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## ***1992 Vangermeersch Manuscript Award***

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# **THE NATURE AND ENVIRONMENT OF COST MANAGEMENT AMONG EARLY NINETEENTH CENTURY U.S. TEXTILE MANUFACTURERS**

*Abstract:* Several authors have suggested that a particular managerial component was needed before cost accounting could be fully used for accountability and disciplinary purposes. They argue that the marriage of managerialism and accounting first occurred in the United States at the Springfield Armory after 1840. They generally downplay the quality and usefulness of cost accounting at the New England textile mills before that time and call for a re-examination of original mill records from a disciplinary perspective.

This paper reports the results of such a re-examination. It initially describes the social and economic environment of U.S. textile manufacturing in New England in the early nineteenth century. Selected cost memos and reports are described and analyzed to indicate the nature and scope of costing undertaken at the mills in Lowell, Massachusetts, in the late 1820s and early 1830s. The paper discusses how particular cost information was used and speculates why certain more modern procedures were not adopted. Its major finding is that cost management practices fully measured up to the business complexities, economic pressures, and social forces of the day.

Several recent studies of nineteenth century cost management<sup>1</sup> [Hoskin and Macve, 1988; Ezzamel, Hoskin and Macve, 1990] have suggested that a particular managerial component was needed before cost accounting could be fully used by owner/managers for accountability and disciplinary purposes.

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<sup>1</sup>The expression "cost management" best describes the use of cost information by nineteenth century mill owners and managers. The terms "cost management", "cost accounting", and "cost keeping" all generally represent the use of cost-based information to assist management and are used interchangeably throughout the paper.

According to the authors, the marriage of managerialism and accounting first occurred at the Springfield Armory after 1840 once West Point-trained managers were firmly in place. The authors acknowledge that cost management was conducted at the U.S. textile mills before that time, but question its overall importance and ability to differentiate skill levels or establish accountability over workers and their production. They also call for a re-examination of the original records from a “disciplinary” perspective [Hoskin and Macve, 1988, p. 71].

This study pursues this challenge by re-examining the nature and environment of cost accounting at the cotton textile mills in Lowell, Massachusetts, during the 1820s and early 1830s. Primary documents and secondary source material are analyzed to arrive at an interpretation of cost management practices during that time. Analysis indicates that cost information was fully utilized by mill owners and managers and, in conjunction with other disciplinary and social factors, provided critical information needed to run the businesses profitably. The absence of certain accounting procedures, including methodical depreciation and norm-based standard costing, are best viewed as reflecting business complexities, economic pressures, and social forces of the day rather than as deficiencies awaiting a particular managerial component or further technical development.

The paper initially describes the environment of U.S. textile manufacturing with special attention given to the Lowell-type mills in the 1820s and early 1830s. The Lowell mills in the 1820s and 1830s have been characterized as “the most technologically advanced factories in the nation” [Dublin, 1979, p. 68]. Social and economic factors within this environment are discussed to illustrate why certain costing procedures were implemented and how cost information may have been used. Surviving examples of cost memos and reports are then described to indicate the nature of costing that was undertaken at that time.

## THE ENVIRONMENT OF TEXTILE MANUFACTURING<sup>2</sup>

Textile manufacturing in New England during the early 1800s exemplifies the transition from mercantile to industrial

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<sup>2</sup>Primary source material for this study was obtained at three locations: the Massachusetts Historical Society (MHS) and Harvard University’s Baker Library (Baker), both in Boston, MA, and the Museum of American Textile History (MATH) in North Andover, MA.

accounting in the United States [Porter, 1980] and is representative of the industry that first embarked on large-scale factory production in America.<sup>3</sup> Aided by the rapid diffusion of technology from England [Jeremy, 1981], factory production of cotton textiles in New England took one of two general forms. In Rhode Island and Connecticut, Samuel Slater built small mills that were organized as partnerships, which were personally managed by owners, utilized family labor, and maintained the putting-out system (hereafter, "the Slater system"). Lowell-type mills were more than ten times larger than the typical mill in the Slater system [Dublin, 1979]. In Massachusetts, a group of Boston merchants formed joint-stock corporations, hired professional managers, and produced textiles in large, fully integrated factories (hereafter, "the Lowell system"). Both systems required the participation of New England labor that was unaccustomed to factory life and periodically in short supply [Prude, 1983].<sup>4</sup>

Factory work in the early nineteenth century entailed six day, 72-84 hour work weeks in harsh environments where illness and injury were commonplace [Luther, 1970]. The degree of labor's complicity with industrial capitalism and the level of owners' willful exploitation of labor are contentious issues that do not clearly illuminate the nature and development of cost management in the cotton textile industry.<sup>5</sup> Social and eco-

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<sup>3</sup> Alfred Chandler [1977] discusses the McLane Report of 1832 which described the current state of American manufacturing. Eighty-eight of the 106 companies having assets greater than \$100,000 were in the textile industry. Textile manufacturing represented a similar proportion of firms with assets between \$50,000 and \$100,000 and of enterprises employing more than 250 workers.

<sup>4</sup> Ware [1966] mentions that mill owners had to overcome the prejudice against factory work and the fact that western lands were available and affordable to New Englanders.

