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Application of Machines to Industrial Cost Accounting

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the National Association of Accountants — November 1957*

PART II — PREPARATION OF THE SYSTEM

We are today on the verge of an industrial cost accounting revolution. Cost accounting is one of the last frontiers of mechanization but technological changes and rising clerical costs will force us to overcome the complex problems facing us in this area and eliminate much of the drudgery in our present cost accounting work. For many companies this breakthrough may not come this year or the next, but for most companies it will surely come within the next decade. For some companies this has already come; we know of one company that has recently programmed its entire cost accounting operations on a magnetic drum data-processing machine, and we know others that perform all or part of their cost accounting work with tabulating equipment.

We can safely say, however, that we are still trail-blazing in this area of cost accounting mechanization and that much more remains to be done than has been done. Most companies, regardless of size, must perform a minimum amount of cost accounting; to them mechanization offers the promise of relief from the continuous reprocessing of production and cost data so commonly found in our cost accounting work. A little over a year ago the NACA surveyed a number of the larger companies to find out for what cost accounting purposes these companies were now using tabulating equipment. From the results of that survey it appeared that not more than half of the larger companies were using tabulating equipment for cost accounting.

While it is true that cost accounting is one of the more complex accounting problems, it is, nevertheless, ideally adapted to the principles by which tabulating machines operate. Most standard cost accounting systems are based on the principle of collecting costs by operation and translating them into product costs, and this is a natural application for the use of tabulating equipment. There have been limitations, in terms of speed and capacity in being able to prepare reports for management in sufficient time for them to be of any use, but as more advanced equipment comes on the market this becomes less and less of a limitation. There have also been limitations due to the size of jobs and to the present low cost of manual operation. Sometimes jobs are too small to transfer to the machines and sometimes they

are too large to be handled. On the other hand, management's need for information is a continual and growing one.

As we move further into the era of professional management it becomes increasingly important to be able to provide cost information for specific purposes, such as management decisions and annual planning, as well as for the historical purposes of pricing inventories, determining profits, and for cost control. It is also quite evident that standard costs, which have been used with considerable success to control production costs, can also be adapted to the control of distribution costs, direct selling costs, and even to the control of tabulating operations. A certain amount of pioneering work has been done in this area — enough to indicate that a great potential exists for its further use.

The great strides that have been made in variance analysis during the past twenty or thirty years should be greatly accelerated by mechanization. Those of you who have a broad knowledge in the field of standard costs, who have actually worked with standard costs and have developed your own systems of variance analysis will appreciate the contribution that can be made by equipment with virtually unlimited data-processing ability. You will be able to explore variances to a greater depth than has heretofore been practicable, and you will be in a position to make these analyses much more often than at present.

OBJECTIVES

The need for good cost accounting is greater today than ever before. As we decentralize profit planning and profit responsibility farther afield and further down in the organization, we must, at the same time, provide various levels of management with all their requirements for planning and control, always being mindful of the profit objective. Plans must be related to achievements, and if the desired goals are not realized, we must have ways and means to determine whether the plans were unrealistic or whether the failures were due to circumstances which might have been controlled. We can use cost estimates for pricing purposes, but we can never be sure of their reliability or inclusiveness unless they are based on realistic and predetermined standards tied into the books of account. We may be satisfied with standards not tied into the accounts as long as we are making money, but when the economy becomes competitive we are not in a satisfactory position to find out why we lost money, and so to profit by our mistakes.

The same situation exists in regard to annual planning. We may draw up budgets and forecasts, but if we do not relate these to actual performance, we are not in a good position to revise our budgets in subsequent

years. It is not uncommon, however, for a company to prepare budgets by organizational responsibility and to maintain its accounting records by nature of expenditure so that it is impossible to make comparisons of performance by responsibility.

In preparing for mechanizing our cost accounting you should be wary of merely translating our present procedures into mechanical form without giving due regard to possible changes that might be of value to others in the organization. It may be possible to improve the content of the present management reports and the needs of the accounting department should be integrated with those of the sales and manufacturing departments, so that the results of your work will be satisfactory to all branches of management.

You should also consider the possibility of incorporating distribution cost accounting into your present system. Unit cost standards could be developed for cost-control purposes by analyzing various distribution costs as to the reasons for the occurrence of such costs, and as to whether they should be expected to vary with sales volume or are essentially fixed in nature, regardless of sales volume. If these unit costs are multiplied by the volumes handled in the various departments, the result will be indicative of what the actual costs should be. Comparison with the actual costs will pinpoint the areas for cost study, and may lead to improvements in your distribution processes. These costs could also be used for determining quantity discounts on a basis conforming to the intent of the Robinson-Patman Act.

