunity to earn a substantial bonus on initial savings, which aids in selling the plan.

3. The bonus return for increments of performance over 90 per cent diminishes. This feature protects the company against excessive incentive earnings due to occasional loose or erroneous standards.

An alternative form of bonus curve is shown in Fig. 20.

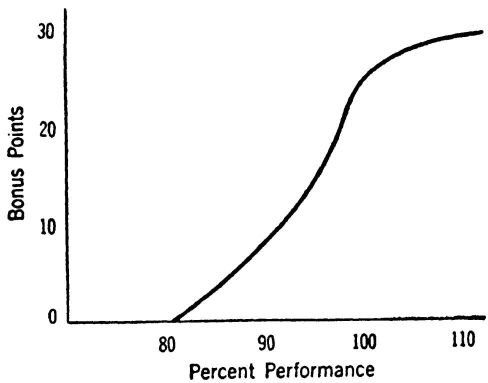


Fig. 20

Advantages of this type of curve are

1. There is still no bonus paid out for less than 80 per cent performance.

2. The amount of bonus paid out increases greatly with each increment of performance between 90 and 100 per cent, being relatively less between 80 and 90 per cent. Reason for this is that initial savings are rather easier for supervisors to attain. As performance improves, subsequent savings are more difficult to attain. Therefore an increased reward is offered at higher performances in order to stimulate foremen to seek these more difficult savings.

3. To protect the company, the curve levels out after 100 per cent.

The starting point of either curve can be set in accordance with the present performance that it is desired to exceed. These two curves are based on different types of thinking with regard to bonus payment, and the choice between them depends on individual preference.

Base-period Plans

In the plans just described the emphasis is on approaching standard cost. If present costs are considerably higher than standard, the standards, although entirely correct, may seem so hard to reach that supervisors feel that an impossible goal has been set for them. Acceptance of the standards is doubly difficult because it is a tacit admission that present practice is very poor. Diplomacy of a high order must be exercised in educating supervisors away from these opinions, and a complete selling job may require the examination and justification of every individual standard. An incentive plan that sidesteps these obstacles by shifting the emphasis is desirable.

Such a plan is that which pays off for savings from costs in some base period. The operation of the system is as follows:

1. A base period of from 6 months to 2 years is chosen, one in which production was normal and costs were neither unusually high nor unusually low compared with average.

2. For this period a set of historical (or base) costs per p.s.h. is obtained that, in their breakdown by operation and account, parallel the standards.

3. In the application of the plan a base cost, as well as a standard cost, of the current operations is calculated. The former figure denotes what the operations would have cost if conducted at base-period efficiency. The latter, of course, denotes what they should cost at standard efficiency.

4. Bonus then depends on the ratio of actual to possible savings. The performance formula is

$$\text{Per cent saved of possible} = \frac{\text{actual savings}}{\text{possible savings}} \times 100$$

$$= \frac{\text{base cost} - \text{actual cost}}{\text{base cost} - \text{std. cost}} \times 100$$

Bonus points are determined from an earnings curve, similar to one of those shown before, on the opposite page.

A plan of this sort is easy to sell because supervisors can be assured that they need only effect a savings from past costs in order to earn bonus. The emphasis is on increasing the gap between past and present costs, with the measure of effectiveness being the proportion that this reduction bears to total possible savings. Many supervisors will argue that it is impossible for them to achieve an as-yet-unrealized and improved standard performance;

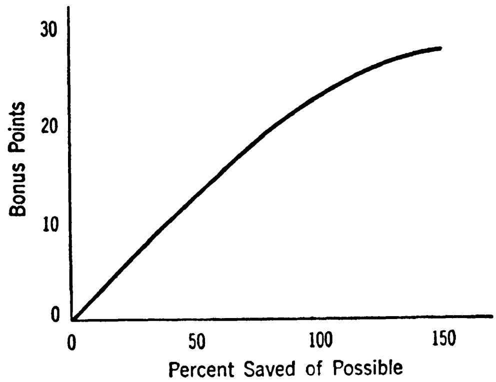


Fig. 21

few can gainsay the feasibility of improving on past practice. At the same time management has a guarantee that no bonus will be paid out except for improved performance.[1]

Budget Plans

Budgets can effectively be tied in with standard costs in supervisors' incentive plans. At the same time certain objections to the base-period type of plan are overcome. These objections are

1. It is unreasonable that the company should forever pay incentive earnings for savings effected from costs in an increasingly remote period.

2. When a supervisor is replaced by a new man, the new man cannot rightfully be held for the good or bad performance of his predecessor, although such a plan implies that he should.

3. Base-period plans are not fully just to the efficient supervisor; they make bonus possibilities best for the man who has high past costs and can thus most easily effect a saving.

[1] An alternative method is to express the savings as a percentage of the base cost, rather than as a percentage of possible savings.

4. There is no provision for new operations, for which no base costs exist. Consequently, a ratio of base to standard must be assumed for them.

A budget plan substitutes budget cost for base-period cost in the performance formula, which then becomes

$$\text{Per cent saved of possible} = \frac{\text{actual savings from budget}}{\text{possible savings from budget}} \times 100$$

$$= \frac{\text{budget cost} - \text{actual cost}}{\text{budget cost} - \text{std. cost}} \times 100$$

Again, bonus points are related to percentage saved by means of a suitable formula or graph.

In administering a budget incentive plan it must be remembered that each annual revision of the budget has an effect on potential incentive earnings. If the budget cost is reduced, then both the numerator and denominator of the performance formula are diminished by an equal amount. Consequently, even if actual and standard costs remain the same, the per cent performance is cut.

For example:

$$\begin{aligned} \text{Budget cost} &= \$10{,}000 \\ \text{Actual cost} &= \$\ 7{,}000 \\ \text{Standard cost} &= \$\ 5{,}000 \end{aligned}$$

$$\text{Per cent saved of possible} = \frac{\text{budget cost} - \text{actual cost}}{\text{budget cost} - \text{std. cost}} \times 100$$

$$= \frac{\$10{,}000 - \$7{,}000}{\$10{,}000 - \$5{,}000} \times 100 = 60 \text{ per cent}$$

If the budget, for the same level and type of operations, is in the following period reduced by $1,000,

$$\text{Per cent saved of possible} = \frac{\$9{,}000 - \$7{,}000}{\$9{,}000 - \$5{,}000} \times 100 = 50 \text{ per cent}$$

(Variances have been exaggerated in this example for the sake of simplicity.)

Thus a reduction in budget, which may have been necessitated by various perfectly sound reasons, has resulted in savings diminishing from 60 to 50 per cent, even though the supervisor maintained exactly the same relationship between actual and standard costs. This may seem unjust until it is remembered that he is expected not only to approach standard but to stay within the budget and that in a dynamic business enterprise he cannot be guaranteed permanent incentive earnings merely for maintaining the *status quo; i.e.*, a budget revision has meaning only if supervisors are given a stimulus to meet it; otherwise the revision would be an empty gesture on paper, since the incentive plan would automatically saddle the company with the effects of a budget perhaps several years old. It should also be noted that each reduction of budget makes the denominator of the fraction smaller and thereby increases the percentage effect of one dollar of savings.

