Technology, Cost Accounting, and Management in the Cut Nail Industry of the Upper Ohio Valley, 1865-90

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My presentation this evening will focus on six cut nail manufacturers in the Wheeling, West Virginia, area during the period between 1860 and 1885. Though there are many interesting facets to the history of nailmaking, I am most interested in examining the passage of these six firms from small, traditional businesses to large-scale, multiunit firms that controlled the entire industry. Most particularly, I am interested in examining the relationships between market decisions, cost accounting, technology, and management structure.

To place my comments in context, perhaps it should be said that the cut nail, an American innovation, first appeared in the 18770s. The process of cutting nails from sheets of wrought iron by machines, rather than manually fashioning nails from rods, introduced great efficiencies and was primarily responsible for the conversion of a labor-intensive cottage industry into a factory-based one during the first third of the 19th century. By 1820 cut nail manufacturing had begun to evolve along two rather distinct paths.[1] In one pattern of development, the most notable example of which being the Pittsburgh manufacturers, nails were manufactured as one of many products of a metal working establishment [24, pp. 102-104; and 3, Vol. 2, pp. 111, 125, 126, 478, and 634]. A second path was characterized by the development of specialized integrated mills that contained puddling, rolling, and nail departments within a single firm.

Nail manufacturing began in Wheeling in 1833 when John Schoenberger and Thomas Agnew, two iron masters from Pittsburgh, built a small nail factory. This lone factory operated with varying success until 1847 when E. L. Stevens, Edward Norton, and his brother George Norton, all nailers from Washington, Pennsylvania, took over its operation. After a brief time the Norton brothers left the Schoenberger mill and established a second nail works. Finding that local investors were interested in what was in the early 1850s a lucrative business, the Nortons soon sold this mill and over the next few years they and other craftsmen made small fortunes building specialty mills and then selling out [25, pp. 7

and 13-31; 9, pp. 376; 23, p. 230; and 37].

Having briefly sketched the early history of nail manufacturing in Wheeling, I would now draw a comparative summary of the Wheeling branch of the industry at two points in time. This comparison will, I think, give some indication that the Wheeling firms changed rather dramatically in the immediate post-Civil War era. In 1860, the mills had a combined total of 250 nail machines and employed about 500 men.[2] All relied upon pigiron supplied largely by Hanging Rock region furnaces and all marketed their nails in the Upper Ohio Valley [32]. Even as late as 1866 when representatives of the Eastern and Western manufacturers met in Pittsburgh to form the National Nail Association, the Wheeling firms were not regarded as important enough to be represented [12].

In 1875, these six Wheeling mills operated 625 machines, employed 3,500 workmen, had much expanded rolling and puddling mills, and were regularly selling their product through the Mississippi and Ohio valleys. All had built blast furnaces, three had built keg factories, several owned steamboats, and as a group they accounted for almost 40 percent of the country's nail output. Moreover, not only were they producing one-half to one-third more nails per machine than competitors but they were selling nails at $2.85 per keg and making a 35-cent profit while at the same time competitors were going bankrupt selling for $3.42 a keg [15; 40; 30, pp. 40-41; 31, pp. 446 and 617; 26, p. 123; and 51, p. 42].

The roots of the changes just noted may be found in the Wheeling manufacturers' reaction to the nail and pigiron market during and immediately after the Civil War. During the war nail prices more than doubled, rising from $3.13 per keg in 1860 to $7.08 per keg in 1865 [26, p. 123; and 51, p. 1]. Although this substantial increase in price provided an unprecedented opportunity for high profits, high prices for pigiron and the constant interruption of supply prevented most of the firms from taking advantage of the high prices [34]. Only one firm, Woodward & Bailey, a company that had leased and then in 1862 built its own blast furnace, managed to make truly large profits during the war [25, pp. 37-38].

After the war nail prices declined rather dramatically and although pig metal supplies were more regular, the cost remained high. During the late 1860s this combination of low nail prices and high pig costs forced all of the nail firms, except Woodward & Bailey, to use retained earnings from the war period, and eventually drove two into bankruptcy. During 1868, each of the firms began to analyze the conditions. Moses B. Cox, a partner at the Belmont Mill, stated the prevailing conclusion in 1869 when he commented,

> It is well known that all the profits in the iron business just now are in the blast furnace and it gives those mills that have furnaces such an advantage that

they can go on operating ... when other mills will be forced to wind up before a great while [49, pp. 1-12; and 25, p. 47].