You should also consider, particularly if you are in the type of business where your raw materials fluctuate widely in price, the possibility of continual revision of manufacturing costs and selling prices to reflect current replacement costs. This can be done quite easily with tabulating equipment and has been done by some companies for a number of years. It is also worth while to consider carrying this one step further, that is, to combine these replacement costs with the daily sales reports so as to determine, at the time that an order is taken, the anticipated profits on these transactions. This will enable the sales manager to take corrective action whenever insufficient profit margins are obtained and also to measure the profit performance of individual salesmen.

You should also consider the possibility of centralizing certain operations to make use of mechanical equipment more feasible. Newly developed communication equipment permits a greater degree of centralization of operations. Much of this equipment is available for use in conjunction with machines that produce perforated tape which makes it possible to centralize functions at a number of different locations. Our horizons can be broadened, therefore, to take in geographical locations throughout the company.

PROBLEMS

One of the difficulties that we must face in attempting to mechanize cost accounting is the fact that costs for different purposes have different bases. In pricing inventories to determine profits, we are dealing with past or historical costs. In controlling costs and setting sales prices, we are dealing with present costs, and in promoting management decisions and annual planning, we are dealing with future costs. If we are to use these costs for different purposes, we must be in a position to revise them at will to reflect either past, present, or future volumes and price levels. This is easy enough to do if we are setting sales prices or planning a new factory, as such studies are usually separate analyses, and approximations are generally satisfactory. The difficulty arises when we are using these costs for cost-control purposes in a company with numerous products in its line.

The annual revision of the standard product costs is a sizeable undertaking, and is not something that can be done readily every time there is a price change in one of the raw materials. Companies which use raw materials that fluctuate widely in price seldom operate a standard cost system for material cost-control purposes, although they may do so to obtain control of other manufacturing costs. Other cost accountants have side-stepped the difficulty of revision by contending that the standard costs should not be revised more than once a year, as otherwise the comparisons would not be valid. The latest effort to simplify a complete revision of the standard product costs is what has been commonly called "direct costing." This has somewhat of an "eat your cake and have it" appeal as it avoids many laborious cost distributions that do not always seem to offer a sufficient return on investment.

SCOPE AND SPECIFICATIONS

You can gather from the foregoing discussion that certain decisions will have to be made about the scope of the program before we start the actual preparation of a system. If you are now using standard costs for setting selling prices, you should consider expanding the system to cover cost control and, conversely, if you are now using standard costs for cost control, you should consider using them for setting selling prices and measuring anticipated profits. If you are now using them for both of these purposes, you should consider adapting them for annual planning and for management decisions, such as costing matters of alternative choice. If your present system already encompasses these objectives, you could consider expansion into the control of distribution costs and the possible improvement

of management reports to increase the effectiveness of management by exception. You would not have to move forward into all these areas immediately, but you should plan for these objectives at the time that you prepare your system.

Cost accounting is a very intricate and complex operation, and is one of the most highly technical fields in the whole financial area. It has drawn together many of the best minds from two of our major disciplines — engineering and accounting — and this professional marriage has been a most fortunate one for the forward progress of American industry.

A good cost system must have a sound foundation. A standard cost system is, in essence, an intricate, conceptual model of a company's manufacturing operations. It represents the inventories of raw materials and work in process; it mirrors the productive capacity of the various operations; it translates the operating costs into product costs for pricing inventories; and it translates the product costs into operating standards for measuring performance.

Standard costs have a fatal fascination for those that work with them (production men and cost accountants) in that there seem to be no limits to their use and no boundaries to their value. As soon as we set up the standard costs as a target for performance, we automatically set up a target for our cost engineers to aim at in reducing costs and in increasing efficiency. This moving target represents the annual increase in productivity which has been responsible for the remarkable increase in our standard of living in this country.

If we are to have a multi-purpose cost system, therefore, it would seem that such a system would have to be a complete standard cost system that could be revised quickly and easily. Whenever there are changes in volume or prices, in overhead budgets, or in the cost-center labor rates, we should be able to revise the standard product costs, the departmental costs per cost unit, and the departmental costs per product unit. In most companies it would be satisfactory if this could be done monthly, but it is conceivable that in some companies this would have to be done weekly, or even daily. At the same time the system should be susceptible of revision for changes in methods of processing, whenever new materials are substituted for those presently in use. There are not many companies that now have this information readily available, because if we were to try to do this with our present practices and procedures we would incur excessive personnel costs far beyond any value that might possibly be received. On the other hand, if this could be done reasonably and quickly, we should all agree that it would be desirable.

REQUIRED FUNCTIONS

Let us take a look at the various functions performed in cost accounting, such as the preparation of budgets, the revision of standards, the evaluation of production, the pricing of inventories, and the determination of operating variances. If we analyze these carefully, we will discover that we are dealing with the same information over and over again. At least one factor in every calculation is one that we have worked with for many months or for many years. Many of these factors are so standard that we have preprinted worksheets. Each week or month we set down new production figures and turn these sheets over to comptometer operators for calculation.