Of course, should it be desired to preserve the supervisors' incentive earnings despite budget revisions, the bonus point value can be readjusted so that in the preceding example a 50 per cent saving would pay the same number of bonus points as a 60 per cent saving formerly did. The policy is, however, unsound.

The chief advantages of budget incentive plans are

1. They stress the desirability of keeping within the budget as well as of approaching standard.
2. As long as budgets do not exceed past costs, they pay bonuses only for savings effected.
3. They provide a continuous incentive for achieving better costs.
4. They are psychologically salable because the bonus possibilities are readily apparent.
5. They are fair, because budget costs are set prior to operations, usually in conference with the supervisors affected.
6. New operations present no problem, since a budget would have to be established for them whether a plan were in effect or not.
7. They do not favor the man with high past costs, since the budget may well be set lower than past actuals.

Variance Plans

A modification of the simple percentage type of plan $\left(\text{per cent performance} = \dfrac{\text{std. cost}}{\text{actual cost}}\right)$ is the variance plan. It is readily described: the percentage criterion is based on the ratio between variance and standard cost, as follows:

$$\text{Variance per cent} = \frac{\text{variance}}{\text{std. cost}} \times 100$$
$$= \frac{\text{actual cost} - \text{std. cost}}{\text{std. cost}} \times 100$$

The per cent variance is tied in with earnings, by means of an inverse curve, in such a way that the maximum bonus points are earned at 0 per cent and no points are earned at some established maximum percentage based on past experience, say, 15 per cent. An example is shown in Fig. 22.

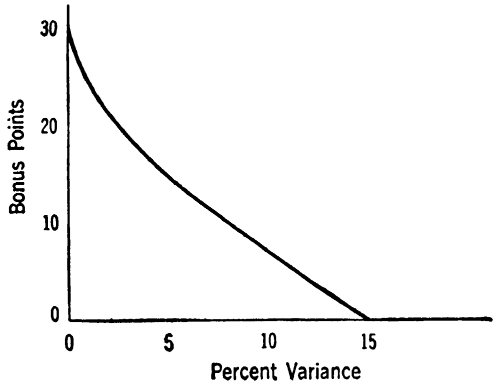


Fig. 22

Reading from right to left, the curve increases more sharply as the variance declines below 5 per cent, in order to provide more of an incentive to attain savings in the more difficult region.

This type of plan is most useful where budgets are not used and where it is desired to focus attention on reducing the variance between actual and standard rather than on beating past costs. It employs the two most significant totals from the cost-comparison sheet: the standard cost and the variance. The per cent variance, on which the bonus is based, is an expression of the degree by which actual costs exceed possibilities.

Capacity

Unless the question of capacity is considered, all the aforementioned plans can result in great inequities. Each of them is based on ratios that reflect the relationship between various costs:

actual, standard, base-period, budget. As they stand, any one of them could produce identical ratios at various levels of capacity. Thus, the first one described might under certain circumstances reveal the following figures in successive months:

Month	Actual cost	Standard cost	% performance
November....	$50,000	$40,000	80
December....	55,000	44,000	80
January......	45,000	36,000	80

In November the variance was $10,000; in December, $11,000; in January $9,000; but the per cent performance and hence the bonus are the same in each case. A similar occurrence can characterize any of the other plans.

The effects of this feature are several.

1. A dollar saved by the supervisor does not earn him the same amount of bonus at various capacity levels.

2. The supervisor is not paid any additional money for the fact that at high levels of operations his responsibilities increase.

3. A disproportionately large bonus may be earned at low levels of operation.

These effects are somewhat mitigated when standard costs are assumed to be completely variable. As explained before, such an assumption is founded on the hypothesis that any expense should at 25 per cent of normal operations be exactly one-fourth of what it is at 100 per cent operations. This theory is so difficult to follow in practice, desirable though it may be as an ideal, that per cent performance is almost bound to decrease at low operation levels, because of the underabsorption of fixed expenses. To put it another way, actual costs under this system usually tend to decline less rapidly than do standard costs as the number of p.s.h. diminishes, and therefore the supervisors' standard-cost performance appears less favorable at low levels. This tendency is illustrated in the graph on page 259.

Because of the tendency of certain costs (mostly indirect ones) to remain fixed or semifixed, the variance represented by the shaded area is larger at lower capacity levels. Accordingly, less bonus is likely to be earned at low levels, since it is more difficult to approach standard cost there. This compensating tendency occurs

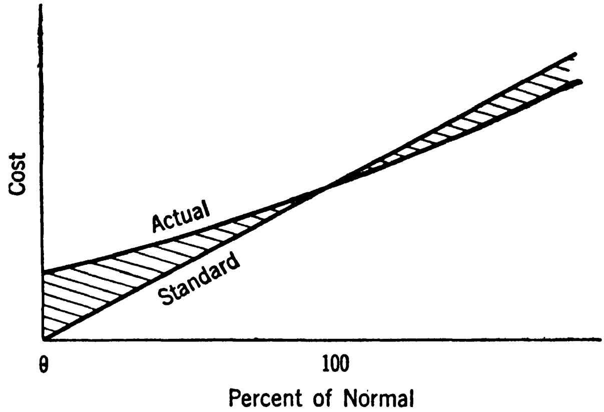


FIG. 23

only when standard costs are completely variable. It becomes less and less effective as the managerial goal of completely variable costs is more nearly realized.

On the other hand, at over 100 per cent levels, some costs which are really fixed are "overabsorbed," so that for these items actual cost may be less than standard. This makes a higher bonus more likely at these levels.

When the standards themselves recognize fixed and variable costs, however, these tendencies disappear, and another means must be found of compensating for the changes in supervisory responsibilities and burdens that accompany fluctuations in per cent capacity. One way is to set up a plan that pays bonuses merely in proportion to total standard dollars for the month. The earnings curve for such a plan is illustrated in Fig. 24.

This rather elementary plan pays off merely for additional standard dollars earned. It does not directly recognize actual expenditures (except to the extent that excess idle or wasted time precludes the earning of productive standard dollars) and is hence not too desirable. Yet it is simple and direct and encourages maximum production.

Alternatively, capacity variations are compensated for in a plan operating as follows:

1. Per cent capacity is determined as the ratio either of total actual to normal p.s.h. for the cost center or of total actual to normal standard dollars for the cost center.

