By Kiyoshi Okamoto**

Introduction

Rome was not built in a day, and cost accounting in the United States of America has not been developed without the efforts of many American people. The purpose of this article is to trace their intellectual efforts in solving cost accounting problems, in order to understand clearly the present status and the developmental trend of cost accounting in this country.

For this purpose emphasis has been laid on culling what is really significant from many sources, so that the reader may grasp the cause and effect relations in the historical development.

I. Early Cost Accounting

Early Growth of Industry in the United States

The growth of industry in the United States can be traced to around the turn of the nineteenth century. Although there was some household industry in the Colonial period, many essential manufactured products were imported from England. With the Revolution, 1775-1783, which separated the Colonies from their mother country, the household industry developed still further, and this was followed by the rapid and remarkable progress in manufacturing in the United States which was encouraged by the international tensions marked by the Embargo Act, 1807, the Nonintercourse Act, 1809, and the second war with England in 1812. These tensions not only disrupted the importing of manufactured products from England but also caused the decline of foreign trade in this country. As a natural consequence, American capitalists engaged in commercial enterprises withdrew their capital from foreign trade and reinvested it in manufacturing. A typical example was the Boston Manufacturing Company (the predecessor of the Saco-Lowell Shops), established in 1813 by a wealthy Boston merchant in foreign trade, Francis Cabot Lowell. The factory of this company was, indeed, the first modern factory in the United States.¹

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¹ Clark, S. V., History of Manufactures in the United States (New York: McGraw-Hill Book Company, Inc., 1929 ed.), Vol. 1, 1607-1860, p. 367; pp. 449-451.

Of course some rough costing method might have been used even in the household industry; but our interest lies in the development of cost accounting after the birth of the modern factory system.

Factory Accounting Records Kept by Wealthy Commercial Capitalists vs. Those Kept by Small Industrial Capitalists

Before 1900 only two cost accounting books seem to have been published in this country: Metcalfe, H., The Cost of Manufactures and the Administration of Workshops, Public and Private (New York: John Wiley and Sons, 1885). Arnold, H. L., The Complete Cost-Keeper (New York: The Engineering Magazine

Press, 1899).

Besides these books, only a few cost accounting articles, published in the *Engineering Magazine*, are available for us. Owing to this scarcity of historical materials, early American cost accounting was ignored until a dim light was shed into this dark area by the Harvard Business Study Group. They published business histories of such companies as the Reed and Barton Company in Massachusetts, the Whitin Machine Works in Providence, the Saco-Lowell Shops in Boston, and the Pepperell Manufacturing Company in New England. These studies have already been introduced by Professor Garner in his work, and they need not be reviewed here.²

From our point of view Professor Navin's opinion of the characteristics of American manufacturing firms in the nineteenth century is significant. He pointed out that these firms followed two management patterns; there were those which were founded by wealthy investing capitalists and were fair-sized institutions from the start. Companies in this group were the beneficiaries of the business experience handed down to them through the ages of marchant capitalism; and they therefore had well-developed double-entry bookkeeping systems, with such refinements as unit cost data and special manufacturing accounts. On the other hand, there were those started by small shopowners, which were small at the beginning but large in potentiality. Companies in the second group usually kept their financial records on the same informal basis as their own personal accounts.³ The Boston Manufacturing Company can be cited as a typical example in the first group; the Whitin Machine Works, as in the second group.

Who Contributed to Early Cost Accounting?

On the basis of Navin's opinion, we may safely presume that the credit for devising cost accounting techniques can be ascribed to companies in the first group. Because companies in the second group began as very small enterprises, the shopowners did not need the elaborate techniques of cost accounting. Manufacturing processes were so simple that owners could estimate the cost of products rather easily and could effectively control their workshop by walking around among the workmen. Besides, they were not capable of devising a sophisticated system, since they were small tradesmen who had no accounting background at all. We will therefore consider how companies in the first group devised cost accounting.

² Garner, S. P., Evolution of Cost Accounting to 1925 (Alabama : University of Alabama Press, 1954), pp. 77-85.

⁸ Navin, T. R., The Whitin Machine Works since 1831—A Textile Machinery Company in an Industrial Village (Cambridge: Harvard University Press, 1950), pp. 149–150.

Garner, ibid., p. 81.

II. Factory Accounting Without a Cost System

Commercial Bookkeeping as Applied to Factory Operations

It is quite natural to presume that the wealthy merchant-manufacturers in the companies making up the first group applied the commercial double-entry bookkeeping, in which they had been well versed in their foreign trade days, to their newly established factory.

As the reader knows, in commercial bookkeeping the cost of merchandise for a given period is calculated by such inventory methods as adding the opening balance of goods to the goods purchased in the period, and then subtracting the ending balance of goods in the merchandise account. In such a case, if the sales of goods in the period are credited in the account, the gross profit or loss of sales is obtained.

Similarly the merchant manufacturers used the same inventory method for calculating cost of products sold; they simply changed the name of the merchandise account to the manufacturing account, to which they debited the opening balance of material, work-in-process, and finished goods as well as purchased materials and labor; they credited the ending balance of materials, work-in-process, and finished goods as well as sales of products. In this way they could determine the cost of the product sold and the gross profit of sales in a period.

It must be pointed out here that expenses are charged directly to the profit and loss account in commercial bookkeeping. These manufacturers followed the same method. Workin-process and finished goods were valued only by their prime costs, and manufacturing expenses were treated as losses.

Wide Use of Manufacturing Account and Its Development

The manufacturing account seems to have been widely used in manufacturing firms in the nineteenth century. The explanation of this method can be found in the following works on bookkeeping:

Fleming, J., Book-keeping by Double Entry (Pittsburgh: W.S. Haven, 1854).

Goodwin, J. H., Goodwin's Improved Bookkeeping and Business Manual (New York: Published by the Author, 1881).

Dow, D.S., Keeping Books (New York: A.D. Curtis, 1882).

Bryant, J.C., Bryant's Counting House Bookkeeping (New York: Published by the Author, 1882).

We can trace the development of this method in two directions. One is toward the inclusion of manufacturing expenses into the cost of a product. The other is toward the separation of material, work-in-process, finished goods, cost of sales, and sales accounts from a manufacturing account. For example, Goodwin wrote that the value of manufactured goods on hand—as shown by the inventory at commencement of business, return of product sold, material cost, machine expense, labor cost, and freight and cartage expense—should be debited to the manufacturing account, and that sales of manufactured goods in the period and the ending balance of manufactured goods should be credited to the same account.⁴ He seemed therefore to think that machine expense and freight and cartage expense were legitimate costs of product, though he simply explained that the ending balance of manufactured goods should be valued by the "present worth" of the goods. Incidentally, his machine expense

⁴ Goodwin, ibid. (24th ed.) pp. 14-16.

was the estimated wear and tear, plus any other losses of machinery value. He might not include any value of work-in-process in his calculation.⁶

Bryant explained his procedure by taking an example from sole leather manufacturing. Those raw and dried hides which are delivered to the tannery, according to his view, should be debited to a tannery stock account, and finished leather should be transferred from the tannery account to the merchandise account.⁶ His tannery stock account may be interpreted to be a work-in-process account separated from the merchandise account.

In 1911 Wildman established material and supplies, direct labor, manufacturing expense, work-in-process, and finished goods accounts and described the same procedure that is used today. It is interesting to note that he named the procedure "accounting cost system" or "financial cost system," for this cost system was based only on financial accounting records.⁷ It would hence be considered a kind of cost system, though incomplete, at that time.

The Advantage and Disadvantage of Factory Accounting Without a Cost System

The advantage of the method is that it may be easily used by small manufacturing firms; it saves a great deal of clerical labor and lowers the cost of record-keeping, for it is based on the inventory method. Even nowadays it is widely used among small manufacturing concerns where elaborate and expensive cost accounting is not necessary.

On the other hand, the disadvantage of the method is that it cannot supply any cost information on manufacturing activities. This is obvious when the reader reviews the debit and credit of the manufacturing account. On the debit side, purchases of materials, labor, and services are recorded. On the credit side, sales of products are recorded; the external transactions are therefore correctly recorded in this account. Since the process of manufacturing operations works from the debit side to the credit side of the account, the cost method discussed above neglects this flow by not recording the transfer of the value of materials, labor, and services into the cost of the various products. This limitation still exists when the account is divided into materials, work-in-process, finished goods, and so on.

By this method cost is determined neither by product nor by department, but by period, so that it could not supply any detailed cost information, especially for pricing purposes, although these were of vital concern to manufacturers who made their products by customer orders at that time. Thus cost accountants in the United States began to devise another methods in order to get information for pricing products.

III. Estimate Cost Accounting

Need for Testing the Accuracy of Cost Estimates

It should be remembered that factory accounting without a cost system is based on the inventory method. The inventory enables one to find the actual quantity of work-in-process and finished goods at the end of a period. But what about the data on their historical unit

⁵ Goodwin's explanations on this industrial accounting, according to Professor Garner, had not been revised at all between the first edition (1881) and the 26th edition (1908).