The same is true of revision. When companies make an annual revision of their standard costs, they may make some changes in volume and in prices, but the quantities are usually the same, subject only to minor revision. The quantities of raw materials used this year will be the same per unit of product as those used last year, and the amount of labor required to process an item in each stage of production will be the same this year as it was last year. We have technological change, of course, and we do develop substitute materials, but these are not usually sweeping changes across the board and can be adjusted for as they occur.

We may say, therefore, that the quantity factors in our standards are relatively stable, and that changes are recognized as they occur. The greater part of the work in revising standards would seem to be purely mechanical. We merely need to substitute new prices and volumes for the old prices and volumes and then calculate the results. Admittedly, it is not quite so easy as it sounds, for we now spend considerable time in revising our standard costs, but an objective examination of the work will show that we are doing the work much the same way as we did it last year and with many of the factors that we used last year.

Those of you who at this point may agree that this is so may still be surprised at the degree to which it is so, and at how small a part of our cost accounting work can be creative as against that which is pure mechanical drudgery. It should be a matter of great concern to all of us that our cost accountants, who are men of more than average intelligence and whose technical horizons are limitless, are, for the most part, pushing pencils or punching desk calculators for the greater part of their working day. What a great contribution we could make to American industry if we can free these men from this clerical drudgery so that they may devote their efforts to the solution of management problems requiring the full exercise of their capabilities!

TECHNICAL DESIGN OF SYSTEM

The actual design of a cost accounting system is a highly technical and extremely tedious operation, so that I will not bore you with details with which you are probably all too familiar. We should, to begin with, have a properly constructed chart of accounts, and we must also have departmental budgets, cost-center budgets, and budgets for all service operations. This phase of the operations may be difficult if the company has not previously had any experience with budgetary control. As more and more companies move toward complete budgetary control, this problem becomes much easier to solve.

The next step, if this has not already been done, is to determine the cost units for each cost center, those units, such as labor-hours or machine-hours, upon which the costs of the particular department or cost center can be properly allocated to the various products. The closer the relationship that we can establish between this cost unit and the finished product, the easier and more accurate our results will be. For example, if we can use feet or square feet of a finished product instead of labor-hours or machine-hours, we may be able to eliminate a number of conversions in our subsequent processing. Once the cost units are established, we must determine the product units for each product that is processed in each department; some unit clearly identifiable with the product, such as a square foot or a pound-processed in a particular department. It is usually desirable to express this product unit as a unit of a particular product and to convert all other products processed in the cost center into equivalents of that product unit by the use of a conversion factor. These conversion factors will not be necessarily the same for each product in each cost center, but will vary in relation to the usage of operations in each cost center.

One further step required will be to determine conversion units between cost units and product units for each cost center, although this step can be omitted if the cost unit is identifiable with the product and if the cost unit and the product unit are the same. It will also be necessary to establish bases for the transfer of service-department costs to the operating cost centers; and this is a place where you can really appreciate the advantages of tabulating equipment. The allocation of service-department costs usually takes several days to do manually, on a trial-and-error basis, but for several years now we have been able to do this operation very rapidly and with relatively unsophisticated tabulating equipment such as many of you have available in your own companies. It is a real pleasure to have such tedious work done for you mechanically while you enjoy a coffee-break.

PROCEDURE FLOW CHART

Planning the program for tabulating equipment or for a computer is a logical process and we have found procedure flow charts to be advantageous as planning tools. For those of you who are not familiar with flow-charting, a procedure flow chart is a pictorial device, employing symbols for various operations, to portray the various steps from the source data to the finished reports. The source data, in this situation, would encompass opening-inventory balances, material price lists, a formula for each intermediate product, a formula for each finished product, actual expenses, and current production information. The final reports would be various inventory reports, monthly production reports, and departmental cost statements.

We must design card forms for each type of input of source data, and we must design the procedures which will convert these various input cards into the shape and form required for the various reports. We must then design output cards to collect this data in a logical sequence for translation into the finished reports.

CASE HISTORY

Perhaps a clear exposition of the nature of this problem can be made by reference to an actual computer program. The company concerned in this case study is not a large company, and they could not justify the use of such equipment on a full-time basis. All of this machine processing is performed on a monthly basis by a service bureau for a fractional part of the average paycheck of a junior cost accountant.

The first step is to clear the machine and the magnetic drum of all previously stored data. This takes a few seconds. Next, a series of load cards are introduced containing the instructions as to where to store the program steps, and the required constant information. Following this, master cards are introduced containing opening-inventory balances, price lists, all necessary product formulae, and production information for the current month. Any changes that might be required in price lists or product formulae would be made in the master cards at the time that the current production data is key-punched. The loading of the program takes about 2½ minutes, at which time the computer, without hesitation, starts processing the current month's work. The master cards and interspersed current production cards are fed into the computer as required.

