Developing Expertise: Two Episodes in Early Nineteenth Century U.S. Management Accounting History

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Prior to 1850, accounting information was used routinely by owner/managers in two large, integrated manufacturing environments in the United States – the Lowell cotton textiles mills and the Springfield Armory. In the textiles mills, accounting costs were assigned to products and product lines to facilitate make-or-buy, product pricing, and factory site selection decisions. At Springfield, product cost data were used primarily to establish target prices against which private contractors were required to compete in order to obtain government contracts. In both locations, labor processes were monitored and efficiencies obtained primarily through piece-rate pay schemes that generated earning levels commensurate with skill differentials and market expectations. Accounting controls in the form of actual-to-standard labor cost comparisons were not employed.

Archival investigations of these two environments were undertaken to evaluate the state of accounting expertise at the time and were stimulated, in part, by assertions from several noted accounting historians in a series of recent papers. These scholars have argued that accounting was strictly mercantile and was not used for managerial purposes during the period because it lacked a needed disciplinary component, thereby retarding management's innate desire to control labor processes. Notwithstanding the uniqueness and novelty of this interpretation, our investigation suggests that accounting information served management in problem-solving scenarios that business historians have long characterized as managerial. Just as importantly, we believe that the use of certain accounting procedures and the absence of others (i.e., norm-based standard costing and variance analysis) befitted the social mores and decision-making needs of the day.

The paper describes the nature of management accounting in these two environments. We initially examine the Massachusetts textiles mills and identify instances where accounting information was used by owner/managers to

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address both special and ongoing business decisions. We next describe the Springfield Armory and present further examples of managerial uses of accounting. In essence, the purpose of this paper is not to stifle or resist new interpretations of accounting history, but rather to examine archival records to determine if long-standing views about the past are sustainable or should be revised. In our view, the evidence favoring conventional views is unequivocal.

Massachusetts Textiles Mills (early 1800s)

Conventional business historians have argued that textiles manufacturing in New England during the early 1800s exemplified the transition from mercantile to industrial accounting [Porter, 1980] and represented the first instance of large-scale factory production in the United States.[1] Prior to this time, accounting was mercantile in that it simply established accountability for financial statement components and apportioned costs among different products and product lines. However, because the cotton textiles industry was highly competitive, both domestically and internationally, owner/managers needed more specific accounting information than had heretofore been provided in smaller, less integrated, and/or family-run enterprises.

Aided by a rapid diffusion of technology from England [Jeremy, 1981], production of cotton textiles took one of two general forms in the United States. In Rhode Island and Connecticut, Samuel Slater built small mills that featured partnership organizations, management by owners, family labor structures, and putting-out systems. In Massachusetts, Boston merchants formed joint-stock companies, hired professional managers, and produced textiles in large, fully integrated factories typically ten times larger than Slater mills [Dublin, 1979] – the Lowell system.

The Slater System: Slater began producing yarns and threads in Rhode Island in the 1790s. In order to induce farm families to live and work in factory communities, Slater fostered traditional church and family values within a paternalistic social structure. Supervisory and authority positions were limited exclusively to males who continually reinforced the virtues of industrial discipline and Puritanism (regularity, sobriety, punctuality, obedience, and self-improvement). These values were accepted by mill operatives, at least until the mid-1830s [Tucker, 1984]. The reliance on paternalism forestalled the use of cost accounting as a monitoring and control device.[2] The hegemony of a family-based authority system precluded differentiating wages solely according to an individual's output, regardless of age or gender. Thus, the dual influences of church and family, rather than aspects of a cost accounting system, facilitated factory discipline [Prude, 1983].

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[1] Primary source material for this section of the paper is located at the Massachusetts Historical Society and Harvard University's Baker Library, both in Boston, MA, and the Museum of American Textile History, in North Andover, MA.

[2] Accounting records at Slater mills were not examined directly. Tucker [1984] investigated these records extensively and in a personal telephone conversation reported her failure to locate any pre-1830 cost accounting reports.

Economic, social, and technological factors combined over time to compel the implementation of more comprehensive costing procedures [McGouldrick, 1968; Tucker, 1984]. The slump in the cloth market in the 1810s, in conjunction with rising cotton prices, forced Slater and his heirs to reduce costs. The adoption of the power loom in the mid-1820s enabled the employment of a larger, full-time labor force whose output needed close monitoring and measurement. The work force became more homogeneous as young children were gradually replaced in factories by single women. Individuals, rather than the family, became the measurable work unit. Factory agents (i.e., professional managers) eventually became accountable for cost and quality [Tucker, 1981].