<sup>5</sup> Mathews [1991] and Morone [1991] discuss tension between self-interest and the common good that characterized the transition to industrial capitalism. Thompson [1967] and Jeremy [1990] provide differing perspectives on this transition. Regarding mill workers' complicity, Dublin [1979, p. 79] concluded "There is little evidence, in the 1820s and 1830s at least, that women workers resented regulation of their conduct by the corporations. Their letters and reminiscences are notably free of complaints on this score." According to Tucker [1984, p. 172, 173], "the home became another training ground for a generation of factory hands. Lessons taught there stressed the implicit, unquestioning obedience and deference to authority deemed necessary for good family and government, for a well-ordered society, and for the successful operation of the factory system."

conomic forces and the shifting balance of power between workers and owner/managers better explain all phases of the work environment including cost management procedures.<sup>6</sup>

### *The Slater System*

Samuel Slater began producing yarns and threads in Rhode Island in the 1790s. In order to induce farm families to live and work in his factory communities, Slater maintained traditional church and family values and a paternalistic social structure. Males were given custody for all family wages and were not forced to compete directly against women and children in low status, machine-tending positions. Supervisory and authority positions were also limited exclusively to males. Factory supervisors continually reinforced the complementary virtues of industrial discipline and Puritanism (regularly, sobriety, punctuality, obedience, and self-improvement) in their roles as church elders.<sup>7</sup> These values generally appealed to mill operatives and, until the mid 1830s, were accepted by them out of moral obligation [Tucker, 1984].

The Slater system's initial reliance on paternalism complemented its work force and underlying social structure and may have forestalled the use of cost accounting as a control device.<sup>8</sup> According to Prude [1983, p. 117]:

... the bookkeeping iconography of these mills reveals further efforts to acknowledge conventional household

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<sup>6</sup>Over time under both systems, increasing mechanization led to a depersonalized, machine-paced environment [Prude, 1983]. Production was constantly stretched out (workers had to tend more machines) and speeded up (workers had to produce more goods in a given time period) in order to maintain profits in light of steadily falling prices and increasing competition [Roediger and Foner, 1989]. The severity of output requirements and piece-rate reductions, and the enforcement of written regulations depended on economic forces (level of competition, supply of labor, etc.) and resulted in varying degrees of worker resistance.

<sup>7</sup>Tucker [1984, p. 170] emphasized the common social structure underlying church and factory: "Many values, including punctuality, attention to duty, and seriousness of purpose, were neatly summarized in the Webster Sabbath school constitution, which was drawn up by local church officials. The constitution was in fact a code of conduct similar to that maintained in the factory."

<sup>8</sup>Accounting records at the Slater mills were not examined directly. Tucker has researched these records extensively and in a personal telephone conversation with the author reported the failure to locate any significant cost accounting reports dating before the 1830s.

relationships and hierarchies . . . Such policies helped assured the viability of families inside local factory compounds.

The hegemony of the family-based authority system also precluded differentiating wages solely according to an individual's output regardless of age or gender. In this environment, the dual influences of church and family, rather than aspects of the cost accounting systems, effectively sustained factory discipline.

Economic, technological, and social factors combined to compel the implementation of more comprehensive costing procedures.<sup>9</sup> The slump in the cloth market in conjunction with the rise in the price of cotton pressured Slater and his heirs to reduce costs. The adoption of the power loom in the mid 1820s enabled the Slater firms to employ a larger, full-time labor force whose output needed to be more closely monitored and measured. The work force also became more homogeneous as young children were gradually phased out of factories and more single women were hired.<sup>10</sup> Privileges once accorded to householders were eventually removed so that individuals rather than the family became the measurable work unit. Beginning in the early 1840s, each worker received his or her wages individually. This pay scheme contrasts with the Lowell system in which workers were compensated individually from the mills' inception. Professional managers in the form of factory agents also replaced Slater family members and became accountable for cost and quality [Tucker, 1981].

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<sup>9</sup> According to Tucker [1984, p. 223], "By the 1830s management appeared to be ready to sacrifice the moral discipline associated with the family and the church in order to obtain more extensive control over the individual worker. Privileges once accorded the householder in the factory came under scrutiny and began to be dismantled as economic forces became the primary influence in the actions of management." Because of "a near-perfect degree of product competition from about 1835 onwards," textile manufacturers were forced to accept the market price for their goods [McGouldrick, 1968, p. 34].

<sup>10</sup> Children were also employed in Lowell Mills, but in far fewer numbers than in the Slater system, primarily because of the complexity of the Lowell machinery [Bender, 1975]. Although the employment of children in factories was condemned for humanitarian reasons [Luther, 1970], economic factors clearly supported it. According to Ware [1966, p. 244], "The wages received by children seem hardly worth working for. The Troy Company paid some of its child workers the miserable sum of thirty-three cents a week." The first legal restrictions limiting child labor (three months of schooling a year were required for children under 15) were enacted by the Massachusetts Legislature in 1836.

