

Nineteenth-Century Cost Management Systems

MANAGEMENT accounting first appeared in the United States when business organizations, instead of relying on external markets to direct economic exchange, began conducting economic exchange internally. These developments occurred during the nineteenth century in industries involved in textile making, railroading, the manufacture of iron and steel, and retail distribution. Firms in these industries specialized in a single economic activity—manufacturing, transportation, or distribution—whereby they converted resources into products or services. By linking many separable processes, complex and extensive organizations evolved to handle each of the activities.

Entrepreneurs linked processes in the new single-activity organizations because they believed that greater value could be achieved by managing the processes in a centrally controlled organization than by exchanging outputs

from the processes in the market. Outputs of separate processes to make textiles, such as sheep shearing, spinning, weaving, and finishing, for instance, were traditionally exchanged in markets, often by merchants. By 1800, however, merchant-entrepreneurs in parts of Britain and America had undertaken to control the output of two or more of these processes (especially spinning, weaving, and finishing) in centrally managed enterprises. The owners of early textile-making firms and of other types of manufacturing firms that followed in their wake after 1800 hoped to achieve greater value by controlling the time that others spent in productive processes. At first the owners probably hoped that centralized control of the work force would enhance profit by stabilizing and increasing the flow of salable output. Very quickly, however, they also began to pay attention to the opportunity for increased profit that lay in reducing costs and increasing productive efficiency.

The owners of nineteenth-century, single-activity businesses created entirely new managerial accounting procedures to monitor and evaluate the output of internally directed processes. Of course, these businesses continued to rely on market price information to guide their external exchanges with suppliers or customers. They recorded these external exchanges using age-old bookkeeping methods, usually in double-entry. In their accounts of external exchanges, the firms kept track of what they owned and owed and, occasionally, of the profit on their exchanges with the outside world. These objectives were altered and new management accounting developments emerged, however, as a consequence of the firms' internally directed processes.

Historians often err in associating the origins of managerial accounting with the coming of "big business," especially railroading. Actually, management accounting preceded the railroads and had no connection with "big business" as such. It did not arise because vast organizations required it.¹ On the contrary, management accounting itself

may have facilitated the growth of large-scale firms. It could do so by reversing Adam Smith's famous proposition that the division of labor is limited by the extent of the market.² Management accounting undoubtedly widened the extent of the market—the quasi-market for exchanges inside a business firm—by rationalizing new internally directed opportunities for specialization and division of labor. Management accounting focused people's attention on the potential gains from *internal* coordination of economic exchange, thereby encouraging manager-entrepreneurs to increase the size of their firms. That this was the case will be confirmed by examining the development of management accounting in the nineteenth century. Such a study properly begins with scrutiny of representative firms engaged in manufacturing, transportation, and distribution. We first consider manufacturing by examining two firms: an antebellum New England textile-making firm and a late nineteenth-century giant steel-making firm.

Cost Management in Early New England Textile Mills

The first American business organizations to develop management accounting systems were the mechanized, integrated cotton textile factories that appeared after 1812.³ They used cost accounts to ascertain the direct labor and overhead costs of converting raw material into finished yarn and fabric. The double-entry cost accounts, among the earliest discovered anywhere, differed radically from any accounting records used previously. A perceptive description of that difference was provided over fifty years ago by D R Scott.

Before the industrial revolution, accounting was mainly a record of the external relations of one business unit with other business

units, a record of relations determined in the market. But with the advent of large scale productive operations . . . necessity arose for more emphasis upon the accounting for interests within the competitive unit and upon the use of accounting records as a means of administrative control over the enterprise. . . . The appearance of cost accounts in manufacturing . . . is [an] example.⁴

Scott recognized that before the advent of the modern factory, businesses used accounts primarily to record the results of market exchanges. He perceived that the development of a new kind of accounting activity accompanied the new mode of production.

The appearance of new accounting techniques in early textile factories was inextricably connected with management's desire to control the rate at which resources (raw materials, labor, and overhead) were converted into intermediate output. The managerial accounting that appeared in American textile-making firms after the early 1800s would have been inconceivable before the introduction of centralized control over production processes. Early managerial accounts do devote some attention to an organization's total costs and profit. They give primary attention, however, to the outlay on internally controlled resources per unit of intermediate output.

The accounts are particularly concerned with the "cost" of labor. The concern emanated, of course, from the wage system, in which workers surrender control over their labor time. Arguments about the causes, costs, and possible benefits to workers of surrendering control over their labor in return for a fixed income have abounded since Ricardo and Marx. Our concern, however, is with the implications for accounting of the complications that factory managers faced once workers were employed at a wage.

Before the coming of the factory, all intermediate components going into a manufactured product were market-priced outputs. In the pre-factory domestic system, for instance, a market-based price—a piece rate—was paid for

the output of independent artisans or subcontractors who carried out almost every process involved in the manufacture of a product. In textile making under the domestic system, spinners were paid per pound for yarn, weavers were paid per yard for cloth, and assemblers were paid per unit. Although merchant-entrepreneurs coordinated the flow of this intermediate output from raw fiber to finished fabric or garment, they did not assume the task of controlling the time spent by artisans in each process. Hence, they kept accounts only to record past exchanges and to keep track of widely scattered inventories. They would not have required information from those accounts to rationalize their undertakings. Indeed, market prices supplied every conceivable bit of information for decision making and control.⁵ The market supplied the merchant not only with prices for raw materials and finished goods, but also with prices for all intermediate outputs used in domestic-style production.