As a result of these changes, the Slater mills came to parallel their Lowell counterparts in managerial structure, level of integration, work-force composition, and their use of accounting information. According to Tucker [1984, p. 205], an "elemental form" of cost accounting was introduced in the late 1830s. More extensive costing procedures were implemented much earlier in the Lowell system chiefly because aspects of its social system and work environment warranted them. Lowell mill owners similarly relied on social institutions to reinforce work discipline, but conditions at the Lowell mills (a substantially larger work force, absentee ownership, greater automation, and fuller integration) generated an earlier utilization of costing procedures to supplement paternalistic devices.

The Lowell System: A group of successful Boston merchants (the Boston Associates) built the first fully integrated textiles mill in Waltham, Massachusetts in 1814, a prototype for similar mills in Lowell and other towns. These mills, organized as joint-stock companies, were capitalized at over $500,000. By 1840, nine Lowell companies operated 29 mills and produced over one million yards of cloth weekly, more yarn and cloth "than is produced in any other Factories without exception in the world" [Montgomery, 1970, p. 162].

Interaction and correspondence among treasurers, factory agents, superintendents, and directors involved in the operations of multiple mills are extensive and well-documented and provide ample evidence of the significance of accounting [Gregory, 1975; Josephson, 1949]. For example, correspondence between William Austin, the factory agent of the Lawrence Manufacturing Company, and Henry Hall, the company treasurer who resided in Boston, addressed a variety of accounting and operational concerns. During March, 1833, Austin wrote seven, lengthy letters which addressed a variety of accounting, operational, and business management issues, including the distribution of account balances, the price of a new hydraulic press, a progress report on new construction, and the impact of river height on operations [Baker Library, *Lawrence Manufacturing Company*, box MAB-1, Letters 1832 file]. Although there were no middle managers per se at the mills, overseers functioned as foremen and were accountable to factory agents for output and quality levels, staffing, and record keeping [Baker Library, *Boston Manufacturing Company*, unbound papers, box 2-A, Archives MSS: 44]. According to Prude

[1983, p. 83], overseers were members of a managerial cadre who "stood indisputably atop the social order of the mill compounds."

Lowell mills adopted power weaving from their onset and integrated all phases of textiles production under one roof. Mill owners, needing a large, full-time work force, established a social system that attracted farm girls to Lowell and maintained factory discipline. Strict rules governing different aspects of behavior were established and became generally accepted, although enforcement efforts varied according to the supply of labor [Dublin, 1979]. The deterioration of factory life and the creation of a permanent working class culture in the 1840s were clearly not anticipated when the mills were established.

In our view, accounting information was a necessity from the inception of the Lowell mills. Large, fully integrated facilities faced foreign and domestic competition in markets characterized by steadily falling market prices [Appleton, 1832b, 1858]. The sophistication of British mill technology and costing procedures was well-known in the United States [Appleton, 1832a]. At a minimum, financial information was compiled and made available to corporate shareholders on a regular basis. For example, the 1867 Treasurer's Report for the Lawrence Manufacturing Company included the annual cost of labor per pound in four processing departments, dating from 1831. Profits or losses, dividends declared, capital improvements, and expenditures incurred for ordinary repairs and renewals were also provided on a yearly basis. Common financial procedures were employed throughout the Lowell system since the mills functioned as a homogeneous group.

Scholars have described the cost reports and procedures that were prepared at the Lowell mills in detail and have intimated their importance to management [Johnson, 1981; Lubar, 1984; Porter, 1980]. These conclusions notwithstanding, the use and usefulness of cost information remains problematic to several noted accounting historians [Ezzamel et al., 1990; Hoskin and Macve, 1988a, 1994, 1996]. However, the existence of discretionary cost reports clearly implies that owner/managers used them in allocating resources and rationalizing various cost-based decisions. Although these reports lacked the ability to assign responsibility to individual workers for excess cost and waste, they facilitated a number of other important managerial responsibilities. Furthermore, when these reports are considered in context with contemporary economic, technical, and social factors, they supplied needed financial information and "provided the management with a clear picture of all the company's sources of profit and loss" [Spalding, 1969, p. 22]. Different reports and their managerial uses are now described in greater detail.