As a result of these changes, the Slater mills eventually paralleled their Lowell counterparts in managerial structure, level of integration, and nature and regularity of the work force. According to Tucker [1984, p. 205], an "elemental form" of cost accounting was introduced (at the Slater mills) in the late 1830s. More extensive cost management procedures had already been implemented in the Lowell system because certain aspects of its social system and work environment warranted them.<sup>11</sup> Lowell mill owners also relied on social institutions (church, family, schools, etc.) to reinforce mill discipline; however, unique conditions of the Lowell system (a much larger work force, absentee owners, greater automation, and full integration) led to the earlier use of costing procedures to supplement these paternalistic devices.

### *The Lowell System*

The development of textile manufacturing at Waltham and Lowell has been described in detail [Dalzell, 1987; Gregory, 1975; Spalding, 1969]. This study focuses on the mills that were built by a group of Boston merchant/entrepreneurs in Lowell, Massachusetts, during the 1820s and early 1830s. Other researchers [Dublin, 1979; Lubar, 1983] have indicated that because of interlocking directorships and common management, technology, resources, and information used by one mill were widely known and available to others. Accordingly, "the Lowell system" will be the terminology used regarding procedures undertaken by one or more of the Lowell mills.

In summary, a group of successful Boston merchants (the Boston Associates) built the first fully integrated textile mill in Waltham, Massachusetts in 1814. Realizing financial success, they constructed a number of similar mills in Lowell, Massachusetts, and other New England towns during the 1820s and 1830s. All of the mills were organized as joint stock companies and were capitalized at over \$500,000 in \$1,000 share increments. By 1840, nine Lowell corporations operated 29 mills and produced over one million yards of cloth weekly; and, according to Montgomery [1970, p. 162], produced more yarn and cloth

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<sup>11</sup> Walsh and Stewart [forthcoming] have re-examined accounting records at the Slater mills and report little evidence of cost accounting before 1820. They also indicate that significant cost data began to appear in the mid 1830s at the Lowell mills; however, comparative cost reports dating from the late 1820s have been located and are described in this paper.

“than is produced in any other factories without exception in the world.”

Although ownership later expanded beyond the Boston Associates, effective control was continually maintained by the members or their kinship networks. In accordance with Massachusetts law, a treasurer was legally responsible for protecting corporate assets. Surviving records indicate that the treasurer prepared a financial report which was examined annually by selected stockholders who served as directors and participated in this and other committee activities.<sup>12</sup> Certain treasurers, factory agents, and directors were actively involved in the operations of more than one mill and their interactions are well-documented [Gregory, 1975; Josephson, 1949].

From inception, operational control at each Lowell-system mill was delegated to a superintendent who acted as technical expert, and a factory agent who served as chief operations officer [Lubar, 1983]. The typical factory agent was not technically trained and was primarily selected for his managerial skills and executive ability.<sup>13</sup> There were no middle managers *per se*, but overseers and second-hands were fully accountable to the factory agent for output and quality levels, staffing, and record keeping.<sup>14</sup> According to Prude [1983, p. 83], overseers were members of the managerial elite, and “stood indisputably atop the social order of the mill compounds.” The administrative functions and hierarchies of the Lowell mills display key char-

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<sup>12</sup> Committees were formed to regularly audit the Treasurer’s books, and, as needed, to identify and purchase suitable mill sites, contract or set prices for buildings and machinery, develop procedures to cut fire risk, and determine the type of cloth each mill should produce. That directors and committee members were never compensated for these services or related expenses [Appleton, 1858] is overlooked by critics of the corporations’ high dividend-to-earnings payout ratio [Dalzell, 1987; Josephson, 1949]. Dividends averaged 10.75 percent between 1825 and 1835 at the Merrimack Company [Gregory, 1975].

<sup>13</sup> Mill agents in 1830 included a former sea captain, prison warden, and school teacher. See Bagnall [1977] for a detailed description of factory agents’ background, training, and responsibilities. Josephson [1949] suggests that factory agents were also selected for their social standing.

<sup>14</sup> An agreement appointing Ebenezer Hobbs as overseer and clerk at the Boston Manufacturing Company on April 1, 1819 reveals the expectations for these positions: “that he will devote to their service all his time and talents, that he will truly and faithfully account for all monies committed to him for the use of said company; that he will comply with the careful directives of the Agent in direction of said company” [Baker, *Boston Manufacturing Company*, Unbound Papers, Box 2-A Archives MSS:44].



acteristics of managerialism that are first attributed to the Springfield Armory only after 1840 [Hoskin and Macve, 1988].

The Lowell mills differed from the Slater system in ways that affected the implementation and nature of cost management. Lowell mills immediately adopted power weaving and integrated all phases of textile production under one roof.<sup>15</sup> The owners needed a large, full-time work force and chose to establish a social system that made a factory life appealing to farm girls, would attract them to Lowell, and yet maintain factory discipline. In addition to large multi-story factories, the Lowell corporations funded the construction of boarding houses, single family dwellings, two churches, and a library.<sup>16</sup> Given their mercantile background, the Boston Associates were probably more export-oriented than their Slater counterparts and, consequently, faced more direct competition from the more mature British mills. Restrictive tariffs protected the U.S. mills from British competition in the U.S. market, but export trade had to be played more evenly. By concentrating on fine cloths, the Lowell mills were able to supplant British dominance in China and South America, and by 1845, overseas trade had become more profitable than domestic commerce [Gregory, 1975].