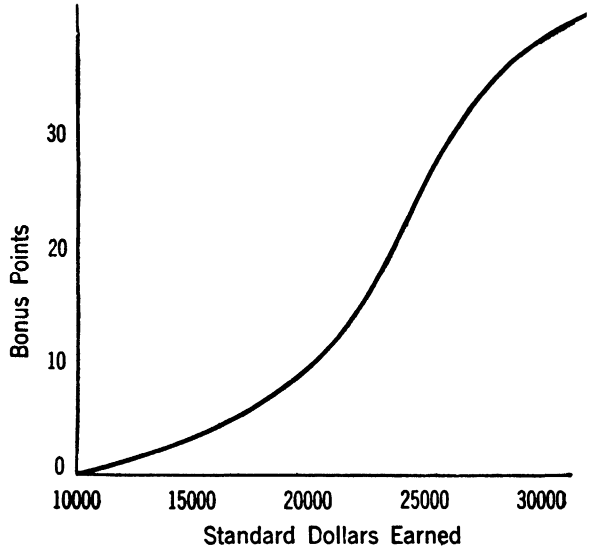


Fig. 24

2. From a graph the maximum possible bonus points for this level of capacity are determined.

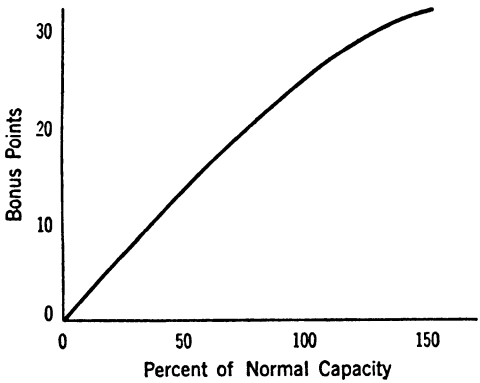


Fig. 25

3. Per cent performance (or per cent saved, or per cent variance) is then computed.

4. This percentage or a function of it is then multiplied by the maximum possible bonus points found in Step 2.

For example:

Normal p.s.h.	20,000
P.s.h. this month	17,000
Standard cost this month	\$ 90,000
Actual cost this month	\$100,000

$$\text{Per cent capacity} = \frac{17{,}000 \text{ p.s.h.}}{20{,}000 \text{ p.s.h.}} \times 100 = 85 \text{ per cent}$$

From the graph, maximum possible bonus points payable for this per cent capacity are found to be 25.

$$\text{Per cent performance} = \frac{\$90{,}000}{\$100{,}000} \times 100 = 90 \text{ per cent}$$

$$\text{Net bonus points actually paid} = 90 \text{ per cent} \times 25 = \underline{\underline{22.5}}$$

Administration of Incentive Plans

To be successful, supervisors' incentive plans must be intelligently administered; they can never function so automatically as do those plans for wage workers which are based solely on individual productivity—and for reasons that will soon be apparent. They must therefore be given a certain degree of personal attention in their operation if they are to pay off to the company.

Education.—When a new incentive plan has been drawn up, the supervisors involved are invited to attend a conference with its author, at which the plan is introduced to them. This schoolroom session is essential for explaining the relationship between costs and bonus earnings. In fact, it may extend into several meetings merely because the supervisors do not have an adequate picture of the costs of their departments. True, they know that they are supposed to reduce costs—but being always under pressure to get orders filled, they may think that economy is secondary to production. And moreover, although knowing that they should cut costs, they may not know just how to go about it. Tell a laborer to tear down a house, and he is bewildered; but tell him to rip the top row of shingles from the roof, and he knows just what to do. So the supervisors must be instructed as to just which costs they are expected to control and in what amount.

When standard-cost incentive plans are explained step by step to the men whom they cover, these men find them most interesting. A new mode of thought is opened up to them. They grasp the idea that just as they themselves would not want to pay more than five cents for a nickel cigar, so the company does not want to pay more than the standard cost for a given amount of production. They discover the importance of each item of expense; they see that time wasted on unnecessary maintenance work, for example, is just as harmful to profits as time wasted on spoiled work. They ask questions about the development of the standards. With some of the development they are familiar, for they have been previously consulted on it. Some of it they may feel is incorrect; and if the objection is valid, the standard is revised to accuracy, or else it is explained to their satisfaction. They are shown an application of the standards to past production; ways of reducing actual costs are pointed out to them; and they have suggestions of their own to make.

When the general functioning of standard costs has been explained and the details of the particular supervisors' costs have been explored, the bonus plan is outlined. In this, of course, the supervisors are most interested, for it offers them a potentially better scale of living. The explanation covers the earnings formula and the cost statements from which its figures are derived, and is illustrated with sample calculations, which the supervisors learn to make for themselves.

Throughout this educational program care is taken to define such words as "variance," "controllable expense," "fixed and variable expense," "standard costs," "prorated expense," "indirect expense," and other esoteric terms which, familar to the cost accountant, are perhaps vaguely identified in the mind of the shopman. In doing this the accountant remembers that he is dealing with men whose intelligence has placed them above their fellows, whose minds are quite capable of adding to their present lore of technical production knowledge the simple facts of cost work presented clearly. He therefore is neither condescending nor apologetic. Those concepts which are new he defines; those points which are misunderstood he clarifies; those standards which are rightly questioned he verifies and revises; those standards which are unjustly assailed he defends with logical explanations.

Conducted rightly, these conferences satisfy each supervisor that standard costs provide him with a useful tool for fulfilling his obligations to the company while at the same time increasing his own pay. At their conclusion he is told of the necessity of reporting any changes in his cost center that necessitate a revision of the standards. He is also told that daily cost sheets will be issued for any items on which large variances occur. And he is invited to drop into the office at the end of the month to observe the calculation of his bonus, so that he can immediately learn the effects of his accomplishments. This is the prelude to the functioning of a successful bonus plan.

What Costs to Include.—One of the greatest problems in administering the plan is that of which costs to include. This really devolves into a question of what is controllable, and its answer is of considerable importance to the operation of the plan. A supervisor who feels that he is being charged in his plan with costs for which he is not responsible soon becomes discouraged, whereas on the other hand, the unwarranted deletion of some cost items relieves the company of possibilities for reducing them. Where possible, rules should be predetermined as to omissions or inclusions of costs. For example, a supervisor may declare that he does not have full supervision over maintenance work in his department and for this reason may request its omission from his incentive plan. Yet he does, by not allowing his equipment to be abused, exercise a partial control of maintenance costs; it is a responsibility jointly shared with the maintenance supervisor. Hence a rule may be set in advance that for incentive-plan purposes only 50 per cent of the maintenance costs will be included, since he is only 50 per cent responsible for them. A solution of this sort is only arbitrary, but it does recognize the justness of the complaint and provides a consistent method of handling it.