Comparative Cost Reporting. One of the most impressive features of the Lowell reports is the comparative costing of mills, time periods, and product lines. In the aggregate these records suggest that cost reporting could have been used for many different managerial purposes [but see Hoskin and Macve, 1996]. For example, an 1827 report provides unit and total costs for each type of cloth during the most recent six-month period at Merrimack Manufacturing Company (MMC) [Appleton Family Papers (AFP), Section 4.7]. This report includes calculations for "apparent waste" and "real waste" for each mill,

indicating that quality was regularly measured, perhaps in comparison to pre-established waste norms.

An 1828 summary charts the prior six-months' profit for each of MMC's five mills. Because each mill produced only one grade of yarn, profitability by product grade is determinable as well [AFP, Section 4.9]. An 1830 report includes revenues by cloth type; direct costs for cotton, carding, spinning, and weaving; and a common allocation for general expenses and repairs. Total profit and an average cost per pound/yard of cotton were computed for each mill. Although noted scholars [Johnson,1981; Johnson and Kaplan, 1987] have concluded that cost accounting in nineteenth century cotton mills helped coordinate, control, and increase the efficiency of multiple internal conversion processes but did *not* link the financial performance in each process to overall profitability, these reports would indicate that linkages were made on a regular basis.

Comparative cost reporting may also have been an important mechanism for stimulating cost reduction and increased efficiency. Regarding relatively stronger financial performance at the Jackson mill in 1836, Appleton's son wrote, "They must wake up at the Appleton and try to beat them the next six months to come" [AFP, Section 5.12]. Shared ownership, rotating management, and a common sales agency enabled information from different companies and mills to be evaluated and compared. Gregory [1975, pp. 242, 257] summarized the impact of these relationships:

> Although the promoters provided the common core of control, through a loosely organized system of interlocking directorates, the companies within the system both competed and cooperated with each other... By pitting one company against another, it [the common sales agency] spurred the mills to increased production and efficiency.

Unit Cost and Profit Calculations: Accurate cost information was needed to maintain profit margins in light of continually falling prices for finished cotton products. Surviving records indicate that detailed cost-per-unit numbers were routinely computed. Reports in 1826, for example, include cost build-ups for the productive processes and common cost allocations for a large variety of cloth styles [AFP, Sections 4.2 and 4.4].

An 1830 factory agent's memo to company directors illustrates how unit costs were a critical factor in allocating productive capacity to products and in making subcontracting decisions. Twenty-five percent higher external demand in June, 1830 led the firm's factory agent to propose to "put out" cloth to the Hamilton Company for bleaching at $.03 a pound. "In this way doing the expensive bleaching only, the apparent cost will be considerably increased, but we expected the saving in dyeing will fully compensate us" [Baker, *MMC*, Volume 1, Directors Meetings, p. 89].

Miscellaneous Cost Reports: Several other cost reports are noteworthy. A computation of an overseer's premium at the Appleton mills in November, 1830 illustrates how cost information was used in conjunction with incentive-

based labor contracts [Nathan Appleton Collection, Section 4.101]. A premium of six mills per pound was given for exceeding a targeted (i.e., standard) level of 10,000 pounds of good output from each mill per week. Another memo indicates that annual bonuses were capped individually ($75 per overseer) and in total ($250 per mill). These incentives certainly engendered greater labor effort, but not without social cost. Incentive pay could have encouraged overseers to abuse individual operatives [Luther, 1970], hence contributing to deteriorating work conditions. An 1831 memo describes output differences between looms operating at high speed and common speed in two mills over a three-week period [AFP, Section 4.109]. The author observed that "the 80 looms on high speed norm 3,083 yards more than the other in 18 days." Applying cost numbers to these output differentials would have enabled management to determine the financial impact of wage-rate adjustments.