Market prices stopped supplying all conceivable information for decision making and control when merchant-entrepreneurs contrived to administer the work of laborers by gathering them together into a centralized workplace.⁶ In the factory, wage contracts were substituted for market piece-rate contracts, and overhead items such as hauling and repair work also began to be supplied internally, not subcontracted. No automatic market signals existed to allow one to evaluate internal intermediate output. The market wage paid to factory workers, for instance, contained only partial information about the price of the intermediate output produced by the worker, the missing information being, of course, the worker's productivity during the time he earned his wage. Whereas market piece rates automatically assigned an unambiguous value to intermediate output in the market-mediated domestic system, managers devised procedures to synthesize these values in the administratively organized factory system. In fact, we find that early textile factory cost accounts match the wages paid to work-

ers with the output produced. These "accounted" cost per unit figures were analogous to, if not the same as, the prices paid for intermediate outputs in the market. Most important, they provided a rational basis to evaluate internal conversion costs and to compare these costs with external market prices.

Among the earliest manufacturing cost records known to American historians are those from integrated, multiprocess cotton textile mills founded in New England during the first half of the nineteenth century. The earliest of these records comes from the Boston Manufacturing Company in Waltham, Massachusetts. Boston Manufacturing was the first mechanized textile mill to integrate in a single plant the processes of spinning and weaving. Company records from as early as 1815 reveal that the Waltham firm used a remarkably sophisticated set of cost accounts.⁷ Indeed, these accounting procedures were adopted by the founders of other New England textile companies that used production methods similar to those of Boston Manufacturing's famous "Waltham system."⁸ One such company for which particularly complete records still exist is the Lyman Mills Corporation. Lyman Mills operated a water-powered, integrated cotton textile mill built during the late 1840s in Holyoke, a town in western Massachusetts.

The accounting records of Lyman Mills, which survive from the early 1850s, are extraordinarily revealing.⁹ They include double-entry general ledgers and subledgers kept by the treasurer at the home office in Boston, as well as double-entry factory ledgers with related inventory, payroll, and production subledgers kept by the Holyoke mill agent. Reciprocal entries in the home office and factory ledgers were kept current by means of daily correspondence between the treasurer and the agent. The Holyoke factory ledgers include accounts for current assets, current liabilities, and all operating expenses. The factory ledgers also include two accounts, referred to as "mill" accounts, in which charges were

entered for all direct and indirect manufacturing costs incurred at the Holyoke site. One of the mill accounts was charged with manufacturing costs related to coarse goods production and the other with manufacturing costs related to fine goods production. The Boston general ledgers include not only all the accounts kept in the Holyoke factory ledger, but also additional accounts for plant and equipment, capital stock, long-term liabilities, and profit and loss. Sales and nonmanufacturing expense figures were entered only in the home office general ledgers, where they appear in the appropriate mill account. Every six months, all books were closed to determine profit and loss.

The two mill accounts kept in the Holyoke factory ledger (see Figure 2-1) apprised management of the *total* manufacturing costs incurred for both grades of final output. Every accounting period, each mill account, one for coarse goods and the other for fine goods, was charged with its respective share of cotton, factory labor, and factory overhead expense. Charges to the mill accounts were transferred from separate control accounts kept in Holyoke. Cotton, the largest single item of expense, was charged to the mill accounts at the end of each six-month accounting period at the cost of raw material that had been used in production through the weaving stage. "Cost" was based on the contract price of cotton, including freight and insurance charges, and was calculated semiannually (after inventory taking) on a first-in, first-out basis. Factory payroll, the next largest item of manufacturing expense, was distributed to the mill accounts monthly in accordance with daily records from each mill that showed employee hours for every process (for example, picking, carding, spinning, warp weaving, weaving). Factory overhead, including costs of repairs, fuel, starch, teaming, supplies, and the Holyoke office, was distributed to each mill account semiannually according to several criteria such as floor space, number of looms, and the rated horse power of water turbines.

Figure 2-1 (cont.)
B. Accounts in factory ledger

HOLYOKE Plant Ledger	Cotton No. 1	HOLYOKE Plant Ledger		Mill No. 1
(Same as home office ledger account)		18xx	78,361	Dec. 31
		July-Dec.		To Treasurer
		Manufacturing		(reciprocal account)
		payroll		
		Dec. 31	296,950	
		Cotton used		
		Dec. 31	42,855	
		Manufacturing		
		overhead		
			<u>418,166</u>	
			<u>418,166</u>	

1. Similar accounts were kept for Mill No. 2.
2. Based on a physical inventory of raw cotton and yardage in process through the weaving stage. The pounds of cotton in inventory were valued at cost on a first-in, first-out basis.
3. Based on a physical inventory of yardage finished beyond the weaving stage and on hand at the mill or with the selling agent. The pounds of cotton in inventory were valued at an arbitrary amount close to actual cost. No amount included for payroll or overhead costs.