⁷ Wildman, J. R., *Cost Accounting* (New York: The Accountancy Publishing Company, 1911), p. 12. He divided the cost system into an accounting cost system and a manufacturing or factory cost system.

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Garner, ibid., p. 357.

⁶ Bryant, ibid., pp. 161-172.

cost to be used for the valuation of inventory? The inventory method alone does not give a periodic profit or loss of the manufacturing concern; this cannot be determined without using some cost estimate.⁸ Manufacturers at that time could not help using in their factory accounting some cost estimate that was determined by their intuition or other rule-of-thumb method. This cost estimate, it must be noticed, might be used also as the basis for pricing their products.

As a natural consequence, the success or failure of a manufacturing business depended entirely upon the accuracy of the cost estimate. If it was erroneous, not only was their pricing policy misleading, but also the profit determined in their factory accounting would be false. They hence began to be uneasy about the accuracy of their own cost estimate as the competition sharpened.

Two Ways of Testing

How then could they test the accuracy of their cost estimate? There were two ways: One was to compare their cost estimate for a product with the historical manufacturing cost of the product after its production. The testing method was simple; but in actual practice it was very difficult, for they had to devise by trial and error the historical cost-finding method itself. This leads us to the evolution of historical costing, which we shall discuss in the next chapter.

The other way was to compare the estimated cost, which was determined by multiplying the per unit cost estimate by the actual volume of production in a period, with the total historical manufacturing cost of the period. The testing principle in the second method was rather complicated, for the accuracy test was made indirectly. In other words, the test was on a periodic basis rather than on a product unit basis as in the first method. But its actual practice was very easy for them for the following reason.

To the manufacturing account in their factory accounting, the historical costs of materials, labor (and later, expenses) in a period were debited, and at the end of the period the inventory value of work-in-process and finished goods was credited. Then, the cost of sales in the period was determined as the balance of this account. It must be emphasized here that the inventory value at the end of the period was based on cost estimate, so that the inventory value was nothing but the estimated costs of work-in-process and finished goods on hand.

If our calculation of the cost of sales is based on the same cost estimate, not calculated from the balance of the account, we shall find that all the amounts credited in this account are estimated costs. Then we can compare the historical cost debited with the estimated costs credited in the same account. If no balance appears in the account, this shows that the cost estimate was accurate; a debit balance shows that it was lower than the historical unit cost of the product; a credit balance, of course, shows that it was higher.

The reader may notice that this testing method is the nucleus of estimate-cost accounting. Thus, the distance between factory accounting without a cost system and estimate-cost accounting is small. The only difference lies in whether the cost of output is determined as the balance of the manufacturing account or by the cost estimate used.

Objectives of Estimate-Cost Accounting

Frank E. Webner referred to this method as the "estimate and test plan of cost finding" in his work. He wrote that this plan was, no doubt, the oldest and the most widely used

⁸ Cost estimate is the estimate of manufacturing cost of a product unit.

plan among factories at that time.⁹ It is interesting to note that Nicholson also called this method the "primary cost system," and Dohr called it also the "partial cost system."¹⁰ These names were given because the authorities thought that the so-called actual cost system was a "complete cost system."

Now the objectives of estimate-cost accounting are obvious. They are: (1) to check the accuracy of cost estimates currently in the double-entry book-keeping that have been used not only as the basis for pricing the product but also as the basis for inventory valuation for income determination; (2) to save the clerical labor and costs which are involved in the costing itself.

In considering the first objective, we must recognize the close relation between the effects that estimate-cost accounting will have on pricing and on income determination. Nicholson and Rohrbach pointed out that if the accuracy of the cost estimate has been tested and the sales price of the product has been properly determined on the basis of the tested cost estimates, then the proper profit margin of the product sold would be assured. The objectives of estimate-cost accounting, according to these authorities, were to assure proper profit for the products sold and to test their manufacturing costs in detail.¹¹ Compared with factory accounting without a cost system, estimate-cost accounting has the advantage that sales profits by products sold can be determined by estimated costs without waiting for the results of the ending inventory.

Early Estimate-Cost Accounting Procedure

In the early days of this century several authorities explained estimate-cost accounting procedure in their works. Among them Nicholson's "Estimated Cost System Based on an Annual Verification of Material, Labor and Indirect Expenses" may be cited as the source of one of the oldest procedures in the sense that it is quite similar to the "manufacturing account" system. The following outline reviews briefly his procedure.¹²

- a) First of all, cost estimates of products are entered by cost elements on a card called "Schedule of Estimated Costs." Material, labor, indirect expense, and sales accounts are established in the general ledger.
- b) At the beginning of the first period all work-in-process and finished goods on hand are inventoried and valued by their cost estimates, the results of which are entered on the inventory sheet by product lines and by their cost elements. Then, the estimated cost totals, calculated by cost elements in the inventory sheet, are debited to material, labor, and indirect expense accounts, respectively, as the opening balance in each account. Materials on hand are also entered in the inventory sheet and debited to the material

⁹ Webner, F. E., *Factory Costs* (New York: The Ronald Press Company, 1911), p. 247. He was a public accountant, who installed cost accounting systems in more than a thousand manufacturing companies in the United States and Canada. He referred to himself as a cost accounting specialist.

¹⁰ Nicholson, J. L., *Cost Accounting, Theory*, and *Practice* (New York: The Ronald Press Company, 1913), p. 159.

Dohr, J. L., Cost Accounting, Theory and Practice (New York: The Ronald Press Company, 1924), p. 464.

¹¹ Nicholson, J. L., and Rohrbach, J. F. D., Cost Accounting (New York: The Ronald Press Company, 1919), p. 459.

¹² Nicholson, J. L., Nicholson on Factory Organization and Costs (New York: Kohl Technical Publishing Company, 1909), pp. 232-236.

Nicholson, ibid., 1913, pp. 166-171.

account at historical cost.

- c) Purchases of materials, wages, and expenses paid and accrued are debited in respective accounts at historical cost.
- d) The estimated cost of sales, calculated by the cost estimate, is entered in a sheet called "Analysis of Cost of Sales." It must be noticed that estimated cost of sales is determined not only by products but by their cost elements.
- e) At the end of the period, the totals of estimated cost of sales are determined by their cost elements in the analysis of cost of sales, and the results are credited to the material, labor, and indirect expense accounts, respectively. The grand totals are debited to the sales account.
- f) By these procedures the gross profit based on estimated cost can be determined from the sales account. On the other hand, the balances in the cost element accounts show the "theoretical inventory based on the estimated cost." The theoretical inventory means that inventory which should be on hand.
- g) Then, by actual inventory with the schedule of estimated costs, the "actual inventory based on the estimated cost" is determined by cost elements.
- h) Thus, the "theoretical inventory" can be compared with "actual inventory." If the cost estimates are accurate, the amounts of both inventories agree. If the theoretical inventory is greater than the actual inventory, the cost estimates have been too low, and vice versa.
- i) Estimate-cost variances found in each cost element account are divided into the variance which should be charged to the inventory on hand and the varience which should be charged to the cost of sales based on the number of units produced. The latter variance is transferred to the sales account, so that the actual gross profit can be determined.

It should be mentioned that the cost estimates are not always accurate even when the theoretical inventory agrees with the actual inventory. This is because some errors in cost estimates of several products might offset each other, or some errors in cost estimates of several materials in product might offset eace other. Therefore, this method is only a rough test.

As explained in b), work-in-process and finished goods on hand at the beginning of the first period are valued by cost estimates. The procedure is necessary only in the first period, since the ending balance of such inventory in the first period may be adjusted to a historical cost basis by the disposition of estimate cost variances.

The above procedure was devised for locating estimate-cost variances by cost elements. Nicholson suggested the use of two older procedures than the above-mentioned one. One was to test cost estimates by the manufacturing cost over a whole period. Historical costs were debited to the manufacturing account, to which the estimated cost of product sold, workin-process, and finished goods at the end of the period were credited. Thus, historical costs and estimated costs were compared in the manufacturing account. By this procedure the general accuracy of cost estimates was tested, but errors at the source were not discernible.¹³

¹⁸ Nicholson and Rohrbach, *ibid.*, 1919, pp. 462-465. This procedure may be older in the sense that it is more like the manufacturing account system. But Nicholson did not refer to the procedure until his 1909 and 1913 books had already appeared. This system was unsatisfactory because it was useless for manufacturers wanting to test the accuracy of cost estimates as a whole. The system therefore seems to be only the product of Nicholson's logic.

The other procedure tested the accuracy of cost estimates outside the double-entry bookkeeping system. This method is quite similar to the estimated cost system based on an annual verification of material, labor, and indirect expenses, which we discussed above. The only difference is that, in this older procedure, the cost of sales was determined as the balance in each cost element account and transferred to the sales account. This balance was then compared with estimated cost of sales calculated by cost elements in the analysis of cost of sales. In other words, factory accounting without a cost system was adopted in formal accounting records, while the check of the cost estimate was made in a subsidiary sheet.¹⁴

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Estimate Cost as Oriented Toward Historical Cost

Estimated cost is the rough estimate of historical cost. Since the latter is thought to be a true cost, the former should be adjusted to historical cost when the estimated cost varies from historical cost. Such an orientation toward historical cost is the essence of estimated cost. With the development of historical costing, cost accounting authorities began to think that one of the advantages of estimate-cost accounting was to show manufacturers where historical costing, although expensive and necessitating higher clerical costs, would be worth installing.¹⁶ The reason is that if the material cost estimate, for example, was judged to be too inaccurate, and it was difficult for manufacturers to estimate it accurately, then historical costing was installed temporarily only in the material-cost accounting field. If the difficulty was in the labor cost estimate, actual working hours spent in each job were measured, and historical labor costing was used for one period. In this way, estimate-cost accounting gradually shifted to historical costing.

