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Cumberland Metal Industries: Engineered Products Division, 1980

Robert Minicucci,[1] vice president of the Engineered Products Division of Cumberland Metal Industries (CMI), and Thomas Simpson, group manager of the Mechanical Products Group, had spent the entire Wednesday (January 2, 1980) reviewing a new product CMI was about to introduce. (See **Exhibit 1** for organization charts.) The room was silent, and as he watched the waning rays of the sun filtering through the window, Minicucci pondered all that had been said. Turning toward Simpson, he paused before speaking.

> Curled metal cushion pads seem to have more potential than any product we've ever introduced. A successful market introduction could as much as double the sales of this company, as well as compensate for the decline of some existing lines. It almost looks too good to be true.

Simpson responded, "The people at Colerick Foundation Company are pressing us to sell to them. Since they did the original test, they've been anxious to buy more. I promised to contact them by the end of the week."

"Fair enough," Minicucci said, "but talk to me before you call them. The way we price this could have a significant impact on everything else we do with it."

The Company

Cumberland Metal Industries was one of the largest manufacturers of curled metal products in the country, having grown from $250,000 in sales in 1963 to over $18,500,000 by 1979. (**Exhibit 2** shows CMI's income statement.) It originally custom fabricated components for chemical process filtration and other highly technical applications. Company philosophy soon evolved from selling the metal as a finished product to selling products that used it as a raw material.

The company's big boost came with the introduction of exhaust gas recirculation (EGR) valves on U.S. automobiles. Both the Ford and Chrysler valve designs required a high temperature seal to hold the elements in place and prevent the escape of very hot exhaust gases. Cumberland developed a product that sold under the trademark *Slip-Seal.* Because it could meet the demanding specifications

[1] Pronounced *Minikuchi.*

Professor Benson P. Shapiro and Jeffrey J. Sherman prepared this case. HBS cases are developed solely as the basis for class discussion. It was made possible by a company that prefers to remain anonymous. All data have been disguised. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

of the automakers, the product captured a very large percentage of the available business, and the company grew quite rapidly through the mid-1970s. Company management was not sanguine about maintaining its 80% market share over the long term, however, and moved to diversify away from a total reliance on the product and industry. Thus, when a sales representative from Houston approached CMI with a new application for curled metal technology, management examined it closely.

The Product

Background

The product that Minicucci and Simpson were talking about was a cushion pad—an integral part of the process for driving piles.[2] Pile driving was generally done with a large crane, to which a diesel or steam hammer inside a set of leads was attached. The leads were suspended over the pile for direction and support. The hammer drove the pile from the top of the leads to a sufficient depth in the ground (see **Exhibit 3**).

The cushion pads prevented the shock of the hammer from damaging hammer or pile. They sat in a circular "helmet" placed over the top of the pile and were stacked to keep air from coming between striker plate and ram, as shown in **Exhibit 3**. Of equal importance, the pads effectively transmitted energy from the hammer to the pile. A good cushion pad had to be able to transmit force without creating heat, and still remain resilient enough to prevent shock. With an ineffective pad, energy transmitted from the hammer would be given off as heat, and the pile could start to vibrate and possibly crack.

Despite the importance of these pads to the pile-driving process, little attention had been paid to them by most of the industry. Originally hardwood blocks had been used. Although their cushioning was adequate, availability was a problem and performance was poor. Constant pounding quickly destroyed the wood's resiliency, heat built up, and the wood often ignited. The blocks had to be replaced frequently.

Most of the industry had shifted to asbestos pads (normally $^1/_4$-inch thick) which were used most often and seemed to perform adequately, or stacks of alternate layers of $^1/_2$-inch-thick aluminum plate and 1-inch-thick micarta slabs. (These were not fabricated, but simply pieces of micarta and aluminum cut to specific dimensions.) Both pads came in a variety of standard diameters, the most common being 11 $^1/_2$ inches. Diameter was determined by the size of the helmet, which varied with the size of the pile.