In the Boston general ledgers, the amounts charged to each mill account for cotton, factory labor, and factory overhead are identical to amounts recorded in the same mill account in the Holyoke ledgers. The Boston general ledger mill accounts also contain entries for items such as nonmanufacturing payroll, insurance, and general (presumably Boston office) expenses. Moreover, each Boston general ledger mill account is credited with sales of finished products and ending inventory values every six months. Therefore, the Boston general ledger mill accounts rationally allocated total profit to the separate mills. When combined, the accounts provided profit and loss data useful in determining the semiannual dividend to shareholders. Separately, each account provided top management in Boston with information about the profitability of the respective Holyoke mills. The mill accounts in the Holyoke factory ledgers, however, recorded costs, and only costs, incurred in Holyoke.

It is evident that Lyman Mills did not compile the cost accounting data in their mill accounts in order to attach costs to product inventory for financial reporting purposes. In the balance sheets found in Lyman's unaudited semiannual reports to stockholders, the inventories of raw cotton and goods in process are valued at market prices, or nearly so.¹⁰ And elements of manufacturing cost such as labor and depreciation are not handled in the factory ledger mill accounts as one might expect were the accounts to be used to value inventories. Depreciation expense does not appear at all in the factory ledgers. Instead of depreciation, charges for plant, equipment, and major renovations are charged currently against profit and loss. Moreover, these charges appear *only* in the home office ledgers. They affect not the manufacturing cost data compiled in the factory ledgers, but only the data on total performance in the Boston ledgers. The overhead items that appear in the factory ledger mill accounts are for periodic outlays on common costs such as supervision, repairs, maintenance, bleach, dyes, fuel, and teaming. These allocated overheads are treated as costs of

the period; none is capitalized in work-in-process inventory, contrary to the policy required in twentieth-century manufacturing cost accounts.

Besides the mill accounts, Lyman Mills books contain other records about company-made intermediate output. They contain cost reports that were designed to keep careful track of the efficiency with which the company used cotton, labor time, and general overhead. The reports especially emphasize labor time. Registers that record daily both the wages earned by each worker and the pounds of cotton converted in every single process—picking, carding, roving, spinning, warping, weaving, dyeing, and finishing—are included in the company's records, even as far back as the 1850s. By combining data from these two sets of records, it is possible to determine for each process conducted in the mill the daily direct labor cost per unit of output, although the company seems to have compiled such data no more often than monthly. Monthly manufacturing cost statements, prepared separately for each mill, show the average cotton and overhead cost per pound and per yard for total mill output. Similarly, they show average labor cost per pound and per yard of output in each separate process, including picking, carding, spinning, warping, and weaving. The information on labor expense and cotton usage in these monthly cost statements is current, but the unit cost factors for cotton and general overhead come from calculations made only once every six months, at the time of taking a full physical inventory of cotton. Semiannual cost of manufacturing statements show current actual costs, therefore, for labor, cotton, and general overhead (by detailed category). The totals for cotton and overhead in the semiannual statements agree with the charges made every six months to the factory ledger mill accounts. The preceding evidence reveals, then, that the company compiled very accurate information on all manufacturing costs semiannually and accurate information on labor costs at least monthly.

In addition to using information from special cost ac-

counts to discover the costs of internally made intermediate output, Lyman Mills compiled data about the unit cost of various styles of finished output. Internal company correspondence suggests that the company treasurer used this information to evaluate prices in the wholesale market and to negotiate special prices on large orders. The unit costs were not used, however, to value inventories. In the early years when the company had only two mills and a small variety of finished cloth styles, unit cost data included only raw material and direct manufacturing labor costs. By the 1880s when the company had five mills producing a multitude of styles, regular reports on unit costs began to include not only direct production costs, but also overhead. The costs resembled modern full-absorption unit product costs (except that no allowance was made for depreciation). It appears that these unit costs were calculated by allocating total manufacturing costs among various styles according to the weight and quantity of yarn used in each style.¹¹

When Lyman Mills and many other American textile mills that copied the Waltham system of the Boston Manufacturing Company began to manage the processes by which people convert raw material into finished output, cost accounts began to provide managers with vital information. The data in Lyman Mills manufacturing cost statements are drawn directly from the company's ordinary double-entry books of account, and they provide cost information that is systematically and reliably reconciled with profit and loss. But Lyman Mills managers did not invest resources in the compilation of this information in order to prepare their semiannual financial reports. They needed the information to make short-run decisions and to achieve control in the one aspect of their operation not governed by market exchange prices, the conversion of raw materials into finished goods. Since competitive market prices, beyond the manager's control, dictated the exchange rates for finished goods, for raw materials, supplies, and the laborers' time, the man-

ager did not need an accounting system to derive those prices. The mill manager, however, could influence the rate at which laborers converted raw cotton into yarn and fabric. Information from accounts about the cost of the conversion activity aided the manager's task of evaluation and control. Such information included the conversion cost per pound of output by department for each worker and for each type of direct overhead expense. Moreover, correspondence between mill foremen and the company treasurer indicates that they made short-run decisions about special-order prices and equipment modifications using contribution margin information that was derived from these direct conversion costs.