Strict rules regarding many aspects of behavior were established and generally accepted, although the level of enforcement varied according to the supply of labor at the time [Dublin, 1979]. Boarding house regulations in the early 1830s include the requirement of attendance at public worship on the Sabbath and note that boarding houses "must be closed at *ten o'clock*, in the evening."<sup>17</sup> These regulations reflect the standards and mores of family life of the day [Ware, 1966] and illustrate how the Lowell system utilized church teachings to instill factory discipline. The deterioration of factory life and the creation of a permanent working class culture that began in the 1840s was certainly not anticipated at the time the mills were established.<sup>18</sup>

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<sup>15</sup>Textile manufacturing requires a series of separate processes to convert raw cotton to finished cloth. These steps include carding, dressing, bleaching, spinning, and weaving and are described in detail by Jeremy [1981]. All of these procedures were first integrated at a single large mill by the Boston Associates in Waltham in 1814.

<sup>16</sup>Baker Library, *Merrimack Manufacturing Company*, Vol. 1, Directors Meetings.

<sup>17</sup>"Regulations of Boarding Houses," MATH, *Nathan Appleton Collection*.

<sup>18</sup>Correspondence between mill girls and their families indicates that factory work was intentionally perceived to be impermanent [Dublin, 1979]. Mill

## COST MANAGEMENT IN THE LOWELL SYSTEM

Accounting historians continue to push back the inauguration of cost accounting practices. Initially, they focused on the 1880s because cost and financial accounts were not thought to be fully integrated until that time [Littleton, 1933; Garner, 1954; Chatfield, 1974]. Historians then examined the cotton textile industry and determined that integration occurred as early as 1810 in England [Stone, 1973], and in the 1840s and 1850s in America [Tucker, 1981; Johnson, 1981]. When the definition of cost accounting is broadened to include cost management, the date recedes even further. For example, Johnson [1981, p. 516] defined cost accounting as “designed to provide financial information for management decision-making and control.” The most recent studies indicate that cost management practices were undertaken in the last third of the eighteenth century in the British textile and ironworks industries [Fleischman and Parker, 1991 and 1990].

Factors that warranted cost-based information were in place from the inception of the Lowell mills. Large, fully integrated facilities faced foreign and domestic competition in markets characterized by steadily falling market prices.<sup>19</sup> Evidence clearly indicates that British mill technology and costing procedures were well known in the United States.<sup>20</sup> Surviving records

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owners also preferred to keep factory work temporary, perhaps to avoid creating a permanent proletariat [Guttman, 1976] or duplicating the same type of factory work environment that existed in England [Appleton, 1858]. Mantoux [1961] described the horrid working conditions that existed for women and children in many British factories, conditions that were well known in America in the early 1800s and were eventually approached in later years. For example, Ware [1959, p. 63] indicated that “by 1846 the weavers (in the U.S.) had been reduced to ‘a state of abject misery and suffering.’”

<sup>19</sup>According to Nathan Appleton [1832, 1858], the price obtained for the same type of cotton sheeting fell steadily from 1816 to 1843 as follows:

Date	Price per yd.
1816	\$.30
1819	.21
1823	.17
1826	.13
1829	.09
1831	.10
1843	.065

<sup>20</sup>According to Gregory [1975, p. 239], “In selecting fabrics, determining articles to be manufactured, and assigning prices, Appleton . . . gathered a mass

also indicate that cost information was compiled and used internally and made available to corporate shareholders on a regular basis. Among its statistics, the *Treasurer's Report* [1867] for the Lawrence Manufacturing Company includes the cost of labor per pound in the Carding, Spinning, Dressing, and Weaving Departments in each year dating from 1831. The report also contains the profits and losses and dividends declared each year, the cost of enlargements and improvements, and expenditures incurred for ordinary repairs and renewals. Furthermore, costing procedures used in one mill can be attributed to the entire Lowell system since interlocking arrangements enabled the mills to function as a homogeneous group.<sup>21</sup>

Various cost reports and procedures in the Lowell system have been discussed previously [Johnson, 1981; Lubar, 1984; Porter, 1980], but to some, the use of cost information has not been clearly demonstrated [Ezzamel, Hoskin, and Macve, 1990; Hoskin and Macve, 1988]. This section describes selected cost reports and discusses how they helped facilitate resource allocation decisions and cost reduction efforts and why certain more modern accounting procedures were excluded. Considered in

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of information from varied English sources: price tags, costs of production from the mills, and data from his old mercantile associates abroad." In 1828, for example, Nathan Appleton received a letter from his brother in England describing the machinery, power requirements, and output of the W. Beavens Factory "which is one of the best to see, it having been in operation only three years, and all its machinery of the newest and most approved kinds" [MHS, *Appleton Family Papers*, Box 4, Folder 4.8]. In 1829, a letter from John Hall discussed the costs of operating a steam engine and mentioned that "the wear and tear, repairing, including the interest may be calculated at 12 per cent per annum" [MHS, *Appleton Family Papers*, Box 4, Folder 4.11]. These letters support Appleton's remarks to the U.S. House of Representatives [1832a, p. 10] regarding the need to know the costs of producing British textiles:

... the first inquiry manufacturing makes is the original cost of the article with which he proposes to compete ... does the gentleman suppose that any rational man would erect a cotton mill to manufacture goods for exportation without ascertaining precisely what goods could be furnished for from Manchester?"