The Absence of Standard Costs: Several factors explain why standard costs, defined as what costs should be and implying the individualization of norms and the calculation of variances, were not implemented in Lowell mills during this period. The lack of education, frequent insobriety, and the pace of production would have hampered factory operatives in providing data [Bagnall, 1977; Luther, 1970]. Stringent work rules and individualized output requirements associated with standard costing may have led to intolerable levels of turnover and thus could well have been intentionally avoided. Continual innovations in technology throughout the early period also discouraged the development of standards that would soon be rendered out-of-date. Instead, productivity was increased by adjusting piece rates, machine speeds, and machine-tending responsibilities so that only industrious workers could earn adequate wages. Using the market to shape the pace and cost of labor was an effective alternative to a standard costing system.

Several scholars have noted that cost accounting was needed to control internal production processes only after wage contracts were substituted for market piece rates [Johnson, 1981; Johnson and Kaplan, 1987]. However, piece rates typified remuneration at the Lowell mills even after cost management practices were initiated. For example, an 1829 report identifies piece rates for 12 different classes of labor, six of which evinced rate differentials depending on the type of cloth produced [AFP, Section 4.96]. Similarly, Dublin [1979] described how piece-rate adjustments were effectively used to reduce operatives' wages in the 1860s, while Englander [1987] indicated that piece-rate accounting, in conjunction with the inside contract system of production, was used by many U.S. industries into the twentieth century.

Other factors suggest why individualized norms were not translated into standard costs during this period. For one, owner/managers frequently exchanged cost and other labor-related information and controlled costs through common directorships and uniform rules and regulations. For example, in 1829, the factory agents of three leading Lowell firms agreed to a uniform set of discharge procedures that served to blacklist recalcitrant workers and thereby strengthen managerial control. Having full and certain knowledge of the costs of production, facilitated through interlocking directorships and

the exchange of key business data, enabled the ownership cadre to maintain consistent wage rates and regulations. Uniform marketing and pricing of finished goods by a common sales agency also helped stave off destructive price competition within the Lowell system.

Section Summary: Surviving cost reports from the Lowell system are comprehensive, computationally exact, and clearly indicative of managerial utility. Because these reports were discretionary, their existence clearly implies use and suggests that cost information assisted owner/managers in a variety of decision-making areas. Although the absence of a complete set of records prohibits a full understanding of cost keeping and reporting practices, one pre-eminent historian has concluded that Lowell owner/managers were "pioneers in the development of business accounting procedures in the decades before the Civil War" [Dublin, 1979, p. 25]. In our view, Lowell costing methods and reports fully met the needs of mill management. The absence of certain accounting procedures, such as standard costing and variance analysis, should not be viewed as a lack of knowledge or a developmental deficiency, but rather as a procedure that management deemed incommensurate with their needs or appropriate for the social and economic environment.

The Springfield Armory (1830s-40s)

The Springfield Armory (SA) was the earliest and most studied prototype of the large, modern factory establishment. Its accounting procedures and controls have been described as the most sophisticated in use before the 1840s [Chandler, 1977], despite their non-integration of piece-rate accounting, performance norms, and a clock-regulated workday.[3] In recent years, a new interpretation of management accounting at the Armory has been proposed. Hoskin and Macve (H&M) [1988a, 1994] concluded that the presence of West Point-trained management at Springfield *after* 1840 was the key factor in accounting's ability to enforce norms of output, to attain disciplinary power over labor, and to yield significant productivity gains. Although this interpretation is intriguing, it downplays the character of the accounting information that was prepared in accordance with congressional oversight and was provided routinely to Armory managers. The new interpretation also ignores contextual factors that would account for the absence of certain modern accounting procedures like standard costing. This section of the paper describes SA's accounting system and the early nineteenth century arms-making environment.

SA's accounting system was initially designed to summarize financial transactions, chart inventory flows, and establish the individual worker's

[3] The history of the Springfield Armory is described in detail [Deyrup, 1970] and in summary [Chandler, 1977; Hounshell, 1984; Uselding, 1972]. For specific details of Springfield's accounting methods and procedures, see payrolls and accounts of U.S. armories and arsenals, 1816-50 [Second Auditor's Accounts, Records of the United States General Accounting Office, Record Group 217, National Archives].

accountability for loss or waste. As outlined by Major Dalliba in his 1823 report to Congress, the Armory used a form of "charge and discharge" accounting in which detailed records of raw materials, work-in-progress, and work completed were maintained. Monthly payroll accounts listed each worker by name, the piece rate for each task, and the type and quantity of work performed. There were four clerks on staff which aided each officer "in keeping his accounts" [American State Papers, 1823, p. 538].