Later Development of Estimate-Cost Accounting

Some manufacturers whose production processes in the factory were simple enough to allow their costs to be estimated rather accurately would have continued to use estimate-cost accounting checked by cost elements. But other manufacturers, who produced a variety of products involving complicated processes, would have taken one of two alternative courses: one course was to give up their estimate-cost accounting by installing historical costing; the other was to improve the estimate-cost accounting itself. We will follow the development of estimate-cost accounting represented by the second course.

What were the limitations in early estimate-cost accounting? Two points should be mentioned. One was the delay in obtaining cost data, since the accuracy of estimate-costs was checked only annually. It therefore began to be checked each month. The other was that the check was made only by cost elements. But it is quite rare to use only one item of material for production. Which cost estimate or estimates of material items, then, should be adjusted? Similarly, which labor cost estimate in production departments should be adjusted? To overcome these limitations, estimate-cost accounting was devised, which checked the accuracy of cost estimates by direct material items as well as by departmental labor. As for manufacturing expense, it was checked either by its total¹⁶ or by departments.¹⁷ Even with this procedure, manufacturers could not, however, find out which product or products might

¹⁴ Nicholson, *ibid.*, 1909, p. 235. The explanation of this procedure was omitted in his 1913 and 1919 works, although the procedure might actually have been used in practice.

¹⁵ Nicholson and Rohrbach, *ibid.*, 1919, p. 460.

¹⁶ Nicholson, *ibid.*, 1909, p. 237; *ibid.*, 1913, p. 171.

¹⁷ Dohr, *ibid.*, pp. 501-502.

be responsible for the estimated cost variance. To locate the variance by products, they should have calculated historical costs of products by historical costing and compared them with estimated costs by products. But such a procedure was nonsense as estimated cost accounting. They therefore devised the "estimated cost system based on a monthly or annual verification of estimated cost of class of product according to departmental material, labor, and indirect expenses."¹⁸ In this procedure many varieties of products sold were classified into several groups according to their use, size, quality, and so on, and cost estimates were checked by this "general classification of the product sold." By this procedure manufacturers could find out the profitability of each product group when the cost estimates became accurate. They thought that accurate historical costing should be introduced for unprofitable product groups in order to compare historical costs periodically for cost control purposes.

From Estimate-Cost Accounting to Historical Costing

We have followed the development of estimate-cost accounting as manufacturers sought to locate variances in more detail. As the reader will note, the more such efforts were made, the more one of the advantages of estimate-cost accounting, that is, simplicity and ease in costing, was lost.¹⁹

Moreover, business circumstances, which had allowed manufacturers to use estimate-cost accounting effectively, were changing rapidly. With the cutthroat competition among manufacturers, they needed information not for pricing but for cost control. Estimate-cost accounting was not relevant for the latter purpose.

After all, estimate-cost accounting by cost elements has the essential character of any estimate-cost accounting. Even now, checking by cost elements is its usual form.²⁰ A check by department became important only in later periods, as in the partial plan of standard cost accounting. A check by product group has been adopted in particular industries such as those producing inexpensive trinkets (pendants, earrings, scarves, and so on) or small wares (pins, needles, and thread). Because products in these industries are small and inexpensive, manufacturers are satisfied if they know only the profitability by product group.²¹ In the next chapter we will consider the evolution of historical costing.

IV. Historical Costing

Historical Cost as the True Cost

In the early days of cost accounting the "cost" of a product had been thought to be actual consumption of materials, labor, and other services, valued at their actual prices, which

¹⁸ Nicholson, *ibid.*, 1909., pp. 244-255.

¹⁹ In estimate-cost accounting which checked cost estimates by general classification of products sold, a perpetual or book inventory system with material requisitions and a time-keeping system had to be introduced in order to identify the consumption of materials and labor with the general classification of products sold. If manufacturers had adopted such troublesome systems, they would have installed historical costing rather than estimate-cost accounting.

²⁰ Matz, Curry and Frank, *Cost Accounting* (Ohio: South Western Publishing Company, 2nd ed., 1957), pp. 448-451.

²¹ Eggleston, D. W. C., *Cost Accounting in Business Accounting*, Vol. III, (New York : The Ronald Press Company, 1920), pp. 349-351.

was incurred in the manufacturing process of the product. In other words, the historical cost of the product was considered the only true cost. There was no other type of cost which could rival the historical cost. As a consequence cost accountants believed that their only function was to "find" historical costs of products which could serve for all purposes.²²

Historical Cost Adheres to Actual Price and Consumption Factors

Then how should historical costs be calculated? If you refer to the readers' column in the Journal of Accountancy, Vol. XI, No. 5, March, 1911, you will find a letter headed "Cost Accounts, Average Prices," written by an accountant who worked for a large manufacturing company. This letter will give you some general notion of the concept of historical costs held by cost accountants in those days. In this letter the writer explained his method of costing or pricing material requisitions. Judging by the example showing his calculations, you will find his method to be nothing but the monthly average price method, which is accepted today as a method of actual material costing.²³ Nevertheless he was afraid that readers might criticize the fact that the raw materials in his company were charged not "on (the) basis of actual cost," but on the basis of average price, although in his opinion his method was the only practical way of pricing material issued in a company where more than 2,700 items of raw materials were used and some 1,000 products were manufactured. He wanted to know how large manufacturing companies solved the problem.

It is evident that his notion about historical material costs was connected with those costs calculated by the specific cost method. Under this method, material tags are attached to purchased materials, and requisitions are priced at the exact cost that is recorded on each tag.

This concept of historical cost was widely accepted among cost accountants in those days. It adhered strictly to actual price factors (material unit price, labor wage rate, and manufacturing burden rate) and actual quantity factors (material quantities consumed, labor hours, and the quantities applied as manufacturing burden). This is the reason why it was considered the true cost.

Introduction of the Card System to the Cost System

With this historical cost notion in mind, cost accountants made great efforts to find actual prices, and actual quantities of materials, labor, and services consumed for production. It can be easily realized that this task was quite difficult.

For example, Captain Metcalfe pointed out that no production order card was used in the military arsenal. Production orders were given to a foreman either orally, or in written form if they were important. In both cases he wrote them in his private memorandom book in the order in which he received them and crossed them out when the jobs were completed. Although this informal memorandum book was the main manufacturing record, it was hardly understood by any other person. It could not be used at more than one place at the same time, for it was a book; and since important orders usually took time for their completion, the records of such orders were apt to be left open for a long time and eventually lost or overlooked.²⁴

²² Historical costs are often called actual costs, but so-called actual costs are vague in concept. The latter mean either historical costs or actual normal costs as the case may be.

²⁸ W. R., "Cost Accounts, Average Prices" (Correspondence), The Journal of Accountancy, Vol. XI, No. 5, March, 1911, pp. 380-381). In his example there are some errors in calculation.

²⁴ Metcalfe, H., The Cost of Manufactures (New York : John Wiley and Sons, 3rd ed., 1900), p. 57-59.

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The same situation was also found in private enterprises. The manager of a manufacturing firm which had 1,400 employees told Metcalfe that the most difficult job was not to forecast the demand for their products accurately, but to trace his production orders continuously in his shop.²⁵ In short, not only were early cost records informal, but they were written in books. There seem to be many reasons why American cost accounting in the nineteenth century did not make rapid progress, but one of the main obstacles might well be the established notion that accounting records should be kept in books. The inflexibility and immobility of books made them inappropriate for the initial recording of cost elements incurred at the sources where goods and services were consumed in a factory.

Then the pioneers began to advocate the adoption of the card system that had been successfully used in libraries as a classification technique for books. For example, Metcalfe maintained the use of "shop-order" cards in his cost system, by which the streams of costs within a factory could be easily and accurately traced. Another authority, H. L. Arnold, added the following words to his book as its subtitle: "...together with an exposition of the advantages of account keeping by means of cards instead of books..."²⁶ There is no doubt that the introduction of cards into cost systems was at that time as much of a revolution as the adoption of electronic computers in the cost-accounting system today.

