

1-1914

Cost Accounting Practice with Special Reference to Machine Hour Rate

Clinton W. Scovell

Follow this and additional works at: <https://egrove.olemiss.edu/jofa>



Part of the [Accounting Commons](#)

Recommended Citation

Scovell, Clinton W. (1914) "Cost Accounting Practice with Special Reference to Machine Hour Rate," *Journal of Accountancy*. Vol. 17: Iss. 1, Article 2.

Available at: <https://egrove.olemiss.edu/jofa/vol17/iss1/2>

This Article is brought to you for free and open access by the Archival Digital Accounting Collection at eGrove. It has been accepted for inclusion in Journal of Accountancy by an authorized editor of eGrove. For more information, please contact egrove@olemiss.edu.

Cost Accounting Practice with Special Reference to Machine Hour Rate*

BY CLINTON H. SCOVELL, A. M., C. P. A.

There is more reason now than at any other time for many years why American manufacturers should consider most carefully the problems of finance and management of their business undertakings. Facing the prospect of increased foreign competition in some lines, and the tendency towards higher wages which inevitably follows the increased cost of living, and especially the increased cost of food, which makes up such an important part of working men's expenses, manufacturers are necessarily interested in any ways or means to make their industrial operations more efficient.

Many things contribute to the efficiency of shop management. When a business is small, its success usually depends on the ability, foresight and good judgment of one or two energetic men. As the business grows, methods and system must more and more take the place of the manager's personal oversight, and the need increases for accounting sound in principle and simple in operation.

Under the influence of the new science of management, there has been a constant study in the last few years of manufacturing methods, operating standards, cutting speeds, etc., resulting many times in such marked increases of production that the management may be sure that an improvement has been made, even if it does not know exactly *how much* saving has been effected.

It has been clearly established, however, that the cheapening of manufacturing operations which is brought about by a better operating practice is frequently secured at a considerably increased cost for office force, planning departments, helpers, supervision and other indirect labor, sometimes wrongly called non-productive. As a result the practical problem for the manufacturer is to compare the lessened direct cost for labor and equipment with the increased cost for the other factors. This

* An address delivered before the annual convention of the National Association of Machine Tool Builders, Hotel Astor, New York, October 22, 1913.

he can do only when he has an adequate cost accounting practice.

It is my purpose to point out the essentials of a cost system for a machine shop, or a manufacturing plant where the operating conditions are similar, with especial reference to the theory and practice of a machine-hour rate. I expect to show you that this is an intensely practical matter, and that it has an important bearing on the sales policy and the general management of your business.

Classify Expense Properly—Distribute it Correctly

Good cost accounting depends on the correct application of a few well understood principles. The first is to have the direct charges from the original sources, that is, pay-roll and material distributions, correctly classified between direct and indirect costs, and then to determine how the indirect, or so-called non-productive charges, may be identified with the product.

Any cost accounting practice worthy of the name should record accurately the direct labor costs. In a machine shop, or under similar conditions, this direct labor cost should be applied with precision to each job going through the shop. *Very little cost accounting practice, however, has attained any similar precision for distributing the indirect charges for equipment, referred to hereafter in this article as burden.*

What is Burden?

As the difficult and important part of cost accounting is to determine how a correct distribution of burden may be accomplished, it is clearly worth while to consider briefly the elements of burden.

It is a tedious and expensive undertaking to build and equip a new plant, and to complete the cycle of manufacture from design to finished product; and there is much to gain in the way of a clear understanding of costs, if we trace out this development step by step, taking careful note of the elements of the problems as we proceed.

When a new industry is to be established, the directors first buy a parcel of land suitable for the location of the proposed shop. If the purchase price is \$40,000 the new enterprise has at once absorbed capital that should earn about \$2,000 to the

Cost Accounting Practice and Machine Hour Rate

ordinary, prudent investor, who takes no manufacturing or trading risks. A site as costly as this is probably situated in or near a city, so that it will be subject to taxes of \$500 or \$600.