Curled Metal and the CMI Cushion Pad

Curled metal was a continuous metal wire that had been flattened and then wound into tight, continuous ringlets. These allowed the metal to stretch in both length and width and gave it three-dimensional resiliency. Because it could be made of various metals (such as copper, monel, and stainless steel), curled metal could be made to withstand almost any temperature or chemical. Stacking many layers could produce a shock mount, an airflow corrector or a highly efficient filter. Tightly compressed curled

[2] Piles were heavy beams of wood, concrete, steel, or a composite material which were pushed into the ground as support for a building, bridge, or other structure. They were necessary where the geological composition could shift under the weight of an unsupported structure.

metal could produce the Slip-Seal for exhaust systems applications or, when calendered and wound around an axis, a cushion pad for pile driving.[3]

Cumberland purchased the wire from outside vendors and performed the flattening and curling operations in-house. The CMI pad started with curled metal calendered to about one inch thick and wound tightly around the center of a flat, metallic disk until the desired diameter had been reached. A similar disk was placed on top, with soldered tabs folded down to hold it all together. The entire structure was then coated with polyvinyl chloride to enhance its appearance and disguise the contents (see **Exhibit 4**).[4]

The advantage of this manufacturing process was that any diameter pad, from the standard minimum of 11 $^1/_2$ inches to over 30 inches for a custom-designed application, could be produced from the same band of curled metal.

Comparative Performance

The Colerick Test

After struggling to find a responsible contractor to use the product and monitor its performance, CMI persuaded Colerick Foundation Company of Baltimore, Maryland, to try its pads on a papermill expansion in Newark, Delaware. The job required 300 55-foot piles driven 50 feet into the ground. The piles were 10-inch and 14-inch steel H-beams; both used an 11 ½-inch helmet and, thus, 11 ½-inch cushion pads. The total contractor revenue from the job was $75,000 ($5 per foot of pile driven).

Colerick drove a number of piles using the conventional $^1/_4$-inch thick asbestos cushion pads to determine their characteristics for the job. Eighteen were placed in the helmet and driven until they lost resiliency. Pads were added, and driving continued until a complete set of 24 were sitting in the helmet. After these were spent, the entire set was removed and the cycle repeated.

The rest of the job used the CMI pads. Four were initially installed and driven until 46 piles had been placed. One pad was added and the driving continued for 184 more piles. Another pad was placed in the helmet, and the job was completed. Comparable performances for the entire job were extrapolated as follows:

		Asbestos	CMI
1.	Feet driven per hour while pile driver was at work (does not consider downtime)	150	200
2.	Piles driven per set of pads	15	300
3.	Number of pads per set	24	6
4.	Number of sets required	20	1
5.	Number of set changes	20	1
6.	Time required for change per set	20 mins.	4 mins.
7.	Colerick cost per set	$50	Not charged

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[3] In calendering, curled metal ringlets were compressed between rollers to make a smooth, tight band.

[4] The managers at CMl were concerned that other manufacturers might discover this new application for curled metal and enter the business before CMI could get patent protection. The company had a number of competitors, most of whom were substantially smaller than CMI and none of whom had shown a strong interest or competence in technical, market, or product development.

Although the CMI pads drove piles 33% faster than the asbestos and lasted for the entire job, Simpson felt these results were unusual. He believed that a curled metal set life of 10 times more than asbestos and a performance increase of 20% were probably more reasonable, because he was uncertain that the CMI pads in larger sizes would perform as well.

Industry Practice

Industry sources indicated that as many as 75% of pile-driving contractors owned their hammers, and most owned at least one crane and set of leads. To determine the contractors' cost of doing business, CMI studied expenses of small contractors who rented equipment for pile-driving jobs. These numbers were readily available and avoided the problem of allocating the cost of a purchased crane or hammer to a particular job.

Standard industry practice for equipment rental used a three-week month and a three-day workweek.[5] There was no explanation for this, other than tradition, but most equipment renters set their rates this way. The cost of renting the necessary equipment and the labor cost for a job similar to that performed by Colerick were estimated as shown in **Table A**.