Shift of Emphasis in the Costing Purpose-From Pricing to Cost Control

Until the turn of this century agriculture had been the most important sector in the U.S. economy. The manufacturing business depended entirely upon the agricultural activities. After the panic of 1873, the domestic consumption of manufacturing products had been constantly decreasing; the businessmen, therefore, became gradually interested in obtaining orders from foreign countries to keep up the volume of their production. Some examples of exported products in this earlier stage of international trade were locomotives, patented machines for making shoes, and agricultural and sewing machines. The exports increased rapidly; goods worth \$107 million were shipped in 1874; \$155 million in 1884, and \$202 million in 1894. The depression in 1894 gave an impetus to the trend. Since the panic of 1873, the price level had been constantly decreasing; it was lowest in 1897. The wages of laborers were Under these circumstances the manufacturers in this country gained the hope low, too. and confidence that they could compete with the European manufacturers in the European market. Efficiency and cost control were therefore vital concerns.²⁷ For this purpose estimated costs were not appropriate. They wanted to have reliable historical cost data and to compare them periodically. "Do I get correct costs? Do I get them in the best way? Do I spend too much money in cost-keeping? Or should I spend more money to get more detailed cost information?" Such questions constantly worried them. To meet such demands H. L. Arnold began to investigate cost systems which had been successfully used by some of the leading American manufacturing firms. He advocated that they could make inroads into the European market and enjoy their national prosperity provided that they made full use of their production

²⁵ Ibid., p. 312. The manager complained that he often had to settle arguments about whether his men actually received a production order or not.

²⁶ Arnold, H. L., The Complete Cost-Keeper, 1899.

²⁷ Clark, V. S., History of Manufactures in the United States (New York : McGraw-Hill Book Co., 1929 ed.) Vol. II, 1860–1893. pp. 172–173.

Noyes, A. D., Forty Years of American Finance, 1865-1907 (New York : G. P. Putman's Sons, 1909), pp. 260-274.

tion capacity. For this purpose he requested progressive companies to publish their cost system. His contribution to cost accounting should not be forgotten.²⁸

Historical Prime Costing and Early Overhead Application

After the card system was introduced, the direct material and direct labor costs of a product began to be accurately measured and recorded. The manufacturers' attention was focused on these prime costs for cost control. But what about the manufacturing expenses?

In the early days, manufacturing expenses were regarded not as the costs of a product, but as a necessary evil or loss in production. They were added to prime costs only when manufacturers wanted to decide the sales price of the product.29

Perhaps the oldest application of manufacturing expenses to products may be the percentage of prime cost method. Two points should be mentioned about the method. One is that its application rate is often determined on the basis of cost information obtained from the financial statements in the preceding several periods. Hence this method can be used without any cost system. The other is that its application rate is often determined in such a way that it covers the portion not only of manufacturing expenses, but also of selling and administrative expenses (and even of profit) for pricing purposes.

Let us glance at the pricing method used by the Reed and Barton Company in the latter part of the nineteenth century. George Brabrook, who was responsible for costing, simply doubled the prime cost of a product to arrive at its selling price. The percentages that direct costs, indirect expenses, and profit represent in relation to the selling price were always 50 per cent, 30 per cent, and 20 per cent respectively.⁸⁰

The Product Cost Character of Manufacturing Expenses

One of the main obstacles which had hindered economic development in the United States during the nineteenth century was the scarcity of labor. With technological progress American manufacturers could eventually adopt labor-saving machines, which also made possible the replacement of skilled workers by unskilled ones. In the meantime, machines became large enough to permit mass production by using the water power, steam power, and later electric power to operate the machines. Despite the scarcity of labor, railroads in this country developed rapidly. This made it possible for the manufacturers in the Eastern states, who had previously been satisfied with limited local markets, to sell their products throughout the Western states. It should not be overlooked that the use of the corporate form of business organization contributed to the financial support of mass production and thus, to the remarkable growth that can be observed in the size of the business unit after 1860. The net production of manufactured goods had exceeded that of agriculture until 1890.

The rapid growth in manufacturing resulted in the rapid increase of manufacturing expenses, which had been regarded as a loss. Some manufacturers must have wondered why manufacturing expenses were losses. Suppose you have some steel bars. If these bars are consumed in manufacturing a product, the cost of bars is treated as the raw material cost of the

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²⁸ His investigations were published by Engineering Magazine Press, that is, The Complete Cost-Keeper, 1899, and The Factory Manager and Accountant, 1903.

²⁹ This is the reason why the manufacturing expense is still called "overhead", "manufacturing burden" or "on-cost."

²⁰ Gibb, G. S., The Whitesmiths of Taunton, A History of Reed and Barton, 1824-1943 (Cambridge: Harvard University Press, 1946), p. 159; pp. 267-269.

Garner, Ibid., pp. 78-80.

product. If the same bars are consumed in repairing a machine which is essential for production, the cost of bars is treated as a loss, even though you cannot manufacture the product without repairing the machine. Why should not the cost of repairs be treated as a legitimate part of the product cost?

If we investigate the prime cost concept which was adopted by the National Switch and Signal Company around the turn of this century, we find that this company included not only direct material and direct labor costs, but also a "proper percentage of unproductive material and unproductive labor" in their prime cost. They therefore seem to have recognized the product cost character of manufacturing expenses only to the extent of indirect material and indirect labor cost. The indirect expenses were still losses to them.⁸¹ Although we can still find some actual cases of the prime-costing system in the books written by Arnold,⁸² the manufacturers began to include the manufacturing expenses in their product cost.

Separate Accounting Treatment of Manufacturing Expenses and Nonmanufacturing Expenses In the early days, manufacturing expenses and nonmanufacturing expenses were combined and applied to products by the percentage of prime cost for pricing purposes. Afterwards these expenses began to be treated separately in the accounts.

We can find an example of this in the cost system which had been used by the Strieby and Foote Manufacturing Company since 1883. Mr. Foote, who was the president of the company and who devised the cost system for himself, separated "total shop costs" from "office charges," on the grounds that the office might be compared to the merchant who deals only in finished products. Since the products have cost the office to the extent of total shop charges, the office must therefore add its own expense (administrative expenses), selling expenses, and profit margin to the total shop charges, as a merchant should do.³³ In other words he maintained that the separation of manufacturing expenses from nonmanufacturing expenses was appropriate for cost control, because the shop manager was not responsible for nonmanufacturing expenses, while the office manager was not responsible for manufacturing expenses. Such a view was dominant among cost accountants at that time. Gradually they found that the application of nonmanufacturing expenses to products was difficult because of the lack of proper basis for the application. They also found that most of these expenses were fixed costs, because the objective of incurring these expenses was not to manufacture specific products but to maintain and develop the company as a whole. Thus, nonmanufacturing expenses are treated now as period costs.

V. The Integration of Cost Records and Financial Records

The Limitation of Costing

In the preceding chapter we traced the development of historical prime costing to historical total manufacturing costing. In spite of its development, historical costing had remained

⁸¹ Arnold, The Complete Cost-Keeper, 1901, p. 204.

³² The cost system used by the De Laval Company in those days may be cited as an example of the prime-costing system.

Arnold, The Complete Cost-Keeper, 1901, pp. 52-82.

⁸³ Arnold, ibid., p. 33.

merely an informal system in the factory and had nothing to do with the general or commercial accounting records in the head office.³⁴

As a result both cost records and financial records were lacking in dependability. In general accounting, for example, there is no record of the material consumption, although the purchase of the materials for a period is accurately recorded. Consequently the material costs for the period are determined by the inventory method. These costs are not the actual cost of the material consumed, but an assumed actual cost in which, for example, loss of materials by theft might be included. On the other hand, there is no record of the material purchased, in a cost system, although the consumption of the materials by products and departments is accurately recorded. Therefore, the material cost of a product can be determined by the material consumption records, but its accuracy cannot be proved.

Accountants' Advocacy of the Integration of Cost and Financial Records

It was accountants who perceived the limitation of costing. If cost records are tied in with financial records, the consumption records in costing and the purchase records in general accounting are checked against each other, and the accuracy of both records is guaranteed.

In 1885, Metcalfe tried in vain to connect the cash account with the cost sheet by some simple method. The problem, according to him, was the time lag between the date of purchase and the time when materials and services were consumed.³⁵

One of the earlier integrationists was Frank Broaker, who was the first Certified Public Accountant in the United States and a President of the American Association of Public Accountants (the predecessor of the American Institute of Certified Public Accountants). At the meeting of public accountants held in the Waldorf Hotel on May 18, 1897, he said in his address that no one would approve of keeping the cash account only by its receiving records. He devised a "consumption journal," by which not only were postings between accounts in a ledger checked, but the purchases and the consumption of materials and labor were controlled in total amounts. Evidently his intention was to control all the shop operations by the records of a double-entry bookkeeping system, but he did not explain the details of his method.³⁶

Engineers' Objection to Integration of Records

It was the engineers who furiously opposed integration of cost and financial records. We may summarize their arguments as follows:³⁷ Bookkeeping was originally devised by merchants. It is a means of recording debits and credits among individuals or firms. Therefore, calculations need to be made with the utmost accuracy on the basis of actual receipts and disbursements. All the accounts should be controlled by a single book, that is, a general ledger kept in the central office. Costing, on the other hand, was devised not by merchants or bookkeepers, but by engineers. Its objective is to measure the degree of efficiency for cost control.

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³⁴ The word "costing" is used here to refer to the cost system which is kept separate from general accounting. The word "cost accounting" is used to refer to the cost system which is integrated in general accounting. It should be noted also that the word "cost accounting" is usually used as the general term applied to any cost system.