Another problem arises in the case of the sudden large expenditures, necessitated perhaps by the breakdown or overhauling of some piece of equipment, that wipe out all bonus possibilities for the month. As suggested before, the existence of a reserve account whereby such costs can be distributed over several months alleviates this difficulty. To delete such expenses altogether from the plan on the ground that they are abnormal is not fair, for they frequently result in reduced maintenance charges in subsequent months, from which the supervisor benefits.

On the other hand, some expenses are legitimately deductible, simply because no plan can adequately provide for them. For example, consider the cost of breaking in or learning to operate a new piece of equipment. In the first place, it may not be possible to set standards for the regular operation of the equipment until it has been observed under normal conditions. Secondly, to set a standard on the breaking-in period might encourage the inept use of the equipment in an effort to get a loose standard. And finally, the foreman should have a chance to get used to the new operation before it is added to his costs. For these reasons the actual cost is removed from incentive-plan calculations for a reasonable period of time.

Many of these questions of which costs may rightly be excluded are decided currently by the administrator of the plans. Because his decisions affect bonus earnings, he is often under great pressure to make rulings favorable to the supervisor but unfair to the company. Accordingly, he can best protect himself by formulating in advance, insofar as possible, rules by which he will be guided under the more common foreseeable circumstances. In this way he can prevent any accusations of partiality or discrimination.

Revisions and Improvements.—Revision of standard costs and hence of the data in supervisors' incentive plans occurs when

1. Existing standards are found to be incorrectly set.

2. Materials or labor prices change to such an extent that the standard prices are no longer indicative of what actual prices should be.

3. New operations or processes are added. Standard costs are provided for these new items as soon as they can be determined. If the standards have been set on the fixed-and-variable expense theory, fixed expenses are reexamined to see if they must be redistributed to comprehend the new operation, with a resulting change in standard product costs if not in the cost-comparison sheet.

4. Improvements are made in existing processes. Existence of supervisors' incentive plans demands special consideration of this revision. From an accounting standpoint, of course, the standards should be revised as soon as possible, just as under item 3 above, so that they will be in line with the facts. From an incentive-plan standpoint this procedure may work an injustice. Suppose that a foreman devises a new method of stenciling crates which reduces labor requirements by 50 per cent. The standard hours allowed for the job are immediately revised to agree with the new method. Perhaps also the cost per standard hour is re-

vised to reflect changed requirements of the new method. In fact it is quite possible that if the old rates were known to be loose, the new ones are set exactly. So the foreman finds that his suggestion has actually resulted in his being on the same or even perhaps a worse level of bonus possibility. As he reduced his actual costs, the standard costs followed right along. Therefore, why make improvements?

Two methods of rewarding for improvements while maintaining the integrity of the standards are possible.

a. The new standards are installed immediately, for accounting purposes. But the old standards are retained in the incentive-plan calculations for a set period—three months to a year, say—during which time the supervisor receives the benefit of his savings. This system has the disadvantages of requiring special memorandum standard costs for bonus purposes and of introducing multiple bonus calculations when several supervisors, only one of whom has suggested an improvement, are paid from the same plan.

b. A percentage of the estimated annual savings in standard costs is paid out as a flat sum at the time when the improvement is made. This method has the advantages of being simple, of offering an immediate reward, and of continuing the use of accurate standards as a constant target to shoot at. It should be noted that the saving is calculated in terms of *standard* costs rather than actual, since to figure it in actual costs might have the effect of paying the supervisor money for being inefficient in meeting the past standard; *i.e.*, the company should pay suggestions awards only on the basis of potential savings in standard cost because savings between actual and standard are already covered by the incentive plan.

Also to be remembered is the fact that no separate award is made for improvements in cost practice that are not accompanied by a change in standard. Economies made with existing methods and materials are compensated for under the incentive plan, and supervisors are expected to make what improvements are necessary in order to earn bonus by approaching standard.

Written Procedure.—All the problems of incentive-plan administration are greatly diminished by the preparation of a manual of procedure. Such a manual describes the purposes of the standard-cost system, defines its terminology, lists (optionally) the chart of accounts, explains the incentive-plan calculations with examples, and states all policies with regard to cost deletions, revisions, improvements awards, and other administrative questions. It is an aid to supervisors in becoming acquainted with the system; it is a source of reference for handling new cases; it is a textbook for new standard-cost employees; and it is a written guarantee of fairness and impartiality in all incentive-plan dealings.

Exhibits

Previous chapters have mentioned the use of various statements of variances, efficiency, and cost practice as a guide to supervisors. These statements carry most weight when they are tied in with an incentive system, for it is then that the supervisor wishes to learn most about his cost in order to earn more bonus. The bonus calculation can, in fact, be exhibited as an integral part of the variance statement, or cost-comparison sheet, as shown in the following example:

COST-COMPARISON SHEET

Cost Center No. 104 Date July 31, 19__

Total p.s.h. 4,000

Account		Total cost		Var.	% var.	Last month % var.
No.	Description	Std.	Actual			
1000	Direct Labor	$4,100	$4,400	$300	7.3	7.0
1001	Producers' Indirect Labor	330	470	140	42.4	35.2
1002	Other Indirect Labor	770	860	90	11.7	12.1
1005	Direct Material	1,500	1,800	300	20.0	15.6
1006	Indirect Material	410	455	45	11.0	11.7
1007	Service Labor	530	610	80	15.1	17.2
1008	Service Material	130	155	25	19.2	22.4
1009	Utilities	380	395	15	3.9	3.8
Total controllable............		$8,150	$9,145	$995	12.2	11.0

Normal standard cost..................	$9,500
Per cent capacity......................	$\frac{\$8,150}{\$9,500} \times 100 = 85.8\%$
Maximum bonus points for 85.8% capacity	19.2
Per cent performance....................	$(\$8,150 \div \$9,145) \times 100 = 89.1\%$
Net bonus points earned................	$89.1\% \times 19.2 = \underline{\underline{17.1}}$

This example illustrates the combining of a variance sheet with an incentive-plan earnings calculation in which capacity is expressed in terms of standard dollars earned (because the dissimilarity of operations covered makes a summary of total p.s.h. earned meaningless) and bonus points depend on both capacity and performance. Bonus points for the level of capacity achieved are obtained from the procedure manual. The summary sheet shown is supplemented by other exhibits which show a finer breakdown of costs.

In preparing all exhibits, certain points are borne in mind.

1. Supervisors have too many demands on their energies to be able to devote time to deciphering cost charts. Exhibits should therefore avoid code letters, complex ratios, intercolumnar computations, abbreviations, and other devices that require interpretation.

2. Large sheets carrying numerous columns of figures are apt to be tossed aside unread, not only because they are hard on the eyes but also because figures, when massed together, lose their individual significance for the average reader. It is better to break the data down to individual sheets. Separate variance sheets for each operation, for example, are easier to follow than one large distributive columnar sheet on which all operation costs are listed. "The more people take an active interest in costs the more important is the need for simplicity." [1]

3. Exhibits that are faint, illegible, sloppy, or cheap looking can never command attention or respect. A little window dressing in merchandising the company's ideas to its employees is just as important as good salesmanship in disposing of its product.