The early cost accounts of Lyman Mills also offered incentives and controls to mitigate slack behavior that might otherwise dissipate the productivity gains inherent in mechanized, multiprocess systems. Workers had a natural inclination to use their time efficiently when paid in the market for each unit of output they produced; they had no automatic incentive to pursue the same goal when paid a fixed wage per period. Periodically, Lyman Mills managers used cost information to monitor employee performance. They compared productivity among workers in the same process at the same time. In addition, they compared productivity for one or more workers over several periods of time. All cost information provided by these accounts was designed to focus managers' attention inward on the shop, rather than outward on the industry. The cost information helped managers evaluate internal processes and encourage workers to achieve company productivity goals. It is significant that these accounting procedures emerged at least fifty years before professional accountants became committed to the idea that manufacturing cost accounting exists to value inventories.¹²

Cost Management in a Late Nineteenth-Century Steel Works

Manufacturing operations conducted by the late 1800s in iron and steel, foodstuffs, petroleum, chemicals, and machinery making were vastly more complex and larger than were operations of the early nineteenth-century New England textile industry. Nevertheless, at the end of the century most of these large manufacturing organizations still conducted, as had the early textile firms, only a single basic activity, the conversion of raw materials into finished goods.¹³ It is not surprising, therefore, that the giant descendants of the first textile mills used refined and elaborate versions of the very conversion cost systems that had originated in early textile factories. Moreover, these capital-intensive giants paid no more attention than did early textile firms to the problems that present-day accountants associate with financial reporting, especially the problem of valuing inventories and goods sold.

The accounting information used by Andrew Carnegie, surely one of the shrewdest entrepreneurs of the nineteenth century, suggests how capital-intensive manufacturers used management accounting in the late 1800s. Although few persons have ever gained access to the accounting records of Carnegie Steel Company, those who have agree that Carnegie made a fetish of using cost statements to manage his giant steel works from 1872 to 1902. Carnegie's own brief descriptions of cost accounts as well as those provided by his former associates and by his latest biographer reveal that his system was concerned primarily with continuously gathering data on all direct costs in every process of the manufacturing activity, from blast furnace to rolling mill.¹⁴ Using these descriptions, Alfred Chandler has pieced together a vivid picture of Carnegie's cost system.

[Carnegie's general manager developed] statistical data needed for coordination and control . . . in part by introducing the

voucher system of accounting which, though it had "long been used by railroads, . . . was not [yet] in general use in manufacturing concerns." By this method, each department listed the amount and cost of materials and labor used on each order as it passed through the subunit. Such information [was used to prepare] monthly statements and, in time, even daily ones providing data on the costs of ore, limestone, coal, coke, pig iron (when it was not produced at the plant), spiegel, molds, refractories, repairs, fuel, and labor for each ton of rails produced. . . .

These cost sheets were Carnegie's primary instrument of control. Costs were Carnegie's obsession. One of his favorite dicta was: Watch the costs and the profits will take care of themselves. He was forever asking [department heads] the reasons for changes in unit costs. Carnegie concentrated . . . on the cost side of the operating ratio, comparing current costs of each operating unit with those of previous months and, where possible, with those of other enterprises. Indeed, one reason Carnegie joined the Bessemer pool, which was made up of all steel companies producing Bessemer rails, was to have the opportunity to get a look at the cost figures of his competitors. These controls were effective. . . . "The minutest details of cost of materials and labor in every department appeared from day to day and week to week in the accounts; and soon every man about the place was made to realize it. The men felt and often remarked that the eyes of the company were always on them through the books."

In addition to using their cost sheets to evaluate the performance of department managers, foremen and men, Carnegie [and his general managers] relied on them to check the quality and mix of raw materials. They used them to evaluate improvements in process and in product and to make decisions on developing by-products. In pricing, particularly nonstandardized items like bridges, cost-sheets were invaluable. The company would not accept a contract until its costs were carefully estimated.¹⁵

An interesting element of the financial information Carnegie relied on to make operating and investment decisions is that which concerned his competitors' direct production costs. Carnegie's operating strategy was to push his own direct costs below his competitors' so that he could charge prices that would always ensure enough demand to keep his

plants running at full capacity. The strategy prompted him to require frequent information showing his direct costs in relation to those of his competitors. Possessing that information, and secure in the knowledge that his costs were the lowest in the industry, Carnegie then mercilessly cut prices during economic recessions. While competing firms went under, he still made profits. In periods of prosperity, when customers' demands exceeded the industry's capacity to produce, Carnegie joined others in raising prices.