Shop buildings are next erected at a cost, let us say of \$200,000 more. This outlay of capital, like the investment in land, involves an annual interest charge (of some \$10,000), and under present laws, an annual penalty of some thousands of dollars more for taxes. But, unlike land, the buildings will require constant repairs. Even then they are subject to a slow but certain deterioration and obsolescence that must be met by a charge for depreciation. To protect the investment, the owners must pay insurance and provide watchmen. To make the buildings usable, they must be heated and lighted, supplied with water and fresh air, and regularly cleaned. The striking thing about these charges is that they all go on without any abatement, unless the shop is shut down, dark and cold, and even then the principal charges—interest, taxes, insurance, repairs and depreciation—abate scarcely at all.

All this expense has been incurred by the management to provide suitable areas for the intended manufacturing process. If there are five or six subdivisions, each one may occupy an entire small building, or all or part of a floor in a larger building. Whatever the details, each department (if we may use that overworked word) uses so many hundred square feet of floor space and must carry its proportionate share of the land and building charges already described.

Within a department there may be one or more different operations, such as, milling, grinding, boring, turning, planing, fitting and assembling. The equipment in each case represents an investment of capital; it requires the payment of taxes and insurance; it suffers depreciation (even more rapid than the building), and it incurs charges for power, repairs, and such indirect items as superintendence, inspection, and helpers' services. If the shop shuts down, the power may be shut off and the foreman dismissed; but so long as it runs, however short handed, or however inefficient, these charges do not change materially; and the fundamentals of interest, taxes, insurance, etc., (with the possible exception of repairs) are not one whit less.

All that has been described so far is overhead expense, more properly termed *burden*, and does not include any labor applied directly to the product (like the operative who is working at a lathe or boring mill).

This great accumulation of burden *represents manufacturing capacity*. Each department, and each separate machine-tool has a known annual burden. Its cost per hour is determined by dividing the total burden by the hours in the working schedule, and the shorter the schedule, the greater the hourly cost.

Having completed the buildings and installed the equipment, the management is ready to begin manufacturing operations. As the several parts of the machine progress from rough castings or forgings to finished pieces ready for the assembling floor, their value has increased as they have absorbed the successive increments of direct or productive labor and of the burden appertaining to the production centres through which they have passed.

Cost Accounting and Production Control

Before illustrating the practical application of this theory, I want to point out that good cost accounting is a help to efficient management, not only as it traces and records values but also as it may be made a powerful agent for production control. From my experience in professional service for industrial plants, I emphasize more and more the practical value of this second aspect of the work.

It follows therefore, that the first step in planning a cost accounting practice for a machine shop is to consider by whom and how authority to manufacture shall be made. It is simple enough to order ten castings from a given pattern which has already been made, but as you all know, the production of a machine tool involves orders for castings of many different patterns and sizes, bar stock for forgings, etc., and these material orders are all very simple in comparison with the complex schedule of machine operations which are required to produce the finished parts. You all recognize how important it is that parts should be made in quantities that are economical and that the different pieces required should all be ready together on the assembly floor. It is, therefore, of the utmost importance to make effective plans to initiate and control the production so

Cost Accounting Practice and Machine Hour Rate

that these results may be accomplished. The management will then have a definite schedule of manufacturing operation on which costs may be determined by orders, by lots, by individual parts—with as much or as little detail as may be necessary.

What Constitutes an Adequate Cost Practice

Returning now to the subject of specific costs, the first step is to provide such labor records, preferably with good automatic time stamps, as will make possible the necessary distinction between direct and indirect operations, and the exact time devoted to each lot of material or each expense order.

The next step is to compute the burden correctly for each department, including interest, taxes, insurance and depreciation on the buildings and equipment, and the additional charges for power, supervision and repairs. In many industrial plants "manufacturing expense" includes only part of these charges. The first cost of manufacturing is plant investment—land and buildings. No management using a rented plant would think of omitting rent from overhead charges. When the manufacturer becomes also a landlord, as when the plant is owned by the manufacturing company, what sound reason can possibly be given for omitting from burden the charges which the management incurs in lieu of rent?