4. Exhibits should be issued promptly. A cost report that comes out on the fifteenth of the month following that to which it applies is hopelessly out of date. People are too busy with today's problems to worry about the snows of yesteryear. The best reports are those which appear the morning after the day they cover, provided they can be quickly read and digested. Those which appear immediately after the close of the month are next best.

In addition to the formal cost statements it is a good idea for the standard-cost accountant to send a monthly letter to each supervisor, pointing out some of the major variances and suggesting means of reducing them. To this the supervisor should reply

[1] Gardner, Fred V., "Variable Budget Control," p. 116, McGraw-Hill Book Company, Inc., New York, 1940.

with a statement of the steps that he is taking to reduce these variances.

QUESTIONS

1. Describe a method of expressing incentive earnings in other than cash values.

2. Given:

Bonus = (per cent performance − 80 per cent) × salary

Standard cost for a given month = $25,000
Actual cost for the same month = $27,500

What is the bonus earned if the salary is $285? If you had been given the job of setting up the bonus formula above, how would you have arrived at the subtractive figure of 80 per cent shown? What is the effect of this figure in the formula?

3. What reasons might be advanced for not having bonus earnings directly proportional to performance, *i.e.*, for not having a straight-line relationship between bonus and performance?

4. What are the arguments for and against paying bonuses based on some measure of savings effected from past costs?

5. Given the following data for a cost center having only one operation:

	Fixed cost	Variable cost per p.s.h.
Base period........	$1,100	$1.98
Standard..........	900	1.76

P.s.h. earned this month................	8,000
Total actual cost this month............	$15,500

Calculate the per cent savings, using the formula on page 253.

6. Why should an incentive plan recognize the level of operations as well as the per cent cost performance, per cent cost savings, or other purely cost indexes?

7. What is the advantage of having a written procedure for incentive-plan administration?

8. A supervisor says: "I notice that my monthly cost-comparison sheet, from which my bonus is figured, carries three or four accounts each of which runs into several thousand dollars. Then there are six or seven accounts each of which contains only a few hundred dollars. Why don't you base my bonus on the large accounts only? Fussing around with those little items is just nickel-chasing. If we ignored them, you'd save a lot of time in getting up your statements, and I could concentrate on the few accounts that really have big money in them. Same way with your costs per p.s.h. Some of them are only a fraction of a cent. Why don't you forget about that little bit of money?" Comment on his statement. Is a dollar saved in a $1,000 account any more important than a dollar saved in a $100 account?

CHAPTER XIX

MISCELLANEOUS FEATURES

So far we have examined the major functions of the managerial device known as "standard costs." We have seen how standards are developed and have discussed how they are associated with a system of actual costs in such a way as to reveal inefficiencies through variances. That standard costs can be utilized to reduce existing clerical work has been pointed out, and their application to supervisors' incentive plans has been examined. A few miscellaneous features of the subject remain.

Job Evaluation

Apparently the contribution that standard costs can make to job evaluation has received little attention. Systems of evaluating wage jobs have long been used successfully. The evaluation of salaried jobs, although perhaps less firmly established, has also been carried out with some success, usually by large organizations. But the methods that characterize wage-rate evaluation frequently fall short of the requirements for salary evaluation, and the substitutes that have been devised for handling salaried jobs, workable though they may be, are frequently complex and unscientific. The possibility that standard costs can surmount these difficulties therefore deserves consideration. The method is not applicable to all salaried jobs but does have a utility when applied to those of operating supervisors.

Wage jobs are usually classified according to a point system. First, a list is prepared of the variable features that affect the worth of all jobs being surveyed. The list includes such items as

Education.
Experience.
Physical ability.
Dexterity.
Mental requirements.

Safety hazards.
Cost of possible damage to materials or equipment.
Environment.
Supervision received.

To each item is assigned a maximum point value in proportion to its importance relative to the other items. This point value is then defined, and for each job it is scaled down in proportion to the degree of that item required. For example, if the maximum educational requirement for any hourly job in the plant is 4 years of high school, and if 15 points have been assigned to this item, a job requiring 2 years of high school might be given 12 points, and one requiring only a grammar-school education might be given 9 points. Each job is classified on the basis of total point values arrived at by determining how many points are allowable for each of the variable features.

This system, once established, is easily applied. For practically all factory jobs an objective study of the job characteristics is possible. The features characterizing all jobs can be clearly defined. The amount of any one characteristic required for a given job can be ascertained with some exactness. And modern industrial emphasis on job standardization and simplification makes it easy to adhere to the rule of evaluating the job, not the man. Assigning fixed money values to point ratings is merely a matter of correlating the points with existing rates of pay for those jobs which are considered to be neither over- nor underpaid and extending the dollar-per-point value thus obtained to other jobs.

But the evaluation of salaried positions is not quite so simple. It is less easy to select those features which, cutting across all the jobs being considered, adequately describe the requirements. Because the jobs are primarily mental, such items as physical ability, dexterity, safety hazards, and environment have little bearing. Those qualities which are important are more difficult to select than for wage jobs because they tend to overlap. For example, on a salary job, we might consider the number of employees supervised as one of the functions on which the salary should depend. But then there is the question of the caliber of the employees. How many points should be assigned to the supervision of a large number of laborers as compared with the supervision of a smaller number of toolmakers? Or as compared with the supervision of an equally large number of typists? Some of the variable characteristics of a supervisory job are

Number of employees supervised.
Caliber of employees supervised.
Value of materials handled.
Degree of precision required in work supervised.
Amount of planning necessary.
Education.
Experience.
Personal contacts made with other supervisors or outside representatives.
Degree of supervision received.
Amount of assistance received from staff departments.
Personality and appearance.
Complexity and conflict.

Other requirements will occur to the reader, but an examination of these serves to reveal the way in which they encroach on each other, and it is obvious that to evaluate quantitatively an important but intangible element like complexity is a dubious undertaking.

Indeed, these problems of evaluation are so great that rather than face the niceties of distinction and limitation that they present, some authorities have sidestepped them altogether by employing a system of classifying jobs with relation to each other rather than by point values. The method here is first to prepare complete descriptions of all jobs. Certain positions are then selected, at various salary levels, that are believed to be just correctly paid. A committee of executives then examines each other occupation and on the basis of the factors covered by the job description assigns it to what is believed to be its proper place in the ranking of "bench-mark" jobs. The system is thus one of classifying jobs by comparison with bench-mark jobs rather than by independent evaluation. It requires a great deal of the time of the top management officials who must do the work.

Whether salary jobs are rated by points or by comparison, it is always difficult to evaluate jobs as distinguished from the men who fill them. Each individual merges his personality with a supervisory job to such an extent that the question of determining the boundaries of the job itself becomes academic.. Hence what is thought to be an objective evaluation of the position must frequently be revised when a new man takes over.