Andrew Carnegie's actions reveal that during the late 1800s, managers made quite sophisticated use of accounting information to rationalize the operations of large single-activity manufacturing concerns. Nevertheless, managers of these capital-intensive giants often gave inadequate attention either to asset depreciation or to the forecasts and the return-on-investment data that twentieth-century accountants commonly assemble in capital-intensive firms.¹⁶ But Carnegie's case demonstrates that large single-activity organizations, operating in the expansive market environment of late nineteenth-century America, did not absolutely require accounting information to select or to monitor long-lived assets. The weekly data on direct material and conversion costs for each process in his mills apparently was all the accounting information Carnegie required to invest more capital and to earn higher returns than any other steel-maker in the world before 1902. Carnegie's success depended upon good information about direct operating costs. For that, accounting systems mattered. For the rest, faith and intuition sufficed.

Cost Management in Railroads

After the 1840s America's new railroads also presented complex administrative problems—surely the most complex of any businesses in the nineteenth century. The

creation of large railroad companies by entrepreneurs wishing to capture the profits made possible by new iron and steam-power technologies marked the advent of "big business."¹⁷ Harnessing the new technologies to reduce transportation costs, the mid-century railroads grew to sizes that dwarfed the scale of the largest textile factories and that surpassed, by the 1880s, even the size of Carnegie's giant steel works. Managing these enormous entities was an unprecedented task, but by 1870 several railroad administrators had devised ingenious solutions that became the core of modern administrative practice. Alfred D. Chandler, Jr.'s important studies of nineteenth-century railroad administration document the leading role of railroads in resolving many problems of management, finance, labor relations, competition, and government regulations that faced giant enterprises in industrial sectors after 1900.¹⁸ Among the solutions achieved by railroads were internal accounting systems designed to provide information and control within large-scale administrative entities.

Unlike early manufacturing firms, railroads devised special recordkeeping systems that recorded enormous numbers of daily transactions and efficiently summarized the consequences of these transactions for frequent internal reporting.¹⁹ Railroads handled a vastly greater number and dollar volume of transactions than had any previous business. The recordkeeping techniques they created to handle and control efficaciously vast flows of dollars are familiar to businesspersons even today. To control and keep account of receipts from passengers and shippers, for instance, they devised systems both for collecting and depositing cash daily at hundreds of different locations spread over a vast geographic area and also for prompt reporting and transfer of funds to headquarter offices. To accomplish this, railroads led the way in developing prenumbered ticket and invoice procedures, in using imprest cash funds, and in using the telegraph to transfer both funds and information. The rail-

roads also devised new accounting systems to control disbursements of cash and to record disbursements in efficient ways that gave management timely and accurate reports on types of expenditures. The companies solved the problems of controlling and recording disbursements by creating what accountants know today as the voucher system of bookkeeping.²⁰

The railroads, like manufacturers, devised cost accounting systems to evaluate and control the internal processes by which they converted intermediate inputs into transportation services. Using the ton-mile as a basic unit of output, they created complex internal accounting procedures to calculate the cost per ton-mile. Perhaps the first railroad manager to use cost per ton-mile information, according to Chandler, was Albert Fink, general superintendent and senior vice president of the Louisville & Nashville in the late 1860s.²¹ Fink constructed sixty-eight sets of accounts grouped into four categories according to the different ways that costs varied with output.²² One category included maintenance and overhead costs that did not vary with the volume of traffic; another category included station personnel expenses that varied with the volume of freight, but not with the number of miles run; a third included fuel and other operating expenses that varied with the number of train-miles run; the fourth included fixed charges for interest. In the first three categories, Fink kept track of the operating expenses on a train-mile basis for each subunit of the railroad. With formulas he worked out to convert costs in each category to a ton-mile basis, Fink not only could monitor costs per ton-mile for the entire road and each of its subunits, but he also could pinpoint reasons for cost differences among the subunits.

The great complexity and geographic scale of a railroad organization suggest why managers such as Fink at the Louisville & Nashville felt compelled to develop more elaborate cost accounts than one finds in manufacturing concerns before the 1880s. The railroads did not simply appoint

one person to manage the integration of several specialized processes in one physical location, as was the case with factory manufacturing in the early textile industry. In railroads, the division of specialized tasks was carried out on such a vast and complex scale that there also had to be division of management tasks as well. As Chandler points out, American railroads were the first businesses in the world in which there was a hierarchy of managers who managed other salaried managers.²³ Cost accounting in the railroads became, then, more than just a tool for evaluating internal conversion processes; in the hands of Fink and those who followed him, it became a tool for assessing the performance of subordinate managers.

The railroads also went beyond most manufacturing concerns of the nineteenth century in developing accounting information about the impact of the organization's separate parts on its total financial performance. For example, the "operating ratio," a ratio of operating expenses to revenues that railroads studied assiduously, indicated how variations in the business of diverse subunits would affect the railroad's total performance.²⁴

As with every other nineteenth-century single-activity business enterprise, the railroads gathered internal accounting information primarily to gauge the efficiency of the processes in which they invested capital, not to gauge the overall efficiency with which they used capital. Hence, they did not use accounting information to judge the efficacy of new investment or to evaluate the performance of old investment.²⁵ The railroads did not account, for instance, for the total amounts invested in plant and equipment. The cost of equipment originally put into service was kept on the balance sheet, with all subsequent modifications or renewals charged to current income. Only replacements of equipment were capitalized and then only the excess of the new asset's value over the replaced asset's original cost. Nor did the railroads record systematic charges for depreciation.