<sup>21</sup> Interlocking arrangements created a community of interest that enabled prices, wages, work rules and technology to be standardized throughout the Lowell system [Dublin, 1979; Josephson, 1949; Layer, 1955; Lubar, 1983]. Far from being unethical, these arrangements were thought to protect society and the economy from destructive competition and speculation. According to Gregory [1975, p. 238], "Daily they (the Boston Associates) met at noon at the Boston Exchange where by private, informal negotiations they borrowed money, planned new projects, and exchanged business information."

context with social, technical, and economic forces of the day, these reports appear to supply all the cost-related information that was needed or would be used and “provided the management with a clear picture of the company’s sources of profit and loss” [Spalding, 1969, p. 22].

### *Comparative Cost Reporting*

The most outstanding feature of the cost accounting reports from the Lowell mills is the detail of comparative cost reporting. Historical records reveal that cost comparisons were conducted between different time periods, individual products and product lines, and different mills. In summary, these records appear to suggest that cost reporting may have been used for cost control purposes. Key aspects of the more noteworthy reports are now discussed.

An October 1827 report entitled “Memo of Cloth Made and its Cost at Lowell” provides unit and total costs for each type of cloth during the most recent six month period at Merrimack Manufacturing Company.<sup>22</sup> The report also includes percentage calculations for “apparent waste” and “real waste” for each of the mills, suggesting that quality was regularly measured, perhaps in comparison to quality norms.

An October, 1828 six-month summary report entitled “Profit and Loss on each kind of Cloth” reports the prior six months’ profit for each of Merrimack Manufacturing Company’s five mills. Because each mill produced only one grade of yarn, profitability by product grade was determinable as well.<sup>23</sup> An 1830 report entitled, “Cost of each Cloth and gain in each Mill” provides more detail by including revenues by cloth type, direct costs for cotton, carding and spinning, and weaving, and a common allocation for general expenses and repairs. Total print and an average cost per pound and per yard of cotton is also computed for each mill. Johnson [1981] and Johnson and Kaplan [1987] contend that the purpose of cost accounting in the nineteenth century cotton mills was to coordinate, control, and increase the efficiency of multiple internal conversion processes, but not to link the financial performance in each process to overall profitability. Surviving summary reports indicate that

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<sup>22</sup> MHS, *Appleton Family Papers*, Section 4.7.

<sup>23</sup> MHS, *Appleton Family Papers*, Section 4.9.

this linkage was made on a regular basis, thereby suggesting cost accounting's importance to ownership.

Comparative cost reporting may have been an important mechanism in stimulating cost reduction and greater efficiency among the Lowell system mills. Regarding comparatively strong financial performance at the Jackson mill in 1836, for example, Samuel Appleton wrote that "They must wake up at the Appleton and try to beat them the next six months to come."<sup>24</sup> Common ownership, rotating management, and a common sales agency enabled information from different companies and mills to be consolidated, evaluated, and acted upon. Gregory [1975, p. 257, 242] summarized the impact of these shared 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 per unit information was needed to maintain profit margins in light of a continually falling market prices for finished cotton products (see footnote 19). Surviving records indicate that a variety of detailed cost per unit calculations were conducted. One report prepared in October of 1826 and entitled "Cost of Various Styles of Prints" provides unit cost numbers for 13 different styles.<sup>25</sup> The cost of "Blue and Whites", for example, is built up by including unit costs for four operations (bleaching, printing, dipping, making up), one cost cell, (the col. room), and an allocation (general expense). This information could have been used to establish or evaluate prices and to help control inventory. The inventory of cloth on hand at the Merrimack Manufacturing Company on April 15, 1826 totaled \$132,504 and was broken down into unit and total pricing for 32 different styles of cloth.<sup>26</sup>

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<sup>24</sup> MHS, *Appleton Family Papers*, Section 5.12.

<sup>25</sup> MHS, *Appleton Family Papers*, Section 4.4.

<sup>26</sup> MHS, *Appleton Family Papers*, Section 4.2.

An October, 1827 report entitled “Cost of Printing” details the total and unit costs of various operations for the prior six month period. The report includes nine separate *operations*, one of which is labeled *General Expenses*. Each operation includes a unique number of yards produced and separate costs for materials and labor. The left and bottom margins also contain individual and summary unit cost notations from April 1828. This report suggests that unit cost information was monitored over time and, when used in conjunction with selling prices, could establish the overall profitability of printing. An 1830 factory agent’s memo to company directors further illustrates how unit costs were a critical factor in allocating productive capacity among products and in deciding to perform work internally or by subcontract.<sup>27</sup>

### *Miscellaneous Cost Reports*

Several other cost-based reports are noteworthy. The computation of the overseer’s premium at the Appleton mills in November, 1830 and a supporting memo illustrate how cost information was used in conjunction with incentive-based labor contracts.<sup>28</sup> The premium of six mills per pound was based on exceeding a targeted (or standard) level of 10,000 pounds of good output from each mill per week (rejected cloth was subtracted from total output). A later memo indicates that annual bonuses were capped individually (\$75 per overseer) and in total (\$250 per mill). These financial incentives certainly mustered greater labor productivity, but not without a social cost. Incentive-based pay schemes may have encouraged overseers to slow down or set clocks back in order to obtain additional output from operatives [Josephson, 1949]. Incentive pay may also have contributed to deteriorating work conditions and the abuse accorded individual operatives [Luther, 1970].