⁸⁵ Metcalfe, ibid., pp. 289-291.

³⁶ Broaker, F., "Cost and Factory Accounts, with Use of Consumption Journal," The Accountant, June 19, 1897, pp. 604-605.

Garner, *ibid.*, pp. 262–263.

³⁷ Gillette, H. P. and Dana, R. T., Cost Keeping and Management Engineering (New York : The Myron C. Clark Publishing Company, 1909) pp. 65-70.

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For the measurement of efficiency the physical unit of measurement is often more useful than the monetary unit. Moreover, standard prices as well as actual prices may be used in the costing. The calculated costs need not always be strictly accurate. Sometimes rough estimates serve the purpose, although the cost information supplied to management should be up to date.

In this view, since bookkeeping and costing are quite different in their purpose and means, the integration of cost and financial records results only in useless confusion and complicated procedures.

The Progress of the Controversy

Just around the turn of this century, the pros and cons on the integration problem in accounting were argued fervently. In 1901 Arnold wrote that there was no real need to mix factory accounting and commerical accounting, although some companies had dovetailed a part of factory accounts into their commercial bookkeeping systems.⁸⁸ But two years later he was inclined to support the integration of records, writing that the commercial accounting system and the cost-keeping system were so closely related to each other in the most modern and best factory practice that neither system could be understood without knowledge of the other.³⁹ In 1903 J.E. Sterrett expressed his dissenting attitude by saying that, in most cases, to maintain the two separate and independent systems would be advisable and absolutely necessary to get proper results.⁴⁰

The weakest point in the supporting argument was the lack of explanation describing the definite and detailed procedures in such integration. H. C. M. Vedder was perhaps the first scholar to give full particulars of the integration procedure, just as it is used in modern cost accounting. In his procedure for example, a "Summary Sheet of Material Consumed" is prepared on the basis of the material requisitions. The direct material cost of a product is taken from the summary sheet and charged to the job order in the cost ledger, while the total direct material costs for the period, which are obtained by totaling the amount on the summary sheet, are charged to the debit side of the manufacturing account, and the same amount is credited to the material account in the general ledger. The integration procedure was thus devised as early as 1905.⁴¹

With this definite description of the integration procedure, arguments in its support gradually became influential.

Social Influences Which Supported the Integration

We should not overlook the fact that integration of records met the needs of the economic world in those days.

Professional accountants first settled in the United States from England sometime between 1880 and 1883.⁴² After the American Association of Public Accountants was organized in August, 1887, the accounting profession gradually developed, making remarkable progress

³⁸ Arnold, The Complete Cost-Keeper, 1901, p. 52. Garner, *ibid.*, p. 263.

³⁹ Arnold, Factory Manager, 1903, Preface, iii.

⁴⁰ Sterrett, J. E., "Cost Accounts," The Accountant, June 25, 1904, p. 836. Garner, *ibid.*, pp. 267-268.

⁴¹ Frost, G. H., "Cost Accounting-An Exposition of Its Theories and Principles as Illustrated by Professor H. C. M. Vedder," The Accountant, November 11, 1905.

⁴² Anyon, J. T., "Early Days of American Accountancy," The Journal of Accountancy, Vol. 39, January, 1925, p. 1.

around the turn of this century, when industrial mergers or trusts were flourishing. This progress came about because the persons interested in mergers wanted information on assets, liabilities, and trading conditions of the companies to be combined. They asked public accountants to prepare the information. It should also be pointed out that many of these combinations were carried out by unscrupulous company promoters. At that time the public was eager to invest its money. The promoters established a new large company by combining several small companies and offered the inflated stocks for subscription. Needless to say, bankers who were asked to furnish funds to such newly organized companies did not consent to finance them without a strict auditing by public accountants.⁴³

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In their auditing practice accountants were always finding strange cost records in a corner of an office or a factory. W. M. Lybrand, relating his own experience, said that he could not find the result of the cost records in any of the general accounting ledgers, and no effort was made to coordinate the cost and financial records. As a result the huge amount of profit which the cost records had shown often mysteriously disappeared in the financial records. It was thus recognized that cost records should be tied in with financial records and should be controlled by general accounting ledgers.⁴⁴

The Significance and the Effect of Integrating Records

What significance does the integration of records have in our history of cost accounting? It is evident that informal costing was raised, by such integration, to the status of cost accounting or internal accounting, which is one of the formal systems for calculating in a business enterprise. General accountants, having dealt with the external transactions between the business enterprise and other enterprises or persons, deliver the results to cost accountants. Then the cost accounting system analyzes the results, classifies them by departments and by products, and delivers its results back to general accounting. In this way all the movement of corporate capital can be controlled by a double-entry bookkeeping system.

In 1912 B. A. Franklin emphasized that integration was the first requirement of the ideal cost system. When the cost system is properly related to the bookkeeping system, the monthly trial balance tells the whole story of the business activities for the month.⁴⁶ He showed clearly that managements could judge the degree of their financial safety for the short term by comparing the amounts of current assets and current liabilities, and for the long term by comparing the amounts of fixed assets and long-term funds (the total amounts of fixed liabilities and capital) on the trial balance. Managements could judge how effectively the capital had been used by the capital invested in the balance of material items and work in process, by product lines. Moreover, he also pointed out that information on earning power by product lines was available from the schedule of the trial balance. He added that a wise management was surely familiar with the appropriate standards for appraising these amounts.

New Problems to be Solved

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After cost accountants had adopted the integration procedure in their cost system, however, they were constantly finding embarrassing variances between cost and financial records.

⁴⁸ Noyes, A. D., *ibid.*, pp. 309-310.

⁴⁴ Lybrand, W. M., "The Accounting of Industrial Enterprises," The Journal of Accountancy, Vol. 7, No. 3, January, 1909, p. 234.

⁴⁵ Franklin, B. A., Cost Reports for the Executives As a Means of Plant Control (New York: The Engineering Magazine Co., 1912) p. 42. This book is a reprint of his articles which appeared in the Engineering Magazine between January and August of 1912.

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In accounting for material cost, for example, a material ledger (in the cost records) is controlled by the material account (in the financial records). When materials are requisitioned from stores, entries are made in the issued and balance sections of the appropriate material ledger cards by the material ledger clerk. The sum of the balances on the various material ledger cards should equal the balance in the material control account. By the use of material requisitions and material ledger cards, the consumption of materials is accurately recorded, so that the balances on the material ledger cards show the quantity and value of material which should be on hand. Ordinarily this quantity, that is, the quantity found by the book inventory, is not equal to the quantity found by the physical count.

What, then, are the causes of the difference? How should it be dealt with in accounting? This was the new problem which cost accountants had to solve. Before integration, accountants could not find the difference between physical and book inventories because they calculated material consumption only by physical inventory methods without having the consumption data in cost records. Cost accountants could have known what the difference was, but they simply ignored its treatment in accounting, because their cost records were kept separate from the financial records.

The same kind of differences were found in other fields; the difference between wages paid and consumed for production, in accounting for labor cost, and the difference between manufacturing expenses incurred and applied to products for a given period, in accounting for manufacturing expenses.

The Contribution Made by E. P. Moxey

Edward P. Moxey, an assistant professor of accounting at the University of Pennsylvania, wrote a booklet in 1913 on cost keeping in factories. Because too much emphasis had been placed on the importance of the card system, cost accounting was apt in those days to be mistakenly considered the mere summary of cost cards. Moxey believed that factory cost keeping was entirely based on the principle of double-entry bookkeeping, and in his booklet he tried to explain the principle of factory cost keeping very clearly and concisely. No one had ever described the nature of the differences and their accounting treatments so briefly and practically as he did at that time.⁴⁶

As for the inventory variance of materials, he explained it in the following way: If the variance is small, the best way is to adjust the physical quantities recorded on the tags to the actual count; at the same time, the quantities in the material ledger should be adjusted, but the value of the material balance needs no adjustment. The materials issued after the adjustment are charged to production orders at a slightly higher unit price.⁴⁷ If the variance is large, an investigation should be made immediately, because such variances might be owing

⁴⁶ Moxey, E. P., Principles of Factory Cost Keeping (New York: The Ronald Press Company, 1913).

⁴⁷ <i>Ibid.</i> , p. 41-42. His illustration is as follows:
Material item: bolt
Book inventory
Quantity: 100,000 units
Unit price: 1 cent
Total amount: \$1,000.00
Physical inventory
Quantity: 99,600 units
Adjusted unit price: \$1,000/99,600 units=1.004 cents
Total amount: \$1,000.00 (unadjusted)

to theft by dishonest employees instead of errors in book entries or mistakes made in good faith. If the investigation shows that the variance is due to a loss, it should be removed from the material ledger; that is, an entry should be made on the credit side of the material account and at the same time on the debit side of "Inventory Adjustment." The balance on the material ledger should, of course, be adjusted by the same amount. The balance on the inventory adjustment account in the general ledger shows the amount of materials which were paid for but which no longer exist in the business enterprise. This balance should be charged to the profit and loss account at the end of a fiscal period, as an item of general expenses. It does not occupy the position of manufacturing costs.⁴⁸ It is evident that Moxey disposed of the variance according to its cause, although he seems to have used the size of the variance **in** choosing how to dispose of it.