Railroads apparently did not feel compelled to invest

resources in capital accounting systems for the same reasons that we suggested Carnegie did not monitor the performance of capital in his giant steel works. Once the decision was made to organize a railroad, little else remained but to build the road and to operate it as efficiently as possible. In designing management accounting information systems, therefore, the railroads were content to ask about nothing more than the efficiency of the firm's internally coordinated processes. For that, the cost per ton-mile and the operating ratio statistics seemed sufficient. Nineteenth-century railroads did, however, release public information, often audited, concerning operating ratios and other financial performance.²⁶ Their unique willingness to issue public reports arose from their heavy reliance on outside financial capital; railroads faced constraints in the capital market that Carnegie and operators of other owner-managed firms did not.

Cost Management in Distribution and Urban Retailing

In addition to manufacturing and railroad transportation, a third type of single-activity enterprise, the large-scale distributor, developed novel management accounting systems during the nineteenth century. In the last quarter of the nineteenth century the American economy witnessed an incredible outpouring of standardized, mass-produced goods for both producers and consumers. Two forces that we have already discussed helped make this possible. One was the widespread development of manufacturing technologies to mass produce all manner of items including iron and steel, petroleum distillates, alcoholic beverages, chemicals, processed foods, farm implements, machine tools, and household tools such as the sewing machine. These technologies used both complex machinery and intense sources of energy to produce unprecedented volumes

of output in large-scale, capital-intensive manufacturing establishments. The other force propelling the outpouring of mass-produced goods was the railroad and the telegraph system, which linked all parts of the nation by 1870²⁷ and provided the rapid, efficient transportation and communication required to move vast quantities of raw materials and output to and from manufacturing sites. A third force, to which we now turn, was the creation of systems for distributing the mass producers' output to the consumer.

The American market system in the last quarter of the nineteenth century did not provide channels through which manufacturers could quickly and efficiently sell their output directly to consumers. Certainly this was true for the makers of unconventional or technically complex products such as sewing machines, dynamite, and frozen beef; manufacturers of those products eventually overcame high costs of reaching the consumer by investing resources in their own internally managed marketing systems.²⁸ But it was also difficult for the new mass producers of familiar everyday items such as tobacco products, beverages, cereals, textiles, hardware, and many, many more to reach customers. Linking the producers and consumers of these products was a new breed of mass distributors—wholesalers and retailers—that appeared on the American scene after the Civil War.²⁹ These firms, associated today with names such as Macy, Marshall Field, and Sears, used all the advantages offered by railroads and telegraphy to widen the market available to manufacturers.

The profit opportunity for mass distributors lay in their ability to narrow the gap between prevailing prices charged by small-scale local manufacturers or distributors and the potentially lower prices that were made possible by the scale economies of mass production and distribution. Distributors could force shippers to compete vigorously, could provide manufacturers with accurate and timely market information, could provide credit and service to consumers, and, above all, could give customers easy access to information

about the variety of available merchandise. Without the unique services provided by mass distributors, it is difficult to imagine how late nineteenth-century American consumers could otherwise have enjoyed the material benefits of a national transportation and communication network and a regionally specialized system of mass producers.

To operate efficiently and effectively, the mass distributors created systems for internally administering the high volume, high turnover, and low margins on which their success depended. They had to be extremely conscious of costs, especially the cost of acquiring and financing inventories and of granting customer credit. Not surprisingly, they quickly developed internal accounting systems to aid them in evaluating costs, throughput, and working capital. Nor is it surprising that these mass distributors gathered internal accounting information along much the same lines as did earlier single-activity firms in manufacturing and railroading. Mass distributors engaged in the single activity of distribution, but they did so by integrating several distinct processes connected with that activity; therefore, they developed unique accounting measures of process efficiency analogous to the manufacturers' unit costs and the railroaders' cost per ton-mile.

The internal accounting systems devised by big-city retailers, and the wholesale jobbers from which they often evolved, focused primarily on the performance of a firm's various selling departments. This was true, for instance, at Marshall Field's in Chicago. As the Field Company's historian reports, each department "was run as though it were an independent business firm. The department head was a merchant, completely and independently responsible for the profits within his own separate department or 'store.' He purchased, priced, and advertised as he saw fit, and received a contracted-for percent of the profits that his department produced."³⁰

To monitor and evaluate these internal department

heads, Field's collected departmental accounting information on both gross margins and inventory turnover (or "stockturn"). The information on gross margins (sales receipts minus cost of goods sold and departmental operating expenses) was not unique to mass distributors; it was analogous to the information collected by railroads to calculate operating ratios. Gross margin information measured each department's performance and provided a means of comparing departments with each other and with the company's overall performance. The information on stockturn, however, was apparently unique to mass distributors; Chandler contends that the concept originated with American marketers after the construction of a national railroad network permitted the rise of the modern wholesaler.³¹ Inventory turnover was for the mass distributor a crucial determinant of gross margins and profit. Unlike the traditional merchant, who considered markup on cost as the determinant of gross margin, the new mass distributors were driven to make profit (or gross margin) on volume. Hence, they placed enormous importance on the rates at which departments turned over their stock each period. Marshall Field was monitoring stockturn as early as 1870.³²