H&M [1988a] concluded that the absence of an integrated system of accountability and work discipline, obtainable (in theory) through a clock-regulated workday and pre-specified norms of output, accounted for the lack of consistent productivity improvements under the leadership of Superintendents Lee and Robb (1815-41). H&M also felt that significant improvements in output and reductions in piece rates after 1841 resulted from an infusion of West Point managerial training. In their view, pre-1840s Armory management, untrained and ill-equipped to enforce labor discipline and improve productivity, was unable to utilize accounting information fully. Notwithstanding, Major Dalliba indicated at the time that "complete accountability is established and enforced throughout" and that the Armory's piece-rate accounting system was "the best of all possible plans" [American State Papers, 1823, p. 542]. The most noted historian of SA similarly concluded that the Armory "was outstanding for its excellent management and high efficiency" during Lee's superintendency [Deyrup, 1970, p. 49].

According to H&M, a particular type of management training was needed for the changed role of accounting after 1840. However, skilled labor shortages, labor's resistance to controls, cooperative knowledge and cost sharing among arms makers, and the absence of significant labor decrafting are all factors that explain why piece-rate accounting and a clock-regulated workday were not integrated earlier [Tyson, 1990]. That Armory management chose to use piece-rates as a positive incentive that rewarded merit rather than a standard costing system that would confront negative performance appropriately reflected the difficulty owner/managers faced in attempting to enforce work discipline at the beginning of the U.S. industrial era.

Labor Shortages and Resistance to Controls: Acute shortages of skilled labor contributed to the early business failures of private arms contractors [Deyrup, 1970]. Because of these shortages, as well as New Englanders' natural propensity for independence and mobility [Prude, 1983], employers were precluded from enforcing norms of behavior and work discipline. Dalliba described in 1819 how piece rates were set by Superintendent Lee at Springfield to provide a reasonable wage for reasonable effort. Piece-rate systems, first introduced at Springfield in 1806 and at Harpers Ferry in 1809, were still utilized as late as 1855, when piece-rate accounting was credited as providing "the greatest amount of work at the least cost to the employer" [Rosenberg, 1969, p. 193].

According to several historians, skilled labor shortages in the United States in the early 1800s encouraged technological innovation and stimulated the subdivision of work processes into precise, specialized tasks [Habakkuk,

1962]. In the arms industry, production tasks were narrowed and simplified to achieve technical and economic objectives (e.g., greater uniformity and efficiency), not in response to new manufacturing methods or to control an unruly labor force [Nelson, 1981]. At Harpers Ferry, the site of the other government armory, the greatest growth in labor specialization occurred between 1811 and 1816, a time of severe labor shortages, rather than accompanying the greater mechanical innovation of the 1820s and 1830s [Smith, 1977].

In rural antebellum communities, little effort was made to control the pace of work [Prude, 1983] because the attempt would surely have encountered stiff resistance. For this and other reasons, accounting procedures at Springfield were not integrated initially with a clocked workday. Dalliba indicated that on-the-job drinking, conversing, and socializing were behavioral norms in most factories. Faler [1974, p. 379] noted similarly that workplace drinking was part of pre-industrial culture, "the subordination of pleasure to productive labor." Smith [1977] concluded that the ability to impose labor discipline at the armories was inversely related to employees' skill levels.

Notwithstanding these difficulties, Deyrup [1970] believed that Superintendent Lee was able to maintain high levels of efficiency. Under Superintendent Robb, Lee's civilian successor (1833-41), management was relaxed, work discipline generally deteriorated, and Springfield's labor and capital costs escalated. The inability to impose discipline was due in part to the expansion and prosperity of the early 1830s which shifted the balance of power towards labor and inaugurated a period of union activity and work stoppages. This increase in SA labor's power vis-à-vis management exceeded but still paralleled relationships in the private sector. However, the Panic of 1837 left workers defenseless against private-sector employers who sought to extend hours, increase output, and achieve profitable operations [Laurie, 1974]. Clearly, the work environment had changed by 1841 when George Talcott, Inspector of Armories, reported that the practice of allowing workers to fix their own wages, privileges, and work hours would not be tolerated in a private business and should not be condoned at Springfield [Benet, 1878].