The equipment presents a slightly different problem. Very few manufacturers operate with rented equipment; if they do, there is rent to pay, as an unavoidable burden on the manufacturing operations. When the equipment is owned, the maintenance charges are equally unavoidable. The manufacturer must get interest on his investment before he has in any sense a profit, and he must bear the expense of taxes, insurance, depreciation and repairs. Although these elements of cost may be neglected or not stated, they are, nevertheless, taking their proper share, or more, of what is figured without them as gross profits.

The weakness of many cost systems is that important elements of indirect cost are thrown together in a "general expense" account, concealing the leaks and wastes that reduce efficiency and curtail profits. Many manufacturers have no doubt been satisfied to handle burden in vague and general terms because they did not know any better way to dispose of it.

The Journal of Accountancy

It may be stated confidently that under ordinary machine shop conditions, no accurate distribution of burden can be accomplished, and therefore no accurate costs determined, by spreading burden over all the work done in the shop as a percentage of the cost of direct labor. In the shop proper, with its widely varying equipment of machine tools, distribution on the basis of a man-hour rate is not very much better, although, as I shall point out later, that plan works very well for fitters and assembly men.

To secure a correct burden distribution it is only necessary to prove, by analysis, the elements of which it is composed and then to consider how all this overhead is actually applied to the product.

Attention Should be Fixed on the Production Center

At this point we encounter another mistaken tradition of "departmentalized costs." To define burden correctly in each department is good as far as it goes, but it does not go very far, especially in a machine shop. *The attention of the manager and the cost accountant ought to be fixed on the individual production centre*, usually a power machine. Recent developments under actual shop conditions show that *the correct burden for a machine tool may vary from less than ten per cent to over three hundred per cent of a machinist's wages*. The widely accepted method of charging burden to costs on the value of productive labor makes no distinction between the mechanic at the bench, whose work has practically no burden except supervision, and the operator using a costly machine, which involves heavy charges for maintenance, power and repairs.

Fallacy of Average Rates

Face this situation squarely and the fallacy of an average rate is exploded forever. Instead we recognize as many elements of burden as possible, and while it is not necessary or desirable to apply these elements separately to the cost of each job, it is from every point of view desirable to identify the burden with the production centers through which it is charged to the jobs. For machine tools, under this plan, there is a charge to each job for the use of a tool as specific and as definite as the charge for the wages of the mechanic who operates the tool.

Cost Accounting Practice and Machine Hour Rate

Bench Hands and Assembling Crews

The work of bench hands and mechanics on the erecting floor must be accompanied by a burden charge which obviously is not literally a machine-hour rate. The burden rate for bench equipment differs not at all in principle from the rates for the machine tools. If, as is usually the case, the mechanics at the bench work under substantially uniform conditions, a uniform rate may be made at so much per hour for the use of the accommodations which they require for their work. In a large shop the bench rate might be different in different departments. Since it is uniform for all mechanics who work at the bench, it is practically a man-hour rate. It must be borne in mind, however, *that it is a rate for the use of equipment only*, unless indeed the circumstances make it convenient to merge the cost of supervision with the cost of equipment.

The erecting hands in a shop present a problem of a different kind. Their work usually requires a considerable area, and important charges for crane service and supervision. To speak of this work in terms which have long been familiar in cost accounting practice, the erecting floor may be considered as a department whose burden is to be distributed with reference to the work performed by the mechanics employed in the department. Probably the best way to distribute this burden is on a man-hour rate derived by dividing the total annual burden by the number of man-hours for the department.