Cox's analysis generally laid the blame for the problem on the pigiron market and specifically on the profits being taken by furnace operators. It may be noted that his view was supported by the example of Woodward & Bailey, the firm that continued to show profitable returns in the immediate post-war period [51, pp. 1-12]. Faced with this situation, the nailmakers had little choice but to build blast furnaces.

The manufacturers had essentially concluded that it was to their advantage to abandon the supplier's market and to internalize the manufacture of pigiron. As Oliver Williamson, author of *Markets and Hierarchies* [50, pp. 9-11 and 83-85; and 6, pp. 6-12] noted, the internalization of such a major transaction frequently requires a restructuring of the internal organization to provide the coordination and cost-establishing functions previously left to the market.

The decision to build blast furnaces immediately destroyed the old partnerships. Because of the high cost of blast furnaces and because the reserves of most of the firms had been depleted by the losses of the late 1860s and frequent reorganization of the partnerships, only one firm, the Riverside, was able to finance postwar furnace construction from retained earnings. In order to raise the money needed, the firms were reorganized as corporations. When the stock was sold, Wheeling merchants, such as Crispin Oglebay, purchased large blocks of the stock and by the early 1870s a new group of men had gained control of the mills [36; 25, pp. 40-52; and 11, Vol. 1, pp. 325, 330-32, and 471]. The corporate form and the new men, who were more interested in long-term growth than capital gain, immediately brought a new stability to the mill ownership [33].

The reorganization of the mills as corporations had an immediate impact on management. Under the old partnership, top- and lower-level management was combined in the same men. Typically the several partners served as mill superintendents and literally left the hearth or cutting machine to participate in the "business meeting." These men had both an intimate understanding of the technical process and direct knowledge of how well both men and machines were performing.

When the corporations were formed, the top-level management was separated from second-level management. As a result, the boards were deprived of the information their predecessors had. To compensate, they came to rely upon the board secretary and a group of subordinate bookkeepers and clerks to collect and organize information from which operational evaluations and decisions were made [2, p. 4].

The information collections system which became a central

feature of the new management was, at base, nothing more that cost accounting. Evidence of cost accounting had first appeared at Woodward & Bailey in 1865. The accounts for the year ending 1 January 1865 listed the firm's assests -- building, equipment, inventory, and so on -- in a fairly standard manner. Costs of manufacturing and income were, however, reported quite differently. Both were calculated on a per-keg basis. Moreover, the cost of a keg of nails was broken down into 10 cost categories -- pig metal, labor, steel, oil, fuel, iron ore, kegs, bricks, taxes, and miscellaneous expenses -- that were totaled to give an average cost per unit. An average selling price was calculated by dividing the number of kegs sold into the income and when the cost was subtracted, a net profit was shown. The books also showed gross per-ton cost for manufactured pigiron and a comparable figure of what market price for the same amount of metal would have been during the same period. Finally, the books contained an entry showing the number of kegs manufactured for each ton of metal.[3]

The accounting system had several important features. First, it did allow the managers to determine how much internally produced iron cost and thereby functioned as an alternative to the market as determiner of this transaction. This was important particularly since Wheeling's competitors continued to rely on purchased pigiron. Given the lack of expertise in blast furnace operations at Wheeling, it was possible that internal costs could have exceeded those of the market place and put Wheeling firms at a competitive disadvantage.[4]

Second, the accounting system allowed managers to compare operating costs over several reporting periods and thereby discover in which areas costs were rising and falling. With this information the boards could quickly spot problem areas. There are numerous examples of boards taking note of changes in cost and seeking explanation [31, pp. 1-14; 1; and 2, pp. 106, 128, and 129; and 25, p. 67].