As did the manufacturers and the railroads before them, the mass distributors had one central reason for internal accounting information. They gathered it primarily to monitor the results of conducting internal processes which otherwise would be coordinated directly through the market, or else would not occur at all. They did not compile this information to gauge the efficiency with which they used fixed capital. Their investment of fixed capital in relation to their volume of business was, of course, much smaller than was typical for either manufacturing or railroading firms.³³ That may explain in large measure their lack of concern for depreciation and fixed asset accounting. It is notable, however, that their use of stockturn information, although concerned only with working capital, presaged a method of link-

ing company performance to capital that early twentieth-century businesses would discover. We will refer to this again in chapter 4, when discussing the evolution of return on investment accounting at Du Pont.

Conclusion

The principal circumstance that shaped the accounting practices we observe in nineteenth-century companies is the search for opportunities to gain by internalizing two or more of the conversion processes for a single economic activity. New management accounting practices in manufacturing, rail transportation, and distribution firms had one common purpose: to evaluate a company's internalized processes. Each type of single-activity business identified a unique type of accounting information for this purpose: in manufacturing firms, the direct cost of converting raw or semifinished material from one stage of production to the next; in railroad transportation, the cost per ton-mile; in mass distribution firms, stockturn. In all cases this new accounting information focused on the efficiency with which single-activity firms used resources in their internally managed processes.

Why did late nineteenth-century circumstances not compel company accountants to produce additional information that seems indispensable to accountants in large-scale businesses today? Particularly puzzling to modern accountants is the absence of accounting information with which to plan and control capital investments. We have already noted that capital-intensive industrial giants of the late 1800s kept no systematic track of physical assets, nor did they use accounting information to evaluate returns on investment. And despite the increased uncertainty that accompanies long-term commitments of capital, these firms apparently used no forecasts or capital budgets to coordinate and monitor investment outlays. Perhaps this absence

of interest in capital accounting can be explained by the enormous expansion of markets in late nineteenth-century America, which could reduce the uncertainty associated with long-term investment. Another explanation may be that nineteenth-century manufacturing, transportation, and distribution firms engaged only in single activities. Each firm diversified only among the processes required for its respective activity, reducing the firm's investment decision to a series of closely linked make-or-buy decisions. For those decisions, the firm had to know only how new capital investment would affect stockturn, costs per ton-mile, or unit conversion costs. Adequate for that purpose was the information supplied in most nineteenth-century management accounting systems.

As we will show in chapter 4, accounting systems begin to link a company's performance to the capital invested in the company's business when organizations combine two or more separable activities in a single managed enterprise. Known as vertically integrated firms, these businesses appeared for the first time in the United States around 1900. But before we turn to these management accounting developments in multi-activity enterprises, we will examine in the next chapter an additional set of late-nineteenth century developments in manufacturing cost accounting. Known as scientific management and standard product costing, these developments were carried out by mechanical engineers in metal-working firms. The objectives of the engineers, working for the most part between 1880 and 1910 in single-activity manufacturing firms, were to control the efficiency of very complex internal production processes and to trace the sources of a company's overall profits.

Notes

1. Alfred D. Chandler, Jr., points out, quite correctly we believe, that American railroads, not early nineteenth-century factories, provided the first

administrative model for the modern multiunit business enterprise. (See Chandler, *The Visible Hand: The Managerial Revolution in American Business* [Cambridge, Mass.: Harvard University Press, 1977], 75–81.) But conversion cost accounting, the earliest example of management accounting, appeared in textile factories even before the first railroads were built. Although the railroads very quickly developed accounting (and many other administrative tools) far beyond what the textile factories ever accomplished and ultimately had a far greater impact on American management practice, they were not the first economic enterprises that used cost accounting to rationalize inter-nally coordinated processes.

2. George J. Stigler, "The Division of Labor is Limited by the Extent of the Market," *Journal of Political Economy* 59 (1951), 185–193.

3. Chandler, *The Visible Hand*, 67–72.

4. D R Scott, *The Cultural Significance of Accounts* (New York: Henry Holt, 1931), 143.

5. The Medici accounts, housed in the Baker Library at the Harvard Business School, show how a pre-industrial domestic organization could maintain excellent accounts of external financial transactions and of physical inventories but not require, apparently, cost accounts per se. For a succinct discussion of the Medici accounts see S. Paul Garner, *Evolution of Cost Accounting to 1925* (Tuscaloosa, Ala.: University of Alabama Press, 1954), 7–15.