Accounting and Managerialism at the Springfield Armory: H&M have tied the establishment of military superintendency at the SA in 1841 to Daniel Tyler's "pathbreaking inspection" in 1832, which enabled managers to exert disciplinary power over labor, stimulate productivity improvements, and utilize standard costs to control labor [Ezzamel et al., 1990; H&M 1988a, 1988b, 1994]. In their view, Tyler's piece-rate setting regime of 1832 and the conversion to military superintendency in 1841 were especially significant in the development of modern accounting systems. They pointed to increased production statistics for barrel welding after1841 as evidence of the conjoining of accounting and managerialism at the Armory. However, contextual economic factors better explain the productivity increases that occurred post-1841. Increasing mechanization, a severe economic depression, and the need for less highly skilled workers enabled Armory management to obtain piece-rate reductions and subsequent productivity improvements from Armory workers. Claims about Tyler's "pathbreaking inspection" and of the transfor-

mation of cost accounting activities at Springfield after 1841 appear significantly overstated. Scholars [Deyrup 1970; Smith 1981] do not accord Tyler any special credit, perhaps because his method of developing piece rates had been in regular use in the U.S. and U.K. for a number of years [see Edwards, 1989; Edwards and Newell, 1991; and Fleischman and Parker, 1990, 1991].

Daniel Tyler's Contribution: Daniel Tyler was a member of an inspection board that examined management and labor practices at the Springfield Armory in 1832 and 1841. In 1832, Tyler spent six months at the Armory prior to the formal inspection. During this period, he apparently timed every musket-making operation, divided the work force into six different classes according to skill and intelligence, and established piece rates for approximately one hundred different labor functions. Some fifty years later, Tyler [1883, pp. 20-21] recalled his activities:

> In this way I came to know accurately what the work-men could earn daily at ten hours' service under the Government prices, and I was enabled to determine – first what the fair price was for each division of "piece work," and second, the exact working time necessary to produce a Springfield musket of the existing model.

Tyler's work has been interpreted as the first component of a two-part transforming event that culminated in 1841 with the establishment of military superintendency. According to Ezzamel et al. [1990, p. 159], the fusion of these two events represented the "invention" of managerialism and the emergence of modern accounting, particularly since Tyler's piece-rate setting produced a "normative" wage. However, a re-examination of the SA archives does not support the uniqueness or importance attributed to Tyler's activities, which we view as the continuation of a process of targeting piece-rate adjustments to market conditions. Deyrup [1970] noted that piece rates, introduced as early as 1806, had been thoroughly revised in 1818. In addition, differentiating labor according to skill level was an earlier development in large manufacturing facilities in the U.S. and U.K. [Babbage, 1971].

The crux of the alternative explanations for the piece-rate establishment at Springfield lies in Tyler's motivations. H&M [1988a, p. 52; Ezzamel et al., 1990, p. 159] perceived the episode as an attempt to generate normative expectations of worker performance, "a norm of what the good worker solidly could and should achieve." However, Talcott's 1841 letter to Secretary of War Bell suggests that the motive was to force Armory workers to accept wage reductions to levels prevailing in the private sector [Benet, 1878, pp. 396-97]:

> A change in the form or models of parts affords a favorable opportunity for the operatives to press an increase of their wages... When a revulsion takes place and prices elsewhere sink to their former level, it is no easy matter to reduce the wages of armorers. *We have witnessed this state of things several times during the last twenty-five years*... The prices of labor had again advanced here in 1832 so much, that a revision was deemed proper, as it was

> alleged that they were very unequal.... The matter was then taken out of the hands of the Colonel of Ordnance by the Secretary of War, in consequence of the clamors of the workmen. He had committees of them calling upon and in frequent correspondence with him and finally yielded the point [italics added].

This letter reveals three points which seriously diminish claims regarding the uniqueness of Tyler's undertakings. First, military management looked to the private sector for guidance on wage-setting practices. Second, the inability to impose lower rates in 1832 was due to political and economic factors rather than the absence of a military superintendent. Finally, and most telling, this problem had confronted the department "several times during the last twenty-five years."