General Burden

There are other charges connected with the management of a machine shop or manufacturing plant which are not necessarily well expressed through an hourly equipment rate. Such are charges for the drafting room, the bookkeeping, cost accounting, supervision, liability insurance, and general charges of management not specifically and directly connected with the maintenance and operation of machinery. These are charges which in a small shop should be applied in a fairly uniform way over all the employees in the establishment, preferably on a man-hour basis. This charge would be known as general burden, and since it would be uniform, it may be applied to the cost of each job, against which hours of mechanics' time have already been recorded, with very little additional work.

The Journal of Accountancy

Why Scientific Machine Rates are Important

The successful operation of a scientific machine rate is the most important development that has occurred in cost accounting practice in a generation. As these rates may be applied to the cost of jobs, the charge for burden which hitherto has been the difficult and uncertain part of cost accounting will be as accurate as the charge for direct labor. Furthermore, the use of equipment rates, in effect a *precision method* for the important part of overhead expense or burden, requires no more work in a cost office than the application of a rate which contains only part of these charges.

There are two good reasons for saying that a scientific machine rate is a development of tremendous importance in cost accounting practice. The first is that referred to in the opening paragraph of this article, namely that it is essential when scientific management is introduced that there should be an *exact* measure of the saving which is effected by it. The literature on this subject has not thus far made a sufficient recognition of the very important fact that if an operative reduces the time on a given job from ten to seven hours, for example, he has not only saved three hours at his wage rate, but also three hours of the rate for the machine tool which he has used, and three hours of general burden. As will appear from the table annexed to this article, these overhead costs are frequently more important than the direct wage which has already received so much attention.

Cost accounting practice, moreover, which analyzes burden charges as described in the foregoing paragraphs would naturally make a very precise account of the increases in overhead expense of any kind. In some cases in connection with the introduction of scientific management, these increases would be in a particular department, and would operate to increase the burden which would be disposed of as a machine-hour rate for the tools in that department. Usually, however, the additional charges would operate to increase the general burden, which is one of the most important and at the same time, one of the most elusive elements of manufacturing cost.

Cost Accounting Practice and Machine Hour Rate

A Measure of Loss Due to Slack Production and Inefficient Operation

The second reason for attaching so much importance to a *scientific machine rate* is that it *makes possible an accurate measure of the loss due to slack production or interrupted operation*. This is perhaps more important than the improved accuracy of cost records referred to above. When the board of directors is gathered at the end of the year, or once in six months, to learn about the results of the period under review, they do not often consider such detailed matters as the cost of individual orders. On the other hand, they are always interested in any explanation which the manager has to make about losses that are due to curtailment of manufacturing operations.

The directors at such times would value more than anything else a clear statement showing *how much* their company had lost on this account, especially if the details of the statement could be readily understood and readily proved by an analysis of the operating conditions. The big problems (in regard to manufacturing) which the directors have to settle are to make an efficient use of plant and equipment, especially if they are asked to decide on new additions to meet a probable volume of business. The new plant means an added investment, and it is of the utmost importance that the accounts should subsequently show to what extent this investment was utilized.

It is essential to distinguish clearly between losses or gains on machines actually made and sold, and losses due to slack production or inefficient use of equipment.

It must be borne in mind that the finished product has *absorbed only the burden of the equipment actually used in its manufacture*. It has not absorbed the burden of unused equipment or idle machinery. If the plant includes a foundry and the management decides to purchase castings, the idle foundry has contributed nothing to the product. It is obviously unfair to charge into the cost of goods the burden charges on the automatic machinery that may be idle because the management is buying and not making machine screws. If only three-quarters of the lathes run, the idle remainder have not helped machine parts actually manufactured, and although the plant may go into bankruptcy if it cannot utilize its equipment, *the cost of the work actually done is not greater on that account*.

The Journal of Accountancy

The burden on idle machinery is no more a part of the cost of manufacture (unless due to enforced seasonal variations) than the burden on a shop owned by another corporation. When there is a proper distribution and application of expense burden, only the burden is charged to cost which represents the equipment utilized in manufacture, and burden not applied remains as a balance to be charged direct to the loss and gain account at the end of a month, six months or a year. (See diagram page 11.)