He maintained that the same kind of comparison should also be made in accounting for labor costs. In this field of cost accounting the total hours recorded on the work cards for operations performed by each individual employee are checked each day with the hours recorded on his time card (that is, the in-and-out clock card). Of course both totals should agree. Differences might occur because a foreman did not assign a job to the workman in advance, or because a timekeeper happened to omit the time records even though the workman worked on the job. In both cases the time lost should not be charged to work-in-process as an item of manufacturing costs.⁴⁹ Moxey concluded that the difference between the wages paid and the labor cost charged to work-in-process should be transferred to the "Labor Adjustment Account" from the labor cost account; the balance on the labor adjustment account shows the loss of direct labor.⁵⁰

Lastly, he recommended an idle capacity account, in which the difference between manufacturing expenses actually incurred and applied to products by a predetermined machine rate would reside.⁵¹

VI. Actual Normal Cost Accounting

Limitations of Historical Cost Accounting

Historical cost accounting had been considered the most perfect method of cost accounting. In reality, however, it had serious limitations which cost accountants began to be especially aware of in accounting for manufacturing expenses.

One of the limitations is that too much clerical labor is necessary for calculating the historical cost of a product, and consequently the historical cost records cannot be kept up to date. To calculate the historical manufacturing expense for a product, for example, we should first determine the total amount of the historical manufacturing expenses incurred for a period. This compels us to defer the calculation until the end of a month. Then we can calculate the historical burden rate on some basis such as direct labor, direct labor hours, and so on. Finally we apply these historical expenses to products. If a company makes some thousands

⁵⁰ *Ibid.*, pp. 61–62.

⁵¹ We will consider the problem in detail with the connection of the development of the machine rate in the next chapter.

⁴⁸ Ibid., pp. 42-43.

⁴⁹ Ibid., pp. 58-59. We should say that the cost for the omitted hours has a production cost character, although the idle hour is a loss.

of products, the enormous amount of clerical labor for the calculation and for the entry of the results into the production order cards can be easily imagined. It is not unusual therefore for management to receive the historical cost reports for a period already one or two months past. Since the management has no interest in such long-delayed reports, the historical cost records, which have been the fruit of the cost accountants' great efforts, are filed away without being used by the management.

The other limitation is worse than the first. The hitsorical cost of a product is useless for the purposes of pricing and income determination. As explained in the preceding chapters, the historical cost of a product is calculated on the basis of the actual price and the actual consumption factors. As a result the calculated historical cost is influenced by the accidental fluctuations of many variable factors, such as the price of materials, the efficiency of labor, the production lot, the product mix, the market conditions, and even labor strikes, fires, and earthquakes. Among these, the volume of business is the decisive factor and the one which has a dramatic effect on the fluctuation of the unit cost of a product. As the reader knows, the historical unit cost of a product fluctuates inversely with the change of business volume; when the volume of production is low, the historical unit cost of a product is high, and vice versa. This is because of the fixed portion of manufacturing expenses. Suppose there happens to be a period of depression, and a manufacturer is eager to get additional orders. Then a buyer comes to our manufacturer and asks him the sales price of his products. It is quite obvious that the manufacturer cannot get the new order if he bases his sales price on the data of historical unit cost, because his unit cost is high when the production is low. On the other hand, he can get more orders in prosperous days if his sales price is based on the historical unit cost. Hence the policy of pricing on the basis of historical cost records tends to cause a considerable fluctuation in the business income. Such situation is far from the ideal of manufacturers, who want to have a stable business income which increases constantly. Why, then, does not the true cost serve managerial purposes? In asking this question, cost accountants began to think that historical costs are not true costs, but accidental costs.⁵²

Alexander Hamilton Church and his Overhead Costing Theory

Alexander Hamilton Church was an electric engineer who emigrated to the United States from England around the turn of this century. In 1901 he wrote a series of articles under the title, "The Proper Distribution of Establishment Charges," which were published in the *Engineering Magazine*.⁵³ His articles indeed represent the starting point for studying modern cost accounting theory.

At that time "the percentage-on-wages method," "the hourly-burden plan," and the old "machine-rate method" were the most widely used methods among business firms in this country for applying manufacturing expenses to products. Church began by analyzing the advantages and the disadvantages of these three methods. The first two, he pointed out, had

⁵² "Accidental costs" is the terminology used by Professor Lang. He wrote, "Regretfully, the conclusion is that actual costs are really accidental costs and, therefore, strangely enough, not true costs as the term is understood today."

Lang, T., "Concepts of Cost, Past and Present," in Solomons (ed.) Studies in Costing (London: Sweet and Maxwell, Ltd., 2nd Impressin, 1959), p. 82.

⁵⁸ Engineering Magazine, Vol. 21, July-September, 1901, pp. 508-517, 725-734, 904-912; Vol. 22, October-December, 1901, pp. 31-40, 231-240, 367-376. These articles were reprinted by John R. Dunlop in 1908, and by The Engineering Magazine Co. in 1916, under the title "Proper Distribution of Expense Burden."

a common disadvantage: they ignored the difference in costs between a job done by a simple and inexpensive machine and a job done by a complicated and expensive machine, because these two methods apply the total manufacturing expenses to products on some single basis (direct labor costs for the first method and direct labor hours for the second method). Consequently the applied manufacturing expense for a product came to be an "averaged result."

The old machine-rate method, on the other hand, had no such a disadvantage, because it is a method using machine rates which vary with the characteristics of the machine. This method did not, however, apply all the manufacturing expenses to products, but only those manufacturing expenses which were directly concerned with the machine. Moreover, they were "hourly charges, based on the probable life of the machine under full work." When the machine did not work to its full capacity, there remained some amount of unabsorbed burden, the treatment of which was neglected in the accounting records.⁵⁴

Here some explanation of the differences in these three methods may be necessary. While the first two methods were devised for the purposes of pricing and inventory valuation, the old machine rate was devised mainly for the purpose of cost control. Machines in a plant are classified into several groups according to the kind of machine, and each group is considered as an independent little shop. The machine rate of the little shop, therefore, can be compared to the rent of this little spop. In other words, the management of the plant leases the little shop out to a foreman at the machine rate. Whether the lease is profitable or not for the management can be found out by comparing the applied manufacturing expenses (the predetermined machine rate, multiplied by the actual machine hours for the little shop) with the actual manufacturing expenses for the period. The old machine rate was a managerial tool for evaluating foremen's performance. That is why (1) only those manufacturing expenses which are directly concerned with the machine were included in a machine rate,⁵⁵ (2) the machine rate was based on its full capacity, and (3) unabsorbed burden was not treated in accounting records.

In the light of these differences, which method is more advantageous? Although the old machine rate has the limitations mentioned above, it also has great merits. One of these is that it takes into consideration the differences in costs created by the use of different machines. In this sense the manufacturing expense derived for a product by applying the old machine rate is more accurate than the expense derived by the other two methods. The other merit, which is more important from our point of view, is that this method overcomes the limitations of historical costs. As explained above, the old machine rate had been a predetermined rate from its beginning, a characteristic which is essential for cost control.⁵⁶ By adopting a predetermined rate, it is possible to overcome one of the limitations of historical cost accounting, that is, the excessive clerical labor for costing and the delay of cost reports. On the other hand, the influence that variation in volume has on the unit cost of a product can also be removed by the predetermined rate, so that management may compare the unit cost in the

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⁵⁴ Church, Proper Distribution of Establishment Burden (New York: The Engineering Magazine Co., 1916), p. 43.

⁵⁵ The salary of a foreman, for example, was not included in the old machine rate, because it is an uncontrollable cost for him. Chamber of Commerce of the United States, Washington, D.C. (Department of Manufacture), *The Evolution of Overhead Accounting*, 1927, p. 9.

⁵⁶ Although either of the other two rates could have been used as a predetermined rate, these rates were the actual rate for the purpose of inventory valuation. Needless to say, historical costing was dominant for determining income in those days.

current period with the unit cost in the past period or periods for cost control.⁵⁷ Moreover, the old machine rate is not a mere predetermined rate. It is quite similar to the normal burden rate based on practical capacity today, by which we can determine the whole amount of idle costs.

Church clearly realized these merits of the old machine rate. All his efforts, therefore, were to reinforce the method. One of the weak points was that the method did not apply all the manufacturing expenses to products. He argued that this problem could not be solved as long as the plant was viewed vaguely as a whole; it must be considered an organization consisting of independent small shops united by certain bonds. He called the small shops "production centers," and he tried to attach manufacturing expense as much as possible to each center.⁵⁸ The second weak point in the method was that it ignored the accounting treatment of unabsorbed burden. He solved this problem by applying unabsorbed burden to products by a "supplementary rate."