Tyler's efforts may have helped set guidelines for lower rates, but his piece-rate calculations had no special significance. An 1841 report in which Davies, Chase, and Tyler discussed both inspections provides no support for the argument that managerialism was invented at the Armory. These examiners requested data from private manufacturers and "ascertained from them the average price of labor, the nature of the work done, and the number of hours per day which the hands are employed" [Benet, 1878, p. 400]. In conjunction with Talcott's earlier comments to Secretary Bell, it is apparent that wage-setting practices at private establishments were perceived to be more advanced, at least from the ability to tie wages to market forces. By 1841, the Armory's piece rates had become so far out-of-line that armorers "were in the habit of selling out their 'chances of work' for up to $200" [letter from Talcott to Bell, quoted in Benet, 1878, p. 397].

The 1841 piece-rate adjustment further demonstrates that Armory management's attention to wage levels represented economically rational behavior rather than the establishment of a disciplinary regime. The Inspection Board's description reflects the use of a target-costing approach and the recognition of the steady shift from labor to capital-based production [Benet, 1878, p. 405]:

> ...the board came unanimously to the conclusion to recommend the adoption of the tariff of prices herewith... By reference to this tariff it will be seen that the board has fixed the price of the labor on a musket at six dollars and fifty cents... In case further labor-saving machinery is introduced, to give perfection to the work and assistance to the workmen, the prices of labor should be proportionably reduced.

Importance of West Point Training: H&M [1988b, p. 14] argued that Tyler's "path-breaking, detailed, scientific examination" could not be implemented at Springfield until military superintendency, established in 1841, provided the culminating portion of Tyler's inspection begun nine years earlier. Ezzamel et al. [1990, p. 158] claimed that West Point-trained military officers were "a new brand of men – 'managers' – who had no entrepreneurial stake in the

outcome." Perhaps the "discovery" of managerialism at Springfield motivated H&M to downplay earlier practices at the Springfield Armory and other U.S. manufacturing facilities. However, managers at Lowell mills utilized accounting data in a variety of ways in the 1820s and 1830s. Presumably, these managers were able to exert needed discipline without the benefit of formal West Point training and their methods were known by SA superintendents and officers.

The contention that Tyler's 1832 standard-setting activities "imposed a different order of rationality" [Ezzamel et al., 1990, p. 159] cannot go unchallenged. In his report [American State Papers, 1823, p. 542], Dalliba explained how Superintendent Lee established market-based piece rates in the late 1810s. In the section dealing with prices that were paid to armorers, Dalliba wrote:

> The prices paid for the working of each piece have been settled by the superintendent, upon the result of much experiment. It is calculated that good industrious men will be able to earn $1.40 per day. Upon this basis the prices have been established. The workmen earn now from $20 to $60 per month; such is the difference in the skill, industry, and ambition of men of the same trade.

Without evidence to the contrary, the phrase "upon the result of much experiment" suggests that work was sampled, activities were analysed, and varying skill levels were considered in the development of piece rates. Tyler's approach does not appear substantively different from the one Lee undertook 13 years earlier. Therefore, Tyler's efforts can be interpreted as one of a series of examinations conducted to revise piece rates and align them with mechanical advances and changing market conditions. There is no evidence which suggests that normalizing judgments or performance evaluations were ever based on accounting numbers. In other words, there are no indications that SA workers were dismissed or forced to work more hours to meet production quotas as a result of the piece-rate experiments. Colonel Bomford, the Chief of Ordnance, discussed the issue of military discipline over a civilian work force in an 1841 letter to the Secretary of War [Benet, 1878, p. 431]:

> The change from civil to military superintendents for the national armories was adopted as the surest means of improving the condition of those establishments, but it was never intended that the workmen should be subjected to military discipline, as the memorialists intimate, nor does it appear that the measure can be attended with such a result; for in placing the armories under the control of military men, it is but putting them on the same footing with the national arsenals and navy-yards, where numerous citizen mechanics are also employed.

This letter challenges the view that Tyler's work effected a "normalising judgement" or turned the work force into "calculable men" [H&M, 1988a, p. 43]. To infer normalizing judgments, close evaluation, and military-type

discipline in light of this letter, absent other supporting documentation, is simply unsustainable.