This is readily accomplished through the means of burden accounts which collect by a very simple bookkeeping practice all of the charges in a given class, and receive credits as burden rates of the same kind as charged to the cost of product going through the works. The unearned burden in some cases may indicate an error which is to be corrected by using a more accurate rate in a subsequent period, but when proper records have been established, *the unearned burden is a clear loss*, and the balances of the burden accounts should be transferred directly to the profit and loss account.

Effect on Sales Policy

If the distinction is maintained between losses or gains on goods made and sold, and losses due to restricted output, the management will consider sales policies in a much more certain way than is possible when the facts are obscured in the haze of average costs, calculated on varying volumes of product. In respect to burden it is frequently true that costs figured as averages vary beyond all hope of comparison as the volume of output goes up or down.

When a cost accounting practice is maintained that distinguishes carefully between prime costs for material and labor, (which vary almost directly with the volume) and overhead charges or burden, the managers can see exactly in times of slack production at what price they can take any work that is offered and get something to carry the burden of the shop, in addition to the direct cost of labor and material. This, it must be admitted, is to some extent a matter of policy, for it may be better to hold a price and restrict output, rather than break the market by quoting prices that will give temporarily a little additional profit.

Cost Accounting Practice and Machine Hour Rate

A Measure of Manufacturing Efficiency

Whatever the effect on sales policy, good cost accounting, including correct burden distribution, is a matter of enduring importance from the point of view of manufacturing. Changes in volume may completely obscure gains or losses in efficiency, and render comparative costs of similar jobs impossible from season to season, solely because of the variations in the amount of business done. Exact costs, comparable under all conditions, are not to be secured unless the burden charged to production is only that appertaining to the equipment that is actually at work.

From the manager's point of view, the significant fact is that the burden, which it is proposed to apply through a series of equipment rates, is not appreciably less when the operating schedule of the plant is reduced. It is true that power charges may be slightly less, but the fixed charges for building space, interest, insurance, taxes, depreciation, and in some circumstances for repairs also, are no less when the machines are idle. *The manager of a machine shop cannot make a greater mistake in figuring costs than to charge a higher burden in any form whatsoever for the operation of part of his equipment, because the rest of it is temporarily idle, or a higher rate for a smaller labor force because the plant is working on part time. These differences which have always attracted the attention of observing managers are almost entirely clear loss or waste, and should be recognized as such and charged directly to the profit and loss account.*

A Practical Example

The practical manager who regards these ideas as too theoretical will do well to inspect the following list which shows the results of working out a machine-hour rate for direct operating burden in a plant operating about one hundred and fifty machines.

<i>Number of Machines</i>		<i>Rates in Cents</i>	<i>Number of Machines</i>		<i>Rates in Cents</i>
6	@	1.5	12	@	7.0
4	"	2.0	12	"	8.0
9	"	2.5	7	"	8.7
4	"	3.0	4	"	9.0
6	"	4.0	3	"	9.5
2	"	5.0	10	"	10.0
4	"	6.0	3	"	11.0
10	"	6.6	13	"	12.0

The Journal of Accountancy

2	@	13.0	3	@	24
2	"	14	2	"	25
11	"	15	1	"	26
1	"	17	1	"	29
3	"	18	2	"	30
1	"	19	1	"	47
1	"	20	1	"	52
1	"	22	1	"	76
4	"	23			

If one is disposed to criticise the minute division that has been made, such as having rates at 8c, 8.7c, 9c, 9.5c, and 10c, it should be borne in mind that there is practically no more work in the cost accounting department in using five rates instead of two. Moreover, if an effort is made to combine some of these rates, it is exceedingly hard to say which rates should be raised and which should be lowered. If five rates like those mentioned above should be brought together, some of the rates would be at least 15% out of the way. Such an error is altogether too large to be tolerated unnecessarily, when one is seeking for really accurate costs.