Thus, Church advocated the theory of the "scientific machine rate" connected with the "supplementary rate." His theory may be summarized as follows:

- The scientific machine rate is carefully determined on the basis of the estimated manufacturing expenses, derived from data collected for each production center, and the capacity of the machine.
- (2) Actual manufacturing expenses incurred for a period are charged to the monthly shop-charges account.
- (3) The total of applied manufacturing expenses, which are calculated by the scientific machine rate multiplied by the actual machine hours, is credited to the above account. It should be noted that applied expenses cover only those expenses which can be reasonably traced to production centers.
- (4) At the end of the month there remains the unabsorbed burden in this account. It is clear that the unabsorbed burden consists of general or what he called "floating expenses" which cannot be reasonably traced to production centers and those expenses which could have been applied to products if machines had worked to their full capacity.
- (5) Then the unabsorbed burden is applied to products according to the supplementary rate. The rate is determined either by dividing the unabsorbed burden by the total of actual machine hours, or by dividing the unabsorbed burden by the applied manufacturing expenses.
- (6) In this way a product is charged its own manufacturing expenses by applying the scientific machine rate, and further charged the average portion of general expenses and idle costs by applying the supplementary rate.⁵⁹

⁵⁷ Church pointed out that the old machine rate established "a permanent relation" between jobs and machines, which does not vary by the volume of business.

Church, *ibid.*, pp. 44-45.

⁵⁸ The idea of production centers had originated in the old machine-rate method. His contribution was to define the idea clearly.

⁵⁹ Ibid., pp. 74-75.

For further studies of Church's theory, see the following works: Solomons, D., "The Historical Development of Costing" in *Studies of Costing*, 1959; Garner, S. P., *Evolution of Cost Accounting to 1925*, 1954; Matsumoto, Masao, Hyojun Genkakeisan Ron (*Standard Cost Accounting Theory*) (Tokyo: Kunimoto Shobo, 1961). Kubota, Otojiro, Kansetsuhi Keisanron (*Overhead Costing Theory*) (Tokyo: Moriyama, 1953), pp. 131-151.

Limitations of Supplementary Rate

When Church's articles were published, they were given the place of a standard reference work among cost accountants. Before long, however, serious limitations were found in his theory. One of the limitations was that the supplementary rate did not indicate shop efficiency. Church thought that the unabsorbed burden at the end of a month consisted of general expenses and idle costs; if the shop worked to its full capacity, the amount of the supplementary rate became minimum, because only the general expenses remained; the more the shop approached idleness, the higher the amount of the supplementary rate became. Consequently, he believed that the supplementary rate could be an index of the shop efficiency.⁶⁰ It is apparent, however, that the supplementary rate increases regardless of the volume of business. Even if the shop works to full capacity, the supplementary rate increases because of the increased price of indirect materials or because of inefficiency in consuming the indirect expenses.

Effort to Improve the Supplementary Rate

John R. Wildman, an assistant professor at New York University, tried to improve the supplementary rate. He advocated the use of two supplementary rates. He illustrated his theory as follows:

(Data)

a. Full capacity of a machine: 2,400 hours

- b. Estimated manufacturing expenses of the machine for a year: \$2,400.00
- c. Scientific machine rate of the machine: \$1.00
- d. Actual hours for the current year: 2,000 hours
- e. Actual manufacturing expense for the current year: \$3,000.00

(Supplementary rates)

On the basis of the above data, he calculated the first and the second supplementary rates.

1. The first supplementary rate =
$$\frac{(2, 400 \text{ hours} - 2, 000 \text{ hours}) \times \$1.00}{2,000 \text{ hours}} = 20 \text{¢}$$

2. The second supplementary rate =
$$\frac{\$3,000.00-\$2,400.00)}{2,000 \text{ hours}} = 30 \text{¢}$$

If production order No. 1 needed 575 machine hours, the application was made as follows: $575 \times 1.00......$ 575.00

Thus, the application of manufacturing expenses to products is made three times. The intention is obvious. Wildman wanted to apply the volume variance to products by the first supplementary rate and then to apply the budget variance to products by the second supplementary rate.⁶¹

Idle Cost as a Loss

Wildman's effort had resulted in success so far as the separation of the volume and burden

⁶⁰ Church thought that capacity management was a problem of commercial efficiency or general efficiency of management. Therefore he confused the problem with that of labor efficiency.

Ibid., p. 99.

⁶¹ Wildman, J. R., *Cost Accounting* (New York: The Accountancy Publishing Company, 1911), p. 73. Needless to say, his volume and budget variances are determined with the use of fixed budget.

budget variances was concerned. However, cost accountants objected to his application method as impracticable. Even one supplementary rate had been too troublesome for them. They therefore began to give attention to the nature of unabsorbed burden, a large portion of which was composed of idle costs, and they questioned the necessity of taking so much trouble to apply idle costs to products.

In 1906 John Whitmore vacillated in his views regarding idle costs as an aspect of product costs. He wrote that the idle cost should be deducted ftom periodic revenue,⁶² although in another part of the same article he accepted them as an aspect of product cost and supported their application to products.63 Frank E. Webner took a practical attitude toward the problem. He admitted the product cost character of idle costs. Nevertheless he doubted the practical value of the supplementary rate. His way was not therefore to enter the idle costs into formal accounting records, although he supported the recording of idle hours by their causes for managerial purposes.⁸⁴ In 1913 Edward P. Moxey advocated that idle cost should be directly charged to the profit and loss account. The use of the supplementary rate was, according to his view, unreasonable and unsatisfactory because the calculation depended upon the company's ability to estimate the working hours of the plant, and an accurate estimate was almost impossible with a fluctuating demand. The best way was to set up an idle capacity account to which the costs of idle hours were charged. This account, he explained, showed the degree of idleness in the production capacity of the plant.⁶⁵ Such a view gradually gained popularity among cost accountants. In 1906 William J. Gunnel and John P. Jordan, both public accountants in Buffalo, charged unabsorbed burden to the monthly profit and loss account in the cost system for their clients.66 The Gantt Company, according to Walter N. Polakov, who worked with H. S. Gantt, adopted the same method in 1908. C. E. Knoeppel had also used the same method in the cost system for Struthers Wells Company in Warren, Pennsylvania.67

Rationale of the Normal Burden Rate Based on Practical Capacity

The scientific machine rate was also called a "normal burden rate" by cost accountants, because the machine rate was determined on the basis of the full capacity of the machine, and the full capacity was considered the normal condition of the business activity. As we have seen, many cost accountants had adopted the normal burden rate and charged the unabsorbed burden directly to the porfit and loss account. Nevertheless, the theoretical basis for the method had not been clearly explained. It was Clinton H. Scovell who established the rationale of the normal burden rate based on the practical capacity by clarifying the loss

68 Whitmore, *ibid.*, p. 257.

⁶⁴ Webner, F. E., *Factory Costs* (New York: McGraw-Hill Book Co., 1911), pp. 321-326. He expected that the underabsorbed burden in a slack period would be absorbed in a busy period. *Ibid.*, p. 319.

⁶⁵ Moxey, E. P., *ibid.*, pp. 85–87.

67 Ibid., pp. 398-401.

⁶² Whitmore, J., "Factory Accounting As Applied to Machine Shops," The Journal of Accountancy, Vol. II, 1906, p. 21.

Garner, *ibid.*, p. 220.

For further study of Whitmore's theory, see Garner, *ibid.*, pp. 218-220 and Kubota, Otojiro, Kansetsuhi Keisan Ron (*Overhead Costing Theory*) (Tokyo: Moriyama, 1953), pp. 152-162.

⁶⁶ We can see such an accounting treatment in the manufacturing expense account of Waterous Engine Works Co. in June, 1907.

Jordan, J. P. and Harris, G. L., Cost Accounting, Principles and Practice (New York: The Ronald Press, 1920), pp. 398-400.

character of idle costs. In 1916 he gave the following argument in his work: Assume that we have two plants in different cities. Owing to a slowdown in business, one of these plants is shut down, although the other is working to its full capacity. Under such conditions is it reasonable to include the cost of idle capacity for the first plant in the manufacturing cost of products from the second plant? The answer is absolutely negative. Consider another example. Assume, further, that we have two departments in a plant. Again, owing to slack business, one of these departments is shut down, although the other department works to its full capacity. Under such conditions is it reasonable to include the cost of idle capacity for the first department in the manufacturing cost of products produced in the second department? Again the answer is of course negative.

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By this illustration he succeeded in proving that idle costs have nothing to do with the manufacturing cost of products. Therefore these costs are losses and should be recovered, not through manufacturing costs of products, but through total revenue for the period.⁶⁸ When we use the normal burden rate based on practical capacity, we can exclude the entire amount of idle costs or losses from applied expenses. This is the rationale of the practical capacity rate.⁶⁹

From Practical Capacity Rate to Average Capacity Rate

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The practical capacity rate was useful for management so long as machines normally worked at full capacity. When Church advocated his scientific machine rate, it was generally accepted that management was responsible whenever the plant was idle. This is the reason why Church believed that managing capacity was a problem of general "efficiency" of management.