6. In early proto-factories, such as Adam Smith's famous pin factory, multiple processes could be centralized without being coordinated administratively. (See S. D. Chapman, "The Textile Factory before Arkwright: A Typology of Factory Development," *Business History Review* [Winter 1974], 451–478.) Such organizations did not require cost records if all inputs, including labor, were paid at market prices for output produced. In *Allocating Common Costs* (Urbana, Ill.: Center for International Education and Research in Accounting, 1978), 46–47, M. C. Wells cites several examples of accounting in early piece-rate factories that historians mistakenly refer to as "cost accounting." Cost accounts became essential only after administrators assumed the task of coordinating the conversion of inputs into output. The move toward cost accounting is seen in early proto-factories where organizers of partly market-priced and partly managed production processes compiled production statistics—not systematic cost accounts as such—to audit the output of sub-contractors or internal artisans. Indeed, Josiah Wedgwood in the early 1770s compiled cost records, with intriguing results, at his Etruria pottery works. A similar use of production statistics, less sophisticated perhaps than Wedgwood's, occurred about fifty years later at Springfield Armory in Massachusetts. For more on these cases see: Neil McKendrick, "Josiah Wedgwood and Cost Accounting in the Industrial Revolution," *Economic History Review*, Vol. 24 (1970), 45–67; Paul Uselding, "An Early Chapter in the Evolution of American Industrial Management," in Louis P. Cain and Paul J. Uselding, eds., *Business Enterprise and Economic Change: Essays in Honor of Harold F. Williamson* (Kent, OH.: Kent State University Press, 1973), 51–84.

7. An excellent discussion of these records is in David M. Porter, "The

Waltham System and Early American Textile Cost Accounting, 1813–1848," *Accounting Historians Journal* (Spring 1980), 1–15.

8. For a comprehensive and insightful discussion of these records see Paul F. McGouldrick, *New England Textiles in the Nineteenth Century: Profits and Investment* (Cambridge, Mass.: Harvard University Press, 1968), 3–6, 219–222.

9. The discussion of Lyman Mills draws material from and substantially revises the conclusions in H. Thomas Johnson, "Early Cost Accounting for Internal Management Control: Lyman Mills in the 1850s," *Business History Review* (Winter 1972), 466–474.

10. McGouldrick, *New England Textiles*, 92; Chandler, *The Visible Hand*, 70.

11. This method of estimating unit costs apparently was not described in published sources until the 1890s. See, for example, William G. Nichols, *Methods of Cost Finding in Cotton Mills* (Waltham, Mass.: E. L. Barry, 1899), 8–18; and James G. Hill, "Various Systems of Computing the Costs of Manufacture," *Transactions of the New England Cotton Manufacturers' Association*, 67 (October 5–6, 1899), 132–137.

12. We discuss the origins of this idea at greater length in chapter 6.

13. Chandler, *The Visible Hand*, chapter 8.

14. Joseph F. Wall, *Andrew Carnegie* (New York: Oxford University Press, 1970), 325–349, 504–506, 583–586; Harold C. Livesay, *Andrew Carnegie and the Rise of Big Business* (Boston: Little, Brown, 1975), 84–90, 102, 109–118, 150–151.

15. Chandler, *The Visible Hand*, 267–268.

16. Richard P. Brief, "Nineteenth Century Accounting Error," *Journal of Accounting Research* (Spring 1965), 21–30; Michael Chatfield, *A History of Accounting Thought* (Hinsdale, Ill.: Dryden Press, 1974), 102, 160; H. Thomas Johnson, "The Role of Accounting History in the Study of Modern Business Enterprise," *Accounting Review* (July 1975), 448–449.

17. Chandler, *The Visible Hand*, 80–89.

18. Glenn Porter, *The Rise of Big Business, 1860–1910* (New York: Thomas Y. Crowell, 1973), 31.

19. Chandler, *The Visible Hand*, 109–120, 186.

20. George W. Wood, *The Voucher System of Book-keeping* (Pittsburgh: G. W. Wood, 1895). See LCNuc, 1943; vol. 165, 348.

21. Chandler, *The Visible Hand*, 116–120.

22. Fink may have learned to group cost accounts according to the way that costs behave by reading *Railway Economy*, the 1850 treatise by Dionysius Larnder, a professor of mathematics in University College, London. See David Solomons, "The Historical Development of Costing," in David Solomons, ed., *Studies in Cost Analysis* (Homewood, Ill.: Richard D. Irwin, 1968), 3–49.

23. Chandler, *The Visible Hand*, 120–121.

24. *Ibid.*, 110.

25. *Ibid.*, 111–112, 115.

26. Richard Vangermeersch, "Comments on Accounting Disclosures in

the Baltimore and Ohio Annual Reports from 1828 through 1850," *Academy of Accounting Historians Working Paper Series*, Vol. II (1979), 318–337.

27. Richard B. Du Boff, "Business Demand and the Development of the Telegraph in the United States, 1844–1860," *Business History Review* (Winter 1980), 459–479.

28. Chandler, *The Visible Hand*, chapters 9 and 10. We discuss the integrated industrial firm in chapter 4.

29. Chandler, *The Visible Hand*, chapter 7.

30. Quoted in Chandler, *The Visible Hand*, 220.

31. *Ibid.*, 223.

32. *Ibid.*

33. *Ibid.*