Table A Equipment Rental, Labor, and Overhead Costs

	Per Standard			
	Month	Week	Per Hour	Average Cost per Real Hour[a]
1. Diesel hammer	\$4,500–7,200	\$1,500–2,400	\$62.50–100.00	\$34
2. Crane	8,000–10,000	2,667–3,334	111.00–140.00	52
3. Leads @ \$20 per foot per month (assume 70 feet)	1,400	467	19.44	8
4. Labor[b]—3 laborers @ \$6–8 per hour each			18.00–24.00	21
1 crane operator			8.00–12.00	10
1 foreman			12.00–14.00	13
5. Overhead[c] (office, trucks, oil/gas, tools, etc.)			100.00	100

(Casewriter's note: Please use average cost per real hour in all calculations, for uniformity in class discussion.)

[a]These costs were calculated from a rounded midpoint of the estimates. Hammer, crane, and lead costs were obtained by dividing standard monthly costs by 4.33 weeks per month and 40 hours per week.

[b]Labor was paid on a 40–hour week, and a 4.33–week month. One-shift operation (40 hours per week) was standard in the industry.

[c]Most contractors calculated overhead on the basis of "working" hours, not standard hours.

[5] This means that a contractor who rented equipment for one calendar month was charged only the "three-week" price, but had the equipment for the whole calendar month. The same was true of the "three-day week." Contractors generally tried to use the equipment for as much time per week or per month as possible. Thus they rented it on a ''three-week'' month but used it on a "4.33-week" month.

Hidden costs also played an important role. For every hour actually spent driving piles, a contractor could spend 20 to 40 minutes moving the crane into position. Another 10% to 15% was added to cover scheduling delays, mistakes, and other unavoidable problems. Thus, the real cost per hour was usually substantially more than the initial figures showed. Reducing the driving time or pad changing time did not usually affect the time lost on delays and moving.

All these figures were based on a job that utilized 55-foot piles and 11 1/2-inch pads. Although this was a common size, much larger jobs requiring substantially bigger material were frequent. A stack of 11 1/2 -inch asbestos pads weighed between 30 and 40 pounds; the 30-inch size could weigh seven to eight times more. Each 11 1/2-inch CMI pad weighed 15 1/2 pounds. The bigger sizes, being much more difficult to handle, could contribute significantly to unproductive time on a job. (See **Exhibit 5**.)

Most contracts were awarded on a revenue-per-foot basis. Thus, contractors bid by estimating the amount of time it would take to drive the specified piles the distance required by the architectural engineers. After totaling costs and adding a percentage for profit, they submitted figures broken down into dollars per foot. The cost depended on the size of the piles and the type of soil to be penetrated. The $5 per foot that Colerick charged was not atypical, but prices could be considerably greater.

Test Results

The management of CMI was extremely pleased by how well its cushion pads had performed. Not only had they lasted the entire job, eliminating the downtime required for changeover, but other advantages had become apparent. For example, after 500 feet of driving, the average temperature for the asbestos pads was between 600°F and 700°F, which created great difficulty when they had to be replaced. The crew handling them was endangered, and substantial time was wasted waiting for them to cool. (This accounted for a major portion of the time lost to changeovers.)

The CMI pads, in contrast, never went above 250°F and could be handled almost immediately with protective gloves. This indicated that substantial energy lost in heat by the asbestos pads was being used more efficiently to drive the piles with CMI pads. In addition, the outstanding resiliency of the CMI product seemed to account for a 33% faster driving time, which translated into significant savings.

In talking with construction site personnel, CMI researchers also found that most were becoming wary of the asbestos pads' well-publicized health dangers. Many had expressed a desire to use some other material and were pleased that the new pads contained no asbestos.

The CMI management was quite happy with these results; Colerick was ecstatic. Understandably, Colerick became quite anxious to buy more pads and began pressing Tom Simpson to quote prices.