To solve these dilemmas we must view the question of supervisory compensation from a different angle. It has been mentioned before that in a business establishment, dollars are the universal measuring stick of supervisory performance, transcending all other indexes like scrap percentages, efficiency ratios, lost-time ratios, etc. So it is here. For what are we paying a supervisor—for directing a large number of subordinates, for having gone 4 years to college, or for handling more paper work than his colleague in the adjoining department? No, we are paying him for the authority and responsibility required to control a portion of the company's money in the form of wages, materials, and manufacturing expense. Therefore the evaluation system should utilize this one factor of control.

Controllable dollars as the measure of an operating supervisory job is well-nigh all-inclusive. It evaluates the effect of all the other variable job characteristics previously listed. The supervisor who has the most subordinates of the highest caliber, who handles the most high-value materials subject to spoilage or loss, who supervises the most expensive equipment, is the one who has the most controllable dollars in his department and hence deserves the highest salary. Conversely, education, experience, technical aptitudes, personality, and appearance are valuable in an operating supervisor only to the extent that they are needed to control costs. For example, the supervision of a battery of open-hearth furnaces producing alloy steel requires a high degree of technical knowledge, in addition to other obvious qualifications. But this technical knowledge justifies a high salary only because it is employed in turning out large quantities of high-value materials. An equal amount of technical knowledge might be very helpful to the foreman of the pie department in a bakery, but it would not in itself command a high salary, because it is not used to control so large a dollar volume of expenses.

To arrive at a salary scale for the supervisors of operating departments it is necessary first to list the jobs in accordance with the normal controllable standard dollars of each. When the actual present salaries are plotted against these dollars the degree of correlation, if any, presented by the existing salary scale is readily seen. A curve is then drawn through the salaries that are considered equitable, and the classified salary for any other job is determined by reading the curve value at the point above the controllable standard dollars for that job. An example is shown.

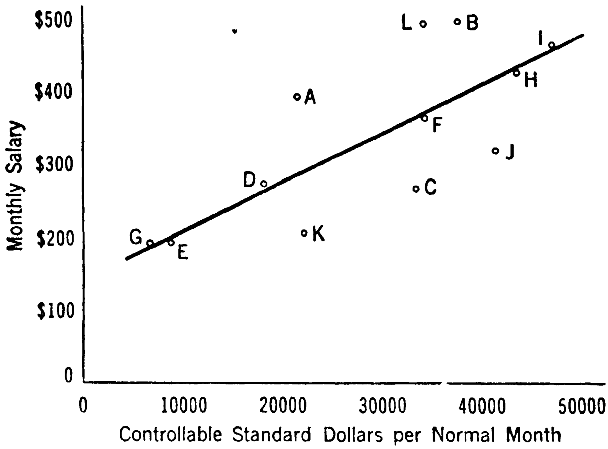


FIG. 26

Steps connected with this graph were as follows:

1. A point was marked on the graph for each job in accordance with its present salary and controllable dollars.

2. Jobs *A*, *D*, *E*, *F*, *G*, *H*, and *I*, it was decided, were already equitably paid. Examination revealed that all of these jobs except *A* could be approximately connected by a line. It was therefore concluded that the original opinion of job *A* was erroneous. A line was drawn that approximately connected *D*, *E*, *F*, *G*, *H*, and *I*. This line is the salary curve.

3. Jobs *A*, *L*, and *B* are now seen to be overpaid with respect to others. The present incumbents will continue to receive their salary, in order to avoid the ill will and injustice of a pay cut, but any new persons going on those jobs will be paid the salary indicated by the graph.

4. Jobs *K*, *C*, and *J* are underpaid with respect to the others. Their incumbents should receive an increase to bring them in line.

5. If the responsibilities of any job change so that the controllable dollar value changes, then the salary will be adjusted immediately.

Several features of this system deserve attention.

1. In the long run there should be no increase or decrease in

total salaries, barring changes in normal standard manufacturing costs, for the only purpose of the whole system is to achieve an equitable salary scale, not to attempt to save money by reducing salaries.

2. Only standard costs can be used for this system. To use actual costs would result in paying higher salaries to the more inefficient supervisors.

3. Salaries are based on controllable standard dollars for the *normal* month. If the volume of business exceeds normal, supervisors are compensated through the capacity feature of a bonus plan.

4. This system still fails to allow for such an intangible as complexity. Thus, of two supervisors having equal controllable standard dollars, one might operate a department in which all operations are the same while the other directs a variety of different operations and hence has a more difficult job. This is a fault in the system. However, it occurs in any system, since there is no way of measuring a factor of this sort.

5. Establishing for each position on the curve not one salary but, say, three, separated from each other by 10 per cent of the curve salary is a convenient device. A supervisor new on the job can then be paid 10 per cent less than the curve salary, receiving an increase after he has proved himself, and an additional increment of 10 per cent can be granted after a further period of satisfactory service.

On the whole, salary evaluation by means of standard costs has the disadvantage of not recognizing *every* factor, but it has the advantages of recognizing a majority of important factors and of being simple, easily understood, and fair.

Cost Estimating

The existence of standard costs greatly simplifies estimating the cost of new orders. This simplification occurs not so much because of any inherent merit in the concept of standards but rather because of the orderly classification of costs that goes with the system. Given these predetermined operational costs, it is necessary only to estimate the time required for a new product in order to determine its cost. The procedure, then, is as follows:

1. The operations required on the new product are listed. Examination of blueprints or models, coupled with a comparison with

existing similar products, provides this information. The list is, of course, checked with various members of the organization—the industrial engineer, the project engineer, the production manager, and the shop foremen—to be sure that it is at once complete and representative of the most efficient manufacturing processes that are available in the plant.

2. For each operation listed, an estimate is made of the p.s.h. needed for its accomplishment. This is really a prediction of the incentive standard which will later be placed on the work by the time-study man. On those portions of the work which are identical to some now being performed on similar products, the existing production standard is used intact. On those which are different, the time-study man visualizes each operational element that will occur and estimates a standard time for it. Suppose, for example, that the new product includes a small casting on which a stem must be turned and threaded. The time-study man, resorting to his accumulated tables and formulas of standard data or of previous standards, estimates the following times:

Pick up piece and grip in pneumatic chuck	0.04
Start machine	0.02
Turn outside diameter	0.06
Expanding die-¼ in.-24	0.06
Stop machine	0.03
Remove piece and set aside	0.02
Total minutes	0.23
Plus 25% allowances	0.29

$$\text{Std. hr. per 100 pieces} = \frac{0.29}{60} \times 100 = 0.483$$

For this part of the work, then, an estimated standard time of 0.00483 standard hours per piece is used. When the job is actually put into production, slight changes and refinements suggested by actual performance may result in the time being somewhat different; but if care is used in estimating, the change should be small.