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<sup>27</sup> Twenty-five percent higher output prevented the bleach works at the Merrimack Manufacturing Company from meeting internal demand in June, 1830. As a result, Kirk Boot, Merrimack’s factory agent, reported that “We have attempted by reducing the quality of all work . . . but find that this is no economy because it not only enhances the cost of dyeing, but makes it less perfect.” Boot proposed to “put out” the *I* and *W* cloth to bleaching to the Hamilton Company 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, *Merrimack Manufacturing Company*, Volume 1 Directors Meetings, p. 89].

<sup>28</sup> MATH, *Nathan Appleton Collection*, Section 4.101.

Other reports show how cost information was or could be used in conjunction with operational decisions. A memo prepared on September 26, 1829 calculates the amount of money that would have been earned by 12 different classes of labor in the 13 weeks ending August 29 if they had been paid at then current prices.<sup>29</sup> Given that prices for finished goods were falling steadily during the period, this particular cost information could have been used to establish the output requirements that were needed to maintain earlier profit levels.

Another memo describes the output differences between looms operating at high speed and common speed in two mills over a three week period in 1831.<sup>30</sup> The memo's author determined 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 impact of wage rate adjustments on profits.

### *The Absence of Methodical Depreciation*

Several researchers have criticized the Lowell cost management system for the absence of methodical depreciation. They suggest a developmental deficiency by implying that the concept of depreciation was unknown to mill management [Hoskin and Macve, 1988] or that its absence was intentional and led to inflated profits, excessive dividends, the under-capitalization of facilities, and the eventual decline of the industry [Dalzell, 1987; Spalding, 1969]. An assessment of environmental factors, however, rationally explains depreciation's absence during this and later time periods [Tyson, 1990; McGaw, 1985].<sup>31</sup>

Evidence indicates clearly that the concept of depreciation as loss of value was widely understood in the cotton textile industry by the early 1830s. Montgomery [1832, p. 191] included 7.5% of machinery for "tear and wear" in calculating Profit and Loss per fortnight for an English textile operation. More directly, the Massachusetts legislature [Laws of the Common-

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<sup>29</sup> MATH, *Appleton Papers*, Section 4.98.

<sup>30</sup> MATH, *Appleton Papers*, Section 4.109.

<sup>31</sup> Johnson and Kaplan [1987] discuss the cost management systems employed in the steel and railroad industries and note their omission of methodical depreciation. Depreciation first appeared with regularity in large vertically integrated firms in the early twentieth century. The reasons why Carnegie and others did not require accounting information to monitor fixed capital in the steel business apply equally well to the cotton textile industry.

wealth, 1831] required existing corporations to provide an estimate of the value of the real and personal "estate" of the Corporation.<sup>32</sup> In response to the Act, a committee of Appleton Company directors prepared a "Statement of Cost and Value" on November 24, 1832. Included in the adjustments to cost are two items that represent depreciation: \$14,944.15, "From first cost of Machinery" and \$15,410.60, "Being 10 per cent deducted for difference between old and new machinery." The committee explained how they derived their "depreciation" adjustments:

The committee have reduced in their valuation the property of this company used for manufacturing purposes, so as to be near the value of other mills built by Lowell, since its establishment, and no regards has been (given) to the effect, that political events may have on this and other property of the kind.<sup>33</sup>

As a result of the valuation, the book value of machinery was reduced and the residual profits adjusted accordingly. Surviving records reveal that machinery valuations and book adjustments were performed at the Appleton Company in 1838, 1845, 1849, and 1857, indicating that valuations were made periodically, perhaps in conjunction with new stock offerings.<sup>34</sup> Incomplete records preclude precise conclusions regarding the regularity and motivation of asset revaluations, but surviving records clearly demonstrate an awareness of depreciation and the difficulties in determining current value. In regard to determining fair value in compliance with the Massachusetts Act of 1830, a committee of Merrimack Manufacturing Company directors wrote:

The greatest difficulty was found in making a satisfactory valuation of the Machinery in the 5 mills for spinning and weaving. In this department very considerable improvements have been made and great reductions in the price of machinery since the contracts were

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<sup>32</sup>The historical record shows that nine identical petitions, each from a separate county, were submitted to the legislature requesting the inclusion of a limited liability feature to corporate ownership. The Suffolk County petition contained 239 names, eight of whom were recognizable as "Boston Associates". The provision within the 1830 law that required the valuation of corporate debts, credits, and property appears to be the cost of obtaining the limited liability feature.

<sup>33</sup>MATH, *Appleton Papers*, Section 3.13.