Third, because all the mills used the same system, directors could compare their operations with other mills in the Wheeling area and thereby obtain some indication of how their particular operations were performing.[5]

Fourth, the accounting system also allowed managers to determine the level of efficiency at which mills operated and gauge the impact of technical changes. The records of Woodward & Bailey, as already noted, carried statistics on the number of kegs produced per ton of metal. During the late 1860s and throughout the 1870s this ratio fluctuated but it showed a favorable long-term trend. When reports did show a temporary slippage, directors and mill superintendents looked for places where waste might be on the rise [51, pp. 10, 36, 38, and 50; and 25, p. 67]. The deep interest in maintaining favorable ratios in this area

as well as in others also had an impact on technical decisions such as the introduction of the automatic nail plate feeders. During the 1870s these devices were tested but believed to be too wasteful with material and, therefore, not generally used in the mills.[6]

By the late 1870s, the systems capability had been expanded and management was actually projecting the cost effect of anticipated changes. The most notable instance of this occurred in 1882 when several firms explored the possibility of using steel instead of wrought iron as the basic material for nails [1, p. 4; 16; 46; and 25, p. 89].

Fifth, the accounting system, which it may be recalled showed the cost per keg divided into several categories, pointed out a relationship between cost and volume. As early as 1872 corporate records indicate that three cost categories -- taxes, interest, and miscellaneous expenses -- consistently had an inverse relationship to the volume of the product [51, pp. 1-15]. Wheeling manufacturers understood this relationship sufficiently well enough to use it as a guiding principle in the formulation of policy. This shows clearly in Wheeling's relationship with the Western Nail Association, an organization of nail manufacturers that had as its main objective establishing and maintaining minimum prices for nails. Initially, the Wheeling firms supported this effort, but in 1877, when it became apparent that the volume of sales was slipping as a result of this policy, the Wheeling men took issue. Beginning in 1878 they consistently voted for lower prices and even opted to pay Association fines rather than maintain the minimum price or close down in an effort to reduce supplies [1, p. 11; 2, pp. 365 and 379; and 49, p. 103].

One very noticeable feature of Wheeling's development to 1875 was the degree to which the activities of the firms were directed at controlling the internal operation of the mills. The restructuring of the pigiron procurement system, the reorganization of ownership, the development of cost accounting, accounting, and the revamping of the management system were all internal changes directed at achieving maximum operational efficiency. Moreover, all were of such a nature that they could be effected without involving other segments of the industry. Indeed, these changes occurred without notice to outsiders [35 and 14].

Beginning in the late 1870s an exclusive reliance on gains through internal efficiencies was no longer possible. The conflict with other Western nail manufacturers over pricing decisions and labor costs forced the Wheeling firms to take a more active role in both issues. When the Wheeling manufacturers took up these problems, they did so with the objective of controlling them as effectively as they had their own mills.

Specifically, their aim was to gain control of certain areas, such as wages, that affected manufacturing costs. This first issue appeared in 1879 when the Wheeling firms noted that "upon comparison

of wages we are compelled to pay 33 1/3 percent to 50 percent more ...than is paid at competitors in the east" [49, pp. 365 and 108-109; and 42]. Until this time the Wheeling firms had not taken an active role in wage formulation. Because of their interest in maintaining production volume, the Wheeling firms not only paid workmen at least the same as comparable workmen in Pittsburgh received, but during labor negotiations had promised in advance to pay prevailing wages if the workmen stayed on the job. Wage negotiations were left entirely to the Pittsburgh iron producers who formed the nucleus of the Western Iron Association, an organization that bargained with the Amalgamated Association of Iron and Steel Workers [43; and 2, p. 369].

After 1879 Wheeling firms pressed their counterparts in Pittsburgh to withdraw from the Western Iron Producers Association and rely upon the Western Nail Association as a bargaining agent. Because the Pittsburgh nailers were integrally associated with the Western Iron Producers Association, they refused to go along with Wheeling's wishes both on the labor question and also on a similar question involving coke prices [1, p. 9; and 44].

A short upturn in nail prices during 1881 and 1882 masked the dispute briefly, but by no means eliminated it. In 1882 the Wheeling firms organized formally the Association of Wheeling Nail Manufacturers and began planning not only to force the Western Nail Association to act as a bargaining agent but also to use it to give Wheeling mills a price advantage [18, p. 14].