3. The standard hours per piece on each operation are multiplied by the number of pieces in the estimate to obtain total p.s.h.

4. The cumulated p.s.h. on each operation are then multiplied by the established standard cost per p.s.h. The summation of these multiplications is the total standard cost. Because of the manner in which standard costs per p.s.h. are built up, this total includes an allowance for setups, unavoidable delays, etc.

5. The total standard cost (or the standard cost by elements of expense) is then multiplied by the current ratio of actual to standard to obtain an expected actual cost of the order.

An alternative procedure, when the new product is closely similar to an existing one, is to start with the standard product cost of the present item and modify it only to the extent of the standard cost of the expected differences in standard time from existing times. The result is then corrected to actual cost by means of the ratio. Materials costs are handled in a similar way, the standard cost being corrected by the ratio of actual to standard prices and quantities that have obtained in recent periods.

This procedure can, of course, be followed without the use of standard costs, if actual operational costs are available. They seldom are, however, available with any great accuracy until the installation of standard costs necessitates a thoroughgoing analysis of the details of each operation.

Another circumstance that demands the use of estimates is the proposed revamping of existing operations or installation of new ones. Then a comparison is usually required of the costs of the present and proposed procedures in order to ascertain whether or not the change would be economical. Available data on present standard costs of each item of expense on existing operations are in these cases usually a valuable guide to the standard cost after the change.

When a revision of methods is being considered, the estimated savings are based on a comparison of standard, not actual, costs, for it is the ultimate potential savings that determine the advisability of the change. Moreover, a comparison of standards sometimes reveals that whereas a saving in standard costs can be realized by new methods, an equal saving can be obtained by reducing the variance between the actual and standard cost of the present methods. Too often money and time are expended on new installations that could be bette rdevoted to achieving maximum efficiency with available ones. And this mistake is made because of a lack of knowledge or appreciation of those wastes which can be revealed only by variance analysis.

Thus it is that standard costs provide a convenient mechanism for estimating costs of new products and a revealing clue to the advisability of changes in manufacturing procedures.

Selling Prices

Attempting to extract every possible drop of virtue out of standard costs, some accountants suggest that they can be used for establishing selling prices. In fact they advance the danger of setting a selling price on the basis of an unattained standard as an outstanding reason for the use of standards representative of past actual costs.

There is no reason why selling prices should be based on standard product costs. The standard cost is a statement of what *should* be spent in making an article. It is not even an absolute truth in this respect but merely the most accurate guess that can be made. Actual costs may be far out of line with it, and it is in the margin of sales over actual, not standard, costs that profits lie. Any firm venturing upon the folly of relating selling prices to standard costs might soon find that those prices are below actual cost and that a loss is incurred because of failure to recognize the fact that the standards have not yet been attained.

Furthermore, it is questionable whether or not prices can rightly be based on costs at all. We may find that the decisions of our competitor's sales manager have more effect on prices than do our own. Perhaps market supply determines our prices. Or again, the price may be determined by the utility of the product to the consumer, by what the market will bear, by what customers are willing to pay. In any of these cases, what influence do costs of production have? Unless we monopolize the market, which is not likely, who is willing to pay more for our product merely because it costs us more to produce it? We are indeed fortunate if we can price our goods at a figure whose relationship to costs is determined at our own discretion.

Nevertheless, regardless of how prices are set, it is still essential to know whether certain products are profitable or not. Perhaps the unprofitable ones should be expunged from the catalogue, provided, of course, that they are not required in order to support the sales volume of other more profitable items. So the question arises, What is this product cost, by comparing which with the selling price we may learn the margin of profit? Some authorities assert that the true cost of any product is its standard cost, all other costs in excess of this being a waste that should be attributed to poor management rather than to the necessities of production.

The excess costs can even be divided into those which are due to subcapacity operations and those which are due to manufacturing inefficiency. These are very interesting speculations, and they are based on sound theory, but they do not really give us useful information on product profit margins. Suppose, for example, that the selling prices and standard costs of four products are

Product	*A*	*B*	*C*	*D*
Selling price............	$1.00	$1.50	$0.80	$2.00
Standard cost...........	0.45	0.55	0.60	0.75

Which items are unprofitable? We do not know, for we are not dealing with comparables. Whether or not the standard costs are true costs, the fact remains that they do not represent all the expenses that must be covered by the selling price. Perhaps it would be better to substitute actual costs for standard. The table then might appear as follows:

Product	*A*	*B*	*C*	*D*
Selling price............	$1.00	$1.50	$0.80	$2.00
Actual cost.............	0.80	1.00	0.85	1.60

Now it appears that Item *C* is being sold at a loss. Exponents of "true costs" will point out, however, that the actuals shown may vary from period to period, depending upon how much fixed expenses they must absorb because of capacity fluctuations, to say nothing of the month-to-month deviations from average efficiency in working on particular orders. Therefore they cannot be used for valid comparison.

So far, then, it appears that neither standard costs nor actual costs for particular periods should be used in ascertaining the profitableness of individual products. The former are too theoretical; the latter are too uncertain. The best solution seems to be to use standard costs that have been corrected by the actual-to-standard ratio obtaining during a recent period of approximately normal activity. This procedure has the following advantages:

1. The standard product costs reflect a fair relationship among various products compared one with another.

2. The correction to actual cost, being based on over-all totals,

will average out in balance for all products. It is valid as long as no large variances occur on particular products, and this is not likely to occur if incentive standards are set correctly.

3. The cost can be revised as the actual-to-standard ratio changes from time to time. A realistic policy demands that current data be used, whether or not they are palatable. If times are hard and volume is low, it is desirable to know how much excess cost is due to subcapacity operations. But it is also desirable to know which products yield the greatest profit at this given time and which the least, bearing as they must the burden of fixed charges; for knowing what the margin would be under normal conditions is of little help when troubles arise.

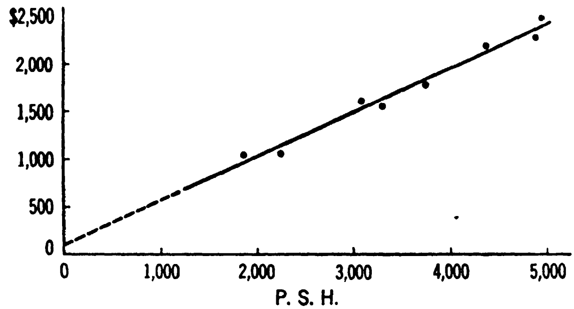
4. Constructed as it is, the standard product cost can be analyzed to find out what portions of it have their origin in fixed expenses, in case consideration is to be given to pricing for the sake of recovering only the variable cost.

To summarize, standard costs, considered in conjunction with current variance ratios, supply a technique for diagnosing the effects of pricing policies but are not in themselves the basis for prices.