A Second Test

To confirm the results from the Colerick test, CMI asked Fazio Construction to try the pads on a job in New Brighton, Pennsylvania. This job required 300 45-foot concrete piles to be driven 40 feet into the ground. Asbestos pads (11 1/2 inches) were again used for comparison. Total job revenue was $108,000, or $9 per foot, and Fazio would have paid $40 for each set of 12 asbestos pads used. The results from this test are shown as follows:

		Asbestos	CMI
1.	Feet driven per hour while pile driver was at work (does not consider downtime)	160	200
2.	Piles driven per set of pads	6	300
3.	Number of pads per set	12	5
4.	Number of sets required	50	1
5.	Number of set changes	50	1
6.	Time required for change per set	20 mins.	4 mins.
7.	Fazio cost per set	$40	Not charged

The Market

Projected Size

There were virtually no statistics from which a potential U.S. market for cushion pads could be determined, so Simpson had to make several assumptions based on the information he could gather. A 1977 report by *Construction Engineering* magazine estimated that approximately 13,000 pile hammers were owned by companies directly involved in pile driving. Industry sources estimated that another 6,500 to 13,000 were leased. He assumed that this total of 19,500 to 26,000 hammers would operate about 25 weeks per year (because of seasonality) and that they would be used 30 hours per week (because of moving time, repairs, scheduling problems, and other factors).

Simpson further assumed that an average actual driving figure (including time to change pads and so on) for most jobs was 20 feet per hour, which amounted to between 290 million and 390 million feet of piles driven annually. To be conservative, he also assumed that a set of curled metal pads (four initially installed, plus two added after the originals lost some resiliency) would drive 10,000 feet.

Purchase Influences

In the pile-driving business, as in other parts of the construction industry, a number of entities participated in purchases. The CMI management was able to identify six types of influences.

1. *Pile hammer manufacturers.* A number of manufacturers sold hammers in the United States although many were imported from Western Europe and Japan. The leading domestic producer in 1979 was Vulcan Iron Works of New Orleans, whose Model #1 had become the standard used by architectural engineers specifying equipment for a job. Simpson did not feel these manufacturers would purchase a large dollar volume of cushion pads, but they could be very influential in recommendations.

2. *Architectural/Consulting engineers.* Pile driving required significant expertise in determining the needs of a construction project. Thorough stress analysis and other mathematical analysis were necessary. Because of the risks in building the expensive projects usually supported by piles, the industry looked to architectural/consulting engineers as the ultimate authorities on all aspects of the business. Consequently, these firms were very detailed in specifying the materials and techniques to be used on a project. They always specified hammers and

frequently mentioned pads. The CMI management felt that, although no sales would come from these people, they could be one of the most important purchase influences.

3. *Soil consultants.* These consultants were similar to the architectural/consulting engineers, but were consulted only on extraordinary conditions.

4. *Pile hammer distributing/renting companies.* This group was an important influence because it provided pads to the contractors. In fact, renting companies often included the first set of pads free. CMI management felt that these companies would handle the cushion pads they could most easily sell and might even hesitate to provide pads that enabled a contractor to return equipment faster.

5. *Engineering/Construction contractors.* The contracting portion of the industry was divided among large international firms and smaller independents. The former almost always participated in the bigger, more sophisticated jobs. Companies like Conmaco and Raymond International not only contracted to drive piles, but also designed jobs, specified material, and even manufactured their own equipment. It was clear to Simpson that if he was to succeed in getting CMI pads used on bigger, complex construction projects, CMI would have to solicit this group actively on a very sophisticated level.

6. *Independent pile-driving contractors.* These contractors represented the "frontline buying influence." Their primary objective was to make money. They were very knowledgeable about the practical aspects of pile driving, but not very sophisticated.

No national industry associations influenced this business, but some regional organizations played a minor part. Contractors and others talked freely, although few were willing to reveal competitive secrets. The company was unsure how important word-of-mouth communication would be. Very little was published about the pile-driving industry, although construction-oriented magazines like *Louisiana Contractor* occasionally reported on pile-driving contractors and their jobs. These magazines featured advertising by suppliers to the trade, mostly equipment dealers and supply houses. One industry supplier, Associated Pile and Fitting Corporation, sponsored professional-level "Piletalk" seminars in various cities, bringing designers, contractors, and equipment developers together "to discuss practical aspects of installation of driven piles."