As early as 1879 the Wheeling firms had analyzed production costs and concluded that the puddling mills were excessively expensive. After failing to negotiate wages in the puddling mills downward in 1882, the Wheeling firms turned to technology to provide cheaper wages. In 1883 they concluded that the substitution of steel for wrought iron would rid them of the troublesome puddlers as well as introducing other savings, and plans were laid for the construction of several Bessemer plants [49, pp. 168 and 173; 1, pp. 80, 101, and 105; 17, p. 26; and 25, p. 89].

The unions that represented the workmen were, of course, opposed to the use of steel. Throughout 1883 and 1884 the puddlers not only complained of the manufacturers' move to eliminate their jobs, but also enlisted the nailers' support by extracting a pledge that they would not cut steel nails. In August 1884, a long-standing grievance between the nailers' helpers and the nailers surfaced. The puddlers sided with the helpers. And the nailers, after meeting with management, withdrew their opposition to steel nails. Within two days all of the Wheeling firms began to close down their puddling mills. Although it is impossible in the time available here to explore this affair thoroughly, it is clear that management successfully split the union and after 1884 was free to deal with each segment separately [45 and 28].

While engaged in the development of steel plants, the Wheeling

manufacturers were also arranging a policy coup at the Western Nail Association. At the March 1885 meeting of the Western Nail Association the Wheeling manufacturers in concert with members from several new mills in the Chicago area passed a resolution moving the Association's headquarters from Pittsburgh to Wheeling. At the April meeting the Wheeling manufacturers literally took control of the Association. The secretary and president who were Pittsburgh representatives were ousted and replaced by Wheeling men, a resolution changing the Association's policy towards labor negotiations was adopted, and, finally, the Association voted to allow steel nails to be sold at a lower price than iron nails [47]. In short, the Wheeling manufacturers won control over labor negotiations and pricing policy for all the Western nail manufacturers. Moreover, they designed the pricing system so as to give themselves an inherent competitive advantage.

Once the Western Nail Association was on record as the industrial bargaining agent, the Wheeling manufacturers moved quickly to reduce wages. At the May 1885 meeting the association voted to reduce nailers' wages by almost 20 percent throughout the Western Nail Association. The nailers responded with a strike that lasted almost a year [27 and 48]. And although the manufacturers finally won, the long period of diminished nail supplies opened the market to the wire nail which in the coming years gradually took the place of the cut nail.

The success of the Wheeling nail manufacturers during the 20 years after the Civil War was in large part due to the evolution of a modern management system that placed high priority on managerial control of both the internal production process and market factors. Using this system, the Wheeling firms structured capital-intensive manufacturing enterprises that were uniquely suited to produce cut nails. They were not able, however, to take account of the possibility of competition from outside the industry they controlled. When the wire nail, which was the end product of a different process, suddenly appeared, the Wheeling manufacturers who had invested so intensely in cut nail production chose not to manufacture the new nail. Instead, they turned existing furnaces and rolling mills to the production of other products, the most prominent of which was tin plate. This change in product and the national move towards horizontal integration of the late 1890s forced several of the firms to merge and eventually form the Wheeling Steel Corporation.

NOTES

1. The most complete source on the history of nail manufacturing is [3]. Additional sources include [22; 8, pp. 238-44; 5, pp. 103-15; and 4, pp. 113-33].

2. Figures on employment and mill size were taken from a series of articles in *The Wheeling Intelligencer* between 2 February and 4 March, 1874.

3. [51]. Woodward, Bailey & Company's cost accounting system is one of the earliest examples of cost accounting in manufacturing enterprises. For general discussions of cost accounting, see [7, 21, and 10]. [7, 21, and 10]. For more specific articles on the subject, see [19 and 20].

4. Wheeling manufacturers were quite fearful that their blast furnaces would produce pigiron that was more expensive than market iron. See [1 and 2]. During this time the directors expressed constant concern for pigiron cost and for furnace efficiency.

5. While evidence for proof of this point is not as direct as one might like, the large number of people (40) who held stock in more than one firm, and the constant shifting of employees, continually made comparison not only possible but inevitable.

6. For discussion of automatic feeders and their use, see [41; 5, pp. 110, 111, and 113; and 29, pp. 448-49].

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