Short Cuts

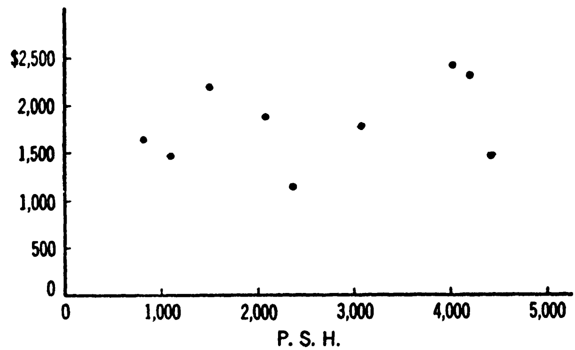
In earlier sections of this book it has been recommended that standard costs be based, wherever possible, on engineering studies. Such studies are particularly applicable to expenses like direct labor, indirect labor, direct materials, and fuel and power. In some plants they can be extended to maintenance or service labor. Less frequently they can also include operating supplies and maintenance materials. However, there are occasions when lack of money, time, or technical assistance makes it impossible to engineer any of the standard costs; yet some sort of standard-cost system may still be desired and may still be better than none at all. In such cases short-cut methods of setting standards must be employed.

Probably the most obvious of these methods is to level past costs. This is done by determining for each account the past actual cost per p.s.h. (or per whatever other denominator or cost determinant is used) and then reducing this by an arbitrary percentage to arrive at the standard cost. Although not a real standard, the figure thus obtained may pass for one and if handled reasonably may have the same psychological effect in a cost-reduction program. The only problem that the method presents is that of selecting the past actual costs to be leveled. A graphical solution is sometimes suggested. For a given expense account the monthly totals are plotted against p.s.h., a line is drawn through the points thus obtained, and the resulting curve is formularized to express the cost as a function of p.s.h. An example of such a graph is shown.



The above graph indicates that there is a fixed cost of $130 and a variable cost of $0.45 per p.s.h. Standard might be set at some percentage of these values.

Unfortunately, the solution is not always so simple. Not infrequently a plotting of past actuals reveals a pattern as shown below.



Here there is no clear trend to indicate a fixed past relationship between costs and productive output. The graph merely demonstrates the fact that past actual costs have not been closely controlled, a condition that may in itself have been responsible for management's desire to install standard costs. As to the reasons for particular deviations from any hoped-for trend, it may have been that when there was a drop in productive output, certain expenses that should have been reduced tended to remain fixed; it may have been that at times increases in p.s.h. were obtained by sudden spurts in efficiency, without a completely corresponding jump in costs; it may have been that charges did not always get into the month in which they belonged; perhaps, as might happen with maintenance, expenses were suppressed by neglect in one month only to be matched by unusually high figures in a subsequent period. An investigation must therefore be made into the operating conditions that prevailed during the span covered by the data, so that there will be a rational basis for selecting the actual cost from which the standard is to be derived. According to the results of his study, the standard-cost accountant may then decide to select for leveling an actual cost per p.s.h. based on anything from simple averages to the method of least squares, or he may select the median, modal, or most frequently recurring low unit costs.

Additional time can sometimes be saved, both in the development and application of standard costs, through the use of cost-center, rather than operational, p.s.h. rates. Consider, for example, a cost center in which there are three operations, each producing 1,000 p.s.h. per normal month and having the following standard costs for direct labor:

Operation	Per P.S.H.
1	$1.10
2	1.11
3	1.12

As long as the output from the three operations remains in the same relative proportions, there is no reason why a single average rate of $1.11 cannot be applied to total p.s.h. earned in any month. The difference between the individual standard-cost rates by operations and the average is too slight to justify a distinction. Employing the same procedure on other expenses further reduces the clerical work required for computing standard costs for particular periods. This method is most useful when

1. Engineering studies have shown that the standard cost per

p.s.h. for a given account is approximately the same on all operations.

2. Standards are being based on past actuals that are not broken down by operation. For example, records may be available showing past actual maintenance charges to the cost center but not to specific operations within the cost center. The standard would then be derived by dividing total p.s.h. into total dollars and leveling the result. This approach is valid only when preliminary inspection indicates that the cost per p.s.h. should, in fact, be approximately the same on the various operations.

3. The proportionate relationship between output on the respective operations does not change greatly from month to month, even though the total rises or falls.

It should be noted that using the same standard cost per p.s.h. for all operations within a cost center precludes the accurate assigning of variances to particular operations. (Of course, the assigning cannot be made in any case unless *actual* costs are collected by operations.) It may also be observed that this use of average rates is a throwback to customary historical cost accounting, where a cost center is sometimes defined as a group of related activities having a common burden rate.

QUESTIONS

1. What are the advantages of using a planned system for setting supervisory salaries?

2. In a plant producing metal stampings the supervisor of the toolroom is responsible not only for fabricating punches and dies but also for keeping them in good condition so that the finished product will meet specifications. How would you recognize this factor in setting up his standard costs for use in salary evaluation?

3. The actual cost of the bulk materials flowing through a certain cost center amounts to many thousands of dollars a month. However, the actual losses of this material that are likely to occur and that the supervisor can control are only a few hundred dollars a month. If you were going to evaluate salaries on the basis of normal standard dollars, which would you use for this item: the total standard cost of materials or the standard cost of losses? Why?

4. In discussing job evaluation, a managerial handbook mentions a particular installation that paid for itself by effecting large annual savings in the general level of pay. This was done by establishing a wage curve and reducing all rates of pay that were above the curve while increasing those below the curve. Total decreases exceeded total increases. Would you advocate such a procedure? State the reason for your answer. What is the true purpose of a wage- or salary-evaluation system?

5. A jobbing plant making large castings and forgings to customers' specifications seldom runs the same job twice. Would the fact that the product is constantly changing minimize the possibility of employing standard costs for control purposes? Why? Would standard costs be of any value for estimating? Discuss.

6. In estimating the savings to be effected by possible revisions of methods or equipment, why is it better to base the calculations on standard, rather than on actual, costs? Should the question of whether or not it will be easier to approach standard cost with the new method than with the existing one be considered?

7. What is the danger of basing selling prices on standard costs alone?

8. Can the standard cost of any product be determined without giving consideration to all other products to be manufactured in conjunction with it? Why?

9. A sales manager, wishing to find what minimum price he can set on certain products at various levels of operations, requests the following information:

The variable standard cost of each product.

The fixed expenses at various levels.

The ratio of actual to standard for the first two items.

How would you expect him to use these data?

10. How would elementary courses in cost accounting be of value to a design engineer? To an industrial engineer? To an operating superintendent? Do you think that it would be helpful for a cost accountant to take elementary courses in such subjects as time study, production control, applied chemistry, machine tools, or power plants? State the reason for your answer.

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