Another potential influence was Professor R. Stephen McCormack of Pennsylvania A&M University. He had established a department to study pile driving and had become a respected authority on its theoretical aspects. Sophisticated engineering/construction firms and many architectural consultants were familiar with his work and helped support it. Cumberland management felt that his endorsement of the operational performance of CMI cushion pads would greatly enhance industry acceptance. The company submitted the pads for testing by Dr. McCormack in the fall of 1979, and although the final results were not yet available he had expressed considerable enthusiasm. Final results were expected by early 1980.

Competitive Products and Channels of Distribution

The pile-driving industry had paid very little attention to cushion pads before CMI's involvement. Everyone used them and took them for granted, but no one attempted to promote pads. No manufacturers dominated the business. In fact, most pads came unbranded, having been cut from larger pieces of asbestos or micarta by small, anonymous job shops.

Distribution of pads was also ambiguous. Hammer sales and rental outlets provided them, heavy construction supply houses carried them, pile manufacturers sometimes offered them, and a miscellaneous assortment of other outlets occasionally sold them as a service.[6] The smaller pads sold for $2 to $3 each; larger ones sold for between $5 and $10. Three dollars each was typical for 11 1/2 inch pads. The profit margin for a distributor was usually adequate—in the area of 30% to 40%—but the dollar profit did not compare well with that of other equipment lines. Most outlets carried pads as a necessary part of the business, but none featured them as a work-saving tool.

The CMI management felt it could be totally flexible in establishing an organization to approach the market. It toyed with the idea of a direct sales force and its own distribution outlets, but eventually began to settle on signing construction-oriented manufacturers' representatives,[7] who would sell to a variety of distributors and supply houses. The company feared an uphill struggle to convince the sales and distribution channels that there really was a market for the new pad. Management expected considerable difficulty in finding outlets willing to devote the attention necessary for success, but it also felt that once the initial barriers had been penetrated, most of the marketplace would be anxious to handle the product.

The Pricing Decision

Simpson had projected cost data developed by his manufacturing engineers. **Exhibit 6** shows two sets of numbers: one utilized existing equipment; the other reflected the purchase of $50,000 of permanent tooling. In both cases, the estimated volume was 250 cushion pads per month. Additional equipment could be added at a cost of $75,000 per 250 pads per month of capacity, including permanent tooling like that which could be purchased for $50,000.

Both sets of numbers were based on the assumption that only one pad size would be manufactured; in other words, the numbers in the 11 1/2 -inch size were based on manufacturing only this size for a year. This was done because CMI had no idea of the potential sales mix among product sizes. Management knew that 11 1/2 inches was the most popular size, but the information available on popularity of the other sizes was vague. CMI accounting personnel believed these numbers would not vary dramatically with a mix of sizes.

Corporate management usually burdened CMI products with a charge equal to 360% of direct labor to cover the overhead of its large engineering staff. Simpson was uncertain how this would apply to the new product, because little engineering had been done and excess capacity was to be used initially for manufacturing. Although it was allocated on a variable basis, he thought he might consider the overhead "fixed" for his analysis. Corporate management expected a contribution margin after all manufacturing costs of 40% to 50% of selling price.

Simpson was enthusiastic about the potential success of this new product. The Engineered Products Division was particularly pleased to offer something with such high dollar potential, especially since in the past, a "large customer" of the division had purchased only about $10,000 per year.

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[6] Supply houses were "hardware stores" for contractors and carried a general line of products, including lubricants, work gloves, and maintenance supplies. Distributors, in contrast, tended to be more equipment oriented and to sell a narrower line of merchandise.

[7] Manufacturers' representatives were agents (sometimes single people, sometimes organizations) who sold non-competing products for commission. They typically did *not* take title to the merchandise and did *not* extend credit.

He was still uncertain how to market the pads and how to reach the various purchase influences. Advertising and promotion also concerned him because there were no precedents for this product or market.