Section Summary: SA's accounting system was originally designed to summarize financial transactions, monitor and control the movement of goods, and enforce the individual worker's accountability for material usage and quality levels. Because SA served to establish price targets for private armories, its accounting procedures initially and appropriately served management's purposes to provide an accurate record of actual product costs. At least until the early 1830s, the objective of the Ordnance Department was to improve the uniformity and interchangeability of small-arms parts. This was accomplished by sharing knowledge and cost data with privately owned armories. The requirement that Armory managers share cost information and the ability of SA to obtain guaranteed government contracts precluded the need for standard costing and other accounting-based labor cost controls and accounts. In any case, a comprehensive, intrusive cost accounting system would have been hard to implement at Springfield before the early 1830s. Arms making was initially craft-based despite the large number of occupational classes. Demanding pre-specified norms of output from workers having varied skill levels may have led to intolerable turnover given the shortage of skilled labor and a natural aversion to intrusive managerial control. By 1850, however, virtually all fabrication was carried out by machine and labor's power to resist capitalist forces had virtually disappeared.

Historians are entitled a measure of poetic license in their interpretation of factual materials. Accounting historiography should accommodate differing perspectives [Fleischman et al., 1996]. Notwithstanding this, attributing the use of standard costing and variance analysis to the SA in the early 1840s appears unjustifiable. Productivity increases after 1841 resulted from a host of economic-driven factors, least of all to the confluence of a pathbreaking inspection with the training given to military superintendents.

Conclusion

It is no easy task to compare and contrast different episodes in U.S. management accounting history even though the foregoing two cases refer to events at proximate locations and time periods. In point of fact, the differences between them are both numerous and noteworthy. SA was a government-owned facility with a guaranteed market for its limited product line. In the case of the Lowell mills, however, production was machine-paced, competition was intense, and the work force was younger, less technically skilled, more transitory, and predominantly female. While both settings evidenced financial accountability to external parties (an absentee treasurer and company directors for Lowell, Congress for SA), Lowell owner/managers were confronted with a much broader set of decision-making scenarios, including where to manufacture products and product lines, which products to produce and promote, what prices to charge, and whether to make them or buy them from competing

or affiliated mills. These and similar operational decisions necessitated the use of detailed and comprehensive management accounting systems.

SA management faced a different and far less expansive set of information needs primarily because the market for government armaments was guaranteed and SA was authorized to share information with private-sector firms. At least until the early 1830s, SA's mission was to produce high-quality arms and to meet congressionally determined production targets. Competitive market forces that confronted Lowell mill owner/managers were noticeably absent which meant that SA officials faced fewer decisions that required and could be resolved with accounting information. Consequently and understandably, SA's accounting system generated information regarding worker accountability and product costs.

To argue that neither system was managerial because it lacked a disciplinary component ignores important economic and social factors that characterized early nineteenth century U.S. manufacturing environments. In both cases, at least until the 1840s, owner/managers could not impose harsh and intrusive disciplinary control procedures on their employees. In the case of the Lowell mills, the work force was comprised primarily of young women who viewed mill work as a temporary reprieve from the rigors and boredom of New England family-farm life. If mill work was known to be unduly repressive, this important source of labor could not be sustained or replenished. On the other hand, SA work was initially craft-based, technical, and individualized. The male work force would not have tolerated heavy-handed managerial tactics given their proclivity to resist work discipline, the allure of westward expansion, and the opportunity to obtain employment in other sectors and locales. Once the United States became more urbanized, factory work became socially accepted, and both environments grew increasingly competitive and machine intensive, workplace power shifted towards owner/managers and their priority of greater cost efficiency. Nevertheless, norm-based standard costing and the imposition of pre-specified levels of output would not be forthcoming for over fifty years with the arrival of Frederick Taylor and a wider acceptance by society of managerial norms and objectives. Even then, the development of productive norms and the imposition of output requirements would only occur in a handful of firms that employed a consultant to design and implement a scientific management system.

Recently, much has been written about the "schism" between accounting theory and practice. Accounting developments in the New England textiles industry and at the Springfield Armory, like those of the British Industrial Revolution, have been understudied because of the absence of a cost accounting literature predating the advent of scientific management in the 1880s. However, recent archival research and the reporting of findings have begun to set the record straight about the nature of management accounting in these early industrial settings. It is apparent that purposeful management accounting was undertaken in practice at both these venues, even if these procedures did not fully measure up to twentieth century costing theory as described in methodological treatises by now-famous management gurus. In

our view, however, the accounting activities that were undertaken fully met the needs of owner/managers and displayed aspects of expertise that would be refined and expanded as economic factors demanded and social forces allowed.

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