<sup>34</sup>MATH, *Appleton*, Section 3.15.



made a part of that now in use. They adopted the principle of considering the machinery in No. 2 which is supposed to unite all the latest improvements, and to have been built at the very lowest price, as the standard.<sup>35</sup>

There are a number of reasons why depreciation may not have been recorded methodically. For one, expenditures to maintain, renew, and improve existing machinery were all recorded in a *Repairs* account that was fully charged to income. Depreciation was also an uncontrollable cost that was about the same for all mills [Lubar, 1983] and essentially irrelevant for making cost comparisons. Depreciation numbers are also unlikely to influence replacement decisions given the rapid pace of technological innovation at that time [McGaw, 1985]. The use of periodic revaluations and residual profit adjustments, in conjunction with recapitalization, is a more direct way of funding fixed capital.<sup>36</sup> In any case, the concept of depreciation and the need to cover the cost of fixed capital were known and understood. In remarks before the House of Representatives, Nathan Appleton [1832b, p. 19] displayed a keen understanding of practical economics and the need to monitor costs:

The natural price of every commodity is the cost of the labor, and the value of the use of the capital employed in its production. The disturbing causes are the relative proportion of supply and demand. Now the practical man watches the disturbing causes which are in constant action, with great indifference for the natural price. The student of political economy knows and cares nothing for the active disturbing causes, but supposes the actual price to be always in conformity with the remote tendency.

### *The Absence of a Fully-Developed Standard Cost System*

Researchers have recently suggested that a certain disciplinary power associated with West Point training was needed be-

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<sup>35</sup>Baker, *Merrimack Manufacturing Company*, Vol. 1, Directors Meetings, p. 75.

<sup>36</sup>The Lowell corporations originally ensured that no more than two-thirds of capital would be tied up in fixed assets, and that expansions would not be financed out of earnings; however, "In some few instances this principle has been disadvantageously encroached upon by increasing the original machinery without a proportional increase in capital" [Appleton, 1858, p. 30].

fore managerialism would individualize norms of behavior, utilize standard costs, and construct a work force described as "a cohort of calculable persons that could be managed" [Ezzamel, Hoskin and Macve, 1990, p. 160]. However, many other factors better explain why standard costs were intentionally not implemented in the Lowell system during this time period.<sup>37</sup>

For one, the lack of education and sobriety, and the pace of production would have prevented individual operatives from self-reporting production data. For example, Bagnall [1908] indicated that most mechanics were addicted to alcohol. In an address on working conditions in New England in 1832, Luther [1970, p. 20] reported that "in 8 mills all on one stream, within a distance of two miles, we have 168 persons who can neither read nor write."

In the early years at Lowell, at least through the 1820s, economic need was not the primary motive that brought farm girls to work in the mills [Dublin, 1979; Ware, 1966]. Some of the reasons for moving to Lowell include the desire to escape the boredom of the farm, the sociability of city life, opportunities for education and greater independence. Therefore, exceptionally stringent work rules and individualized output requirements in conjunction with standard costs may have led to intolerable levels of turnover and were thus intentionally avoided. According to Prude [1983], workers' voluntary terminations accounted for nearly 50 per cent of the turnover between 1816 and 1820. Mill girls' own accounts from this same time period suggest that quitting behavior was a common form of protest to work rules and conditions perceived to be unreasonable [Dublin, 1979; Josephson, 1949]. According to Ware [1966, p. 236]:

In contrast to the starvation wage with which the English could obtain pauper labor, the American manufacturers had from the first to offer a wage which would entice into the mills a class of self-supporting farmers and mechanics, as well as girls for whom 'gain, not bread' was the motive for factory work.

Continual innovations in technology throughout the early period also discouraged the development of standard costs that would quickly be rendered out-of-date. Instead productivity was

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<sup>37</sup> Unfortunately, *standard costs* do not have a universally accepted definition and are often interpreted differently. This writer defines *standard costs* as the level of costs that should be. Standard costs also suggest the individualization of norms and the calculation of variances.

increased by adjusting piece rates, machine speeds, and tending responsibilities so that only industrious workers could earn fully adequate wages. Using the market to shape the cost of labor through piece-rate adjustments reflected rational decision making rather than a cost accounting deficiency.

Several noted researchers have argued 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]. Surviving records indicate, however, that piece rates were the common form of remuneration at the Lowell mills long after cost management practices were initiated. For example, a September, 1829 memo entitled "Prices for Job Hands" identified piece rates for twelve different classes of labor, six of which had different rates depending on the type of cloth produced.<sup>38</sup> Dublin [1979] describes how piece-rate adjustments were effectively used to reduce operatives' wages in the 1860s. Englander [1987] indicates that piece-rate accounting, in conjunction with the inside contract system of production, was used by many U.S. industries into the twentieth century. More research is needed to determine the impact of piece-rate accounting on standard costs, budgets, and other accounting procedures. Market-based piece rates were used by the Boston Manufacturing Company in 1814 and by Superintendent Lee at the Springfield Armory as early as 1819 [American State Papers, 1823]. Therefore, attributing the transition of piece-rate accounting into individualized norms to West Point managerialism appears unwarranted.