At the plant where these rates are in force the burden for erecting hands, including the charges for floor space, crane service and supervision, was *five times the rate for bench hands*. In addition to these rates every employee participates in a general burden which includes superintendence, managers, drafting, cost accounting, and all general charges, except those connected with selling expenses.

Inaccuracy of the Old Methods

The results which have been secured in working out these machine rates need only be stated to a practical man to show the violent inaccuracy which there must have been in cost accounting when overhead charges were applied as a percentage of productive labor, or even on a uniform man-hour basis. The following figures will supply a vivid illustration of the inaccuracy of the old method:

	<i>Job No. 1</i>		<i>Job No. 2</i>		
5 hours labor @ 28c	=	\$1.40	5 hours labor @ 28c	=	\$1.40
5 hours burden on the average plan @ 30c	=	1.50	5 hours burden on the average plan @ 30c	=	1.50
		= \$2.90			= \$2.90
Total cost			Total cost		

Cost Accounting Practice and Machine Hour Rate

At the same wage rate the two jobs show the same cost because they took the same time, although job No. 1 may have used a machine worth 3c per hour and job No. 2 a machine worth 24c per hour, or even one worth 50c per hour or more. Under these conditions, and assuming a general burden rate of 10c per hour, the true cost of these two jobs was as follows:

<i>Job No. 1</i>		<i>Job No. 2</i>	
5 hours labor @ 28c	= \$1.40	5 hours labor @ 28c	= \$1.40
5 hours machine rate @ 3c	= .15	5 hours machine rate @ 24c	= 1.20
5 hours general burden @ 10c	= .50	5 hours general burden @ 10c	= .50
Total cost	\$2.05	Total cost	\$3.10

This is a very conservative comparison. If job No. 2 required a machine worth 60c per hour, the cost would have been \$1.40 + \$3.00 + \$.50 = \$4.90. The percentage on labor method, or a straight man-hour rate in the shop, would show that these three jobs had the same cost, although as a matter of fact in the second case the cost was 151% and in the third case 239% greater than the first.

Perhaps the best thing that can be said about cost accounting practice by machine-hour methods is that it does not require any more work than any of the older methods that have been well developed as a means for taking out costs. At the plant from which the above illustration is drawn, it is not expected that there will be any increase in the cost accounting force for the operation of the plan as outlined. Of course, if a plant with an under-developed cost practice, or none at all, starts to make improvements in a wholesale way, it must expect to increase the overhead charges. If this increase is wisely planned, it is sure to be a money making expenditure.

Mass Production and Automatic Machines

As noted earlier in this article, there are some conditions, of course, under which a machine rate cannot be used to distribute burden, *but the underlying principle of collecting all burden charges for each production center is sound, whatever method may be used for distribution.* Some operations can best use a process rate, which includes labor and accessory supplies as well as burden. This method is particularly applicable to mass

production, or any work that is not made on successive and clearly distinguished manufacturing orders. The application of overhead charges, however, can be made through a process rate strictly in accordance with approved principles of burden distribution.

Automatic or semi-automatic machines present a troublesome problem of burden distribution, especially as the burden is usually far more important than the labor as an element of manufacturing cost. This problem has been handled at a plant operating several hundred automatic machines by a plan of efficiency charts, which provide for charging to the job the cost of the effective operation of the machine. Cost accounts under this plan measure with great precision the loss due to slack production, or careless attention from the operator.

Conclusion

There are still some managers who do not realize the importance of a good cost and accounting practice, but the knowledge it supplies is undoubtedly a valuable business asset, as well as a powerful aid to efficient management. The best possible evidence for this statement is that progressive and successful manufacturing enterprises are making liberal expenditures for work of this character.

The present day trend of business is undoubtedly in the direction of a more exact and scientific knowledge of every important detail. Success by rule of thumb, or from energy and enthusiasm alone, is becoming more and more impossible. "The man who knows and knows he knows" is the man who wins.

Cost Accounting Practice and Machine Hour Rate