Taking one raw material at a time, the opening balance, the purchases, and any adjustments are added algebraically both for quantities and for dollars to determine the average cost of material available for the current month. These raw material costs are stored for subsequent use. The raw

materials transferred into process for each required mixture are subtracted from the material available and priced at these average costs. The standard material requirements, including predetermined yields and wastage allowances, are priced at these average costs. The results are compared to determine gains or losses due to variations from the standard formulae.

The material cost components of the in-process mixtures are computed in like manner. At this time about 400 program steps have been completed, but this is not an accurate measure of effort, as many of these steps are repetitive for each raw material and product mixture. Probably 5,000 calculations or transfers of data have been made up to this point in one or two minutes of actual operation.

LABOR AND EXPENSE CALCULATIONS

Each master product card contains the standard labor and expense rates for each of the possible production-cost centers. Based on the finished production of each cost center, the work-in-process and finished-goods inventories are calculated. Standard labor and expense allowances are accumulated by cost center at the same time as the product costs are determined. At this time the finished-goods cards are punched, showing all the necessary data for the report of finished-goods production. The labor and expense phase of this operation includes about 700 program steps and perhaps 40,000 separate calculations, which would require five to six minutes of machine time.

COST VARIANCE DETERMINATION

The final phase is to read in the actual labor costs and expenses for each cost center, to compare them with the standard allowances for labor and expense, and to compute the cost variances. These results are punched into cards for preparation of departmental cost-variance reports. All other data necessary for inventory reports or for next month's processing are also punched into cards for subsequent use. The reports are prepared in a matter of minutes on a standard accounting machine. The case described illustrates an application of electronic computers to provide all cost objectives from one cost system and in a single computer program. The company feels that the system will provide it with whatever cost information it may desire quickly and accurately.

PLANNING THE CHANGE

It is not a simple matter to engineer a procedural change. There are many problems that have to be worked out. Equipment must be purchased,

forms must be designed, communications must be established, and structural changes may also be required. Far more important than all of these are the individuals who will be affected by the change and who will be responsible for the routine operation of the new procedures. The cooperation of these employees is essential to the successful operation of the new system and it is most desirable to have the employees informed by the company rather than to have them get such information through the local grapevine. Many companies have made successful changes of this nature and have notified their employees that no individuals would be discharged voluntarily as a result of the proposed procedural changes. If such a policy is to be adopted, it should be recognized that decisions as to marginal employees should be made before such a policy is announced. As most installations would take place over a fairly long period of time, any reductions in staff could usually be accomplished by not replacing employees leaving the organization to take more responsible positions elsewhere. On the other hand, turnover will not take care of the problem of the first-line supervisor. The department head who has worked faithfully for the company for fifteen or twenty years and has now reached a position of responsibility must be placed elsewhere in the organization, and such opportunities do not develop every day. These individuals are vital to the present operation, and their cooperation will be essential during the changeover period. Employee loyalty is a difficult thing to gain and it should not be thrown away thoughtlessly. Such employees should be assured of continued employment, and, if possible, some indication of their new assignment should be given to them in advance so that they will have something to look forward to. In this particular area I do not think that we shall see substantial clerical savings, but rather we shall be freeing present personnel from the drudgery of low-level repetitive tasks and we shall be increasing their responsibilities for analytical work on a higher plane.

ACTUAL CHANGEOVER

One of the more important problems to be faced is the actual date of changeover to the new procedures. If a company has not previously had a cost accounting system of such scope, it may be desirable to begin with a new fiscal year. This may be modified to a degree by the availability of equipment for this purpose. Even where a cost accounting system is already in existence, it may require six months to plan such a program from start to finish. It would also be desirable to have a month or two of testing or of parallel operations to work the errors out of the new system.

The change of procedures may afford an excellent opportunity for a

company that does not now have written procedures to develop procedure manuals. The ramifications of procedural changes such as would be required in a mechanized cost accounting system are so great that it is highly desirable to have all procedures written down and all eventualities covered. This will provide adequate opportunity for those primarily responsible for the installation to review such procedures before they are put into effect. While the greatest immediate advantage may be in offering the opportunity for review, to avoid trouble during the installation period, the written procedures will also serve for training the present staff in the new procedures, and ultimately for training any new staff.

Much of the turbulence of changeover periods can be avoided if the procedures are well thought out, and a distinct plan of action is adopted for the installation of the new program. If the employees are satisfied with the projected changes, and are sufficiently acquainted with the new procedures, many of the problems of mechanizing cost accounting will disappear.