Ezzamel, Hoskin, and Macve [1990, p. 159], in discussing how Daniel Tyler in 1832 at the Springfield Armory developed norms of what "the good worker working solidly could and should achieve," contend that "there appears to be no historical precedent for this kind of standard setting." However, Pollard [1965, p. 191] describes how prizes were given to the hardest working boy and girl, "and their output became the norm for the rest." Surviving records from the Lowell mills in the 1820s similarly show that output norms and associated piece wages were set according to the efforts of the most skilled workers. Competition within the cotton textile industry may account for the early development of this productivity-enhancing mechanism.

A number of factors explain why individualized norms were

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<sup>38</sup> MATH, *Appleton Papers*, Section 4.96.

not incorporated into standard costs during the time-frame under study. Owner/managers were able to fully exchange cost and other labor related information; consequently, they could control costs effectively and efficiently through a uniform set of rules and regulations. An 1829 memo labeled "Regulations Agreed upon by Agents of Merrimack, Hamilton, and Appleton" outlines the terms of discharge and form of discharge letter to be issued and illustrates how blacklisting served to strengthen managerial control. In another example, a statement detailing the number of girls working, missing, and out sick on March 6, 1841 in each of the five Lawrence mills was sent to the agent of the Appleton Company.<sup>39</sup> The fact that the Lowell work force was predominantly female may help explain their general complicity with these rules and why management was able to delay the use of cost accounting for control purposes.<sup>40</sup>

Having full and certain knowledge of the costs of production, facilitated through interlocking directorships and the exchange of key business data, enabled gentlemen's agreements to maintain consistent wage rates and regulations.<sup>41</sup> The uniform marketing and pricing of finished goods by a common sales agency also staved off destructive price competition among the Lowell companies. The growth of organized labor, the increasing complexity of multi-activity firms, and the inability to utilize piece-rate adjustments all help explain the need for standard costs in later years.

## SUMMARY AND CONCLUSIONS

To argue that Lowell costing methods were under-developed discounts the social environment of early American textile

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<sup>39</sup> MATH, *Appleton Papers*, Section 4.36.

<sup>40</sup> There were several minor work stoppages during the early 1830s at Lowell, but these lasted only a few days and were not widely supported. Guttman [1976, p. 20] quotes an unnamed source regarding the advantage of employing females in the mills: "Women are much more ready to follow good regulations, are not captious, and do not clan as the men do against the overseers."

<sup>41</sup> On January 16, 1828 the following vote was passed: "That the presidents be requested to communicate to the ??? Mfg. Company . . . that the practice of inveigling workers from other Establishments is inconsistent with the preservation of good fellowship as it is with their mutual interests [Baker Library, *Merrimack Manufacturing Company*, Vol. 1, Directors Meetings]. Empirical research has shown that wages were standardized across the whole textile manufacturing industry [Layer, 1955].

manufacturing as well as the economic factors that demanded that certain cost information be routinely provided to owner/managers of successful businesses. To further contend that a particular type of managerial training was needed to enforce accountability or utilize accounting to its full potential ignores a record replete with detailed cost keeping and accountability procedures. Tucker [1984, p. 105], for example, relates how Samuel Slater monitored his work force by examining every piece of cloth in the early years from outworkers:

If weavers took more than four months to complete their work, they were docked a half-cent a yard on the cloth returned, and if they failed to return all the yarn given out, they were charged for it and dismissed.

The absence of certain accounting procedures is better interpreted as reflecting business complexities, economic pressures, or social forces of the day rather than as a lack of knowledge, a developmental deficiency, or missing a needed managerial component.

Perhaps strict rules, regulations, and labor costing procedures were not implemented at the Springfield Armory much before 1840 because of the absence of a highly competitive market, or because armory workers, being more skilled, were able to maintain control of work processes until that time. Ware [1966] and Dublin [1979] support this latter position, while Grimsted [1985, p. 8] seemingly refutes it:

Whatever the differing sources of strength and vulnerability of various groups of skilled craftsmen and unskilled industrial workers in this era, they were in sufficiently similar situations to make use of broadly similar mechanisms to try to protect their interests.

In either case, a War Department board examining practices at the Armory in 1841 determined that "in all the private establishments which were visited by the board, the hours of labor are fixed by regulation" [Benet, 1878, p. 401]. The board was probably referring to the cotton mills in Lowell where operatives had been subject to strict industrial discipline for nearly twenty years. Accountability and costing systems may also have been utilized in other large, highly integrated, and competitive industries before 1840. According to Cochran [1981, p. 98]:

In the years before 1820, the United States had become firmly set on the road to modern industrializa-

tion; twenty years later, by the standards of that day, the nation was industrialized.

Surviving cost reports from the Lowell mills are comprehensive and mathematically exact and suggest that cost information was regularly provided to assist in a variety of important decision-making areas. Although the absence of complete records prohibits a full understanding of cost-keeping and reporting practices, enough records survive for one historian to conclude that Lowell owner/managers were "pioneers in the development of business accounting procedures in the decades before the Civil War" [Dublin, 1979, p. 25]. One can safely conclude that systematic cost-keeping procedures were present and well-utilized in the United States before 1840.

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