For the moment, however, Simpson's primary consideration was pricing. He had promised to call Colerick Foundation Company by the end of the week, and Minicucci was anxious to review his decision with him. He hoped other prospects would be calling as soon as word about the pads' test performance got around.

Exhibit 1 Engineered Products Division Organization Chart

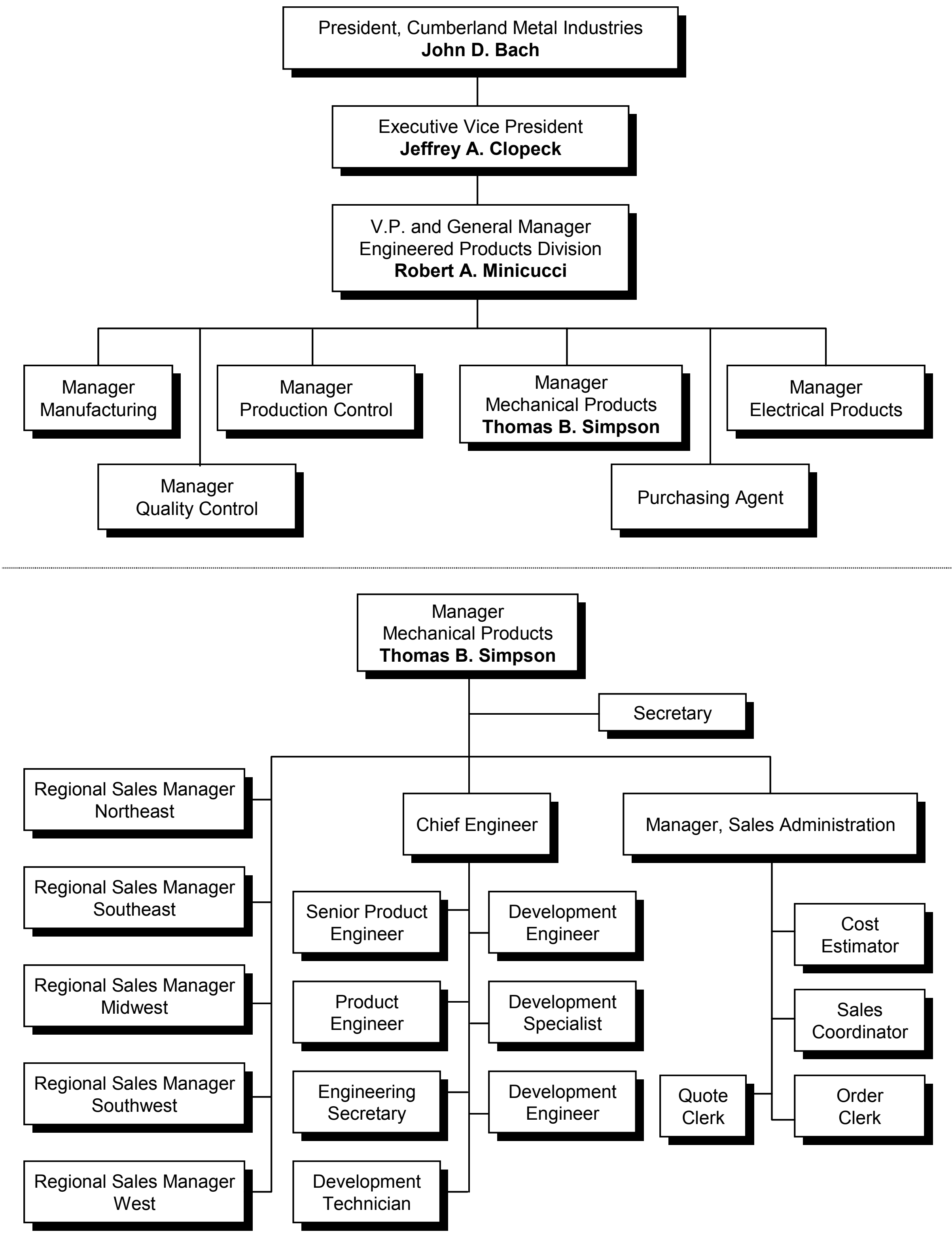