With the maturing of the American economy, however, manufacturing has suffered from the curtailment of production. The use of the practical capacity rate under such conditions always results in unfavorable volume variance, however hard management may try to get business. Therefore cost accountants gradually gave up the use of the practical capacity rate and began to adopt the normal burden rate based on the average capacity.⁷⁰ In 1906 Whitmore realized that it was unreasonable to set practical capacity rates indiscriminately for all the machines of a plant. He classified the machines into three groups according to their degree of use. The first group consisted of efficient machines which were expected to work to their full capacity. The second consisted of machines used only for special purposes, although they were efficient and in good working order. The third consisted of inefficient machines kept in

⁶⁸ Scovell, C. H., Cost Accounting and Burden Application (New York: D. Appleton and Co., 1916), p. 71; pp. 179-180.

⁶⁹ Professors Schlatter and Schlatter, and Professor Bamba support the practical capacity rate on the basis of this reasoning.

Schlatter, C. F. and Schlatter, W. J., Cost Accounting, (New York: John Wiley and Sons, Inc., 2d ed. 1957), p. 435.

Bamba, Kaichiro, Tanaoroshi Shisan Kaikei (Accounting for Inventories) (Tokyo: Kunimoto Shobo, 1963), p. 774.

⁷⁰ The practical capacity is determined by deducting the decrease in production due to repairs of machines, shortage of materials, physical inventories, and other unavoidable shutdowns which prevent the plant from meeting the theoretical maximum capacity. Hence, it is determined solely from the technical viewpoint. On the other hand, average capacity is the average volume of production which can be expected in several future periods. For further details, see Diekey, R. I. (ed.) Accountant' Cost Handbook (New York: The Ronald Press Co., 1960, 2nd ed.), p. 102.

reserve to provide needed production when all the efficient machines were already being used. Then he calculated the machine rates by these groups. The machine rate for the first group was the basis for calculating the machine rates for the other groups.⁷¹

In 1911 Webner explained how to determine standard working hours for machines. His method was to set "the maximum efficiency of the machine under existing conditions" by deducting unavoidable shutdowns from "the highest output of the machine under ideal conditions."⁷² Webner seems to have supported the use of practical capacity. As mentioned above, however, he expected that the underabsorbed burden in a slack period would be absorbed in a busy period. If he expected the offset at the end of a year, his standard hours were not the practical capacity.⁷³ Moxey seems to have determined his standard machine hours by considering the demand for the products when he referred to the limitation of the supplementary rate. In short, we cannot identify the machine rate of these writers with the practical capacity rate.

It was during the slack period after World War I when cost accountants began to support the average capacity rate. J. P. Jordan and G. L. Harris may be cited as two of the earliest advocates of the average capacity rate. Having emphasized the limitations of historical cost data as a basis for the pricing decision, they maintained the use of the departmental normal burden rate, which was determined by using the monthly average of manufacturing expenses over a long period for the purpose of estimating the sales price, and figuring the product cost for income determination.⁷⁴

Because their intention was to cancel the influence that seasonal activities of the business might have on the applied burden, their "long average" means only the average for one year for most industries.⁷⁵

The Rationale of Normal Burden Rate Based on Average Capacity

When Jordan and Harris supported the average capacity rate, they cited the rationale advocated by C. H. Scovell as their theoretical basis. This was a mistake. The rationale of the practical capacity rate cannot be applied to the average capacity rate, because a part of idle costs is applied to products by the average capacity rate. To defend the use of the average capacity rate, one must explain why a part of idle costs, which is a loss, can be a legitimate cost of a product.⁷⁶ Jordan and Harris did not know the difference between the practical capacity rate and the average capacity rate.⁷⁷

Their explanation of the disposition of overabsorbed or underabsorbed burden was therefore vague. When the practical capacity rate is used, the idle costs should be directly charged to the monthly profit and loss account, while the calendar variance should be deferred to the

¹¹ The machine rate for the first group was calculated on the basis of 2,430 standard hours, which was determined by counting 300 working days a year, deducting 10 per cent for unavoidable shutdowns, at 9 hours a day (9 hours \times 300 days \times 90 per cent). Kubota, O., *ibid.*, pp. 157–158.

⁷² Webner, *ibid.*, p. 320.

78 He could expect the offset of calendar variances at the end of a month with the practical capacity rate.

⁷⁴ Jordan, J. P. and Harris, G. L., Cost Accounting. Principles and Practice (New York: The Ronald Press, 1920), pp. 392-393.

⁷⁵ Loc. cit.

⁷⁶ The part of idle costs which is applied to products by the average capacity rate is calculated by the following method: (average capacity rate-practical capacity rate)×(actual volume of production). See Schlatter and Schlatter, *ibid.*, p. 413.

 77 As a result they criticized, not the practical capacity rate, but the historical cost when they advocated their average capacity rate.

subsequent months. When the average capacity is used, on the other hand, volume variance should be carried forward and should be offset within the period used in calculating the average capacity rate. If the balance still remains at the end of the period, it should be transferred either to the profit and loss account or to the earned surplus account, according to the net profit concept of the company. Jordan and Harris, however, described both of these methods; in one part of their work they explained the method of offsetting within a year, while in another they gave examples of transferring the variance to the monthly profit and loss account. They seem to have supported both methods.⁷⁸

It was C. B. Williams who found the proper approach to the problem. On April 4, 1921, he addressed the local meeting of the American Institute of Accountants in Detroit titling his speech the "Treatment of Overhead When Production Is below Normal." He argued as follows: Most accountants would think that one year, which is further divided into twelve months, is a proper accounting period. However, is it too much to say that we have been mistaken in this point? Capitalists do not invest their money in a manufacturing plant for only one year's gain. Rather, they expect to get satisfactory profits for a number of future years. These profits are based on the normal cost of production as well as the expected sales price. Because an entrepreneur plans his business activities according to the "expected normal volume of business over a period of years," overhead accounting should also be considered from "the standpoint of a reasonably long period of time."⁷⁹ Today we can find this idea in the theory of income determination advocated by A. C. Littleton and R. L. Brummet. Since the present writer wrote on this subject several years ago,⁸⁰ only the main points are mentioned here.

In 1937 Littleton argued that the concepts of business income could be stated in the following way: a management plans the future activities of the company after considering a number of alternative courses of future action. And costs are incurred just when the plan is carried into effect. Costs, therefore, represent the "quantitative measures of policies translated into action."⁸¹ Because costs are the causal factor and revenues are their effect, the plan or intent of management should be emphasized in the theory of income determination so that we may match revenue and expense more reasonably. Brummet supported this view. He maintained that a periodic net profit of a company can be an index for the company's economic progress (or the performance of its management.⁸² For this reason he advocated that the "longrun planned utilization of facilities" is the most appropriate basis for the overhead application for income measurement.⁸³ Management would plan to recover capital investments through all the products manufactured in the entire period between the installation and the removal of the equipment. It is true that idle costs are losses. However, that part of them which is

⁷⁸ *Ibid.*, pp. 394–399.

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⁷⁹ Williams, C. B., "Treatment of Overhead When Production Is below Normal." *The Journal of Accountancy*, Vol. 31, No. 5, May, 1921, pp. 337-338.

⁸³ Ibid., p. 71.

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⁸⁰ Okamoto, K., "Controversy in the U.S.A. on True Costs" Hitotsubashi Journal of Commerce and Management, Vol. 2. No. 1, 1962.

⁸¹ Littleton, A.C., "Concepts of Income Underlying Accounting," *The Accounting Review*, Vol. XII, No. 1, March, 1937, p. 19.

⁸² Brummet, R. L., Overhead Costing: The Costing of Manufactured Products (Ann Arbor: Bureau of Business Research, Graduate School of Business Administration, University of Michigan, 1957, pp. 21–26, pp. 46–75.

applied to products by the average capacity rate is a legitimate part of the manufacturing costs of the products, because it is incurred by the management for the purpose of obtaining satisfactory profits for a long period.

From the True Cost to the Relevant Cost

We have traced so far the development of the theory of normal burden. It should be noted that the same phenomena can be seen in other fields of cost accounting. For example, the monthly or moving average method in the costing of materials issued has been accepted in order to exclude the accidental fluctuation of material prices. Today the specific cost method is not considered an accurate method for costing stock materials. Another example is the inclusion of the normal spoilage cost in product costs and the exclusion of the abnormal spoilage loss from product costs. These phenomena may be called the normalization of historical costs. In other words, cost accountants began a long way back to think that the historical cost was not the true cost, and that the normal actual cost was the true cost.⁸⁴ Today they are beginning to think that there is no true cost; actual normal cost is a "more meaningful and representative" cost for the purposes of the pricing and income determination.⁸⁵ In short, the concept of historical cost should be normalized in order to get the relevant cost for these purposes.

In the next chapters we will consider the development of standard cost accounting, direct costing and differential cost and revenue analysis.

(to be continued)

⁸⁴ It is interesting to note that Church came to the conclusion that "normal costs due to the call on services at the tool point" is the true manufacturing expense of a product. Church. A. H., "Production Factors in Cost Accounting and Works Management" (New York: *The Engineering Magazine*, 1910), pp. 119-121.

⁸⁵ Horngren, C. T., Cost Accounting: A Managerial Emphasis (N. J.: Prentice-Hall, Inc., 1962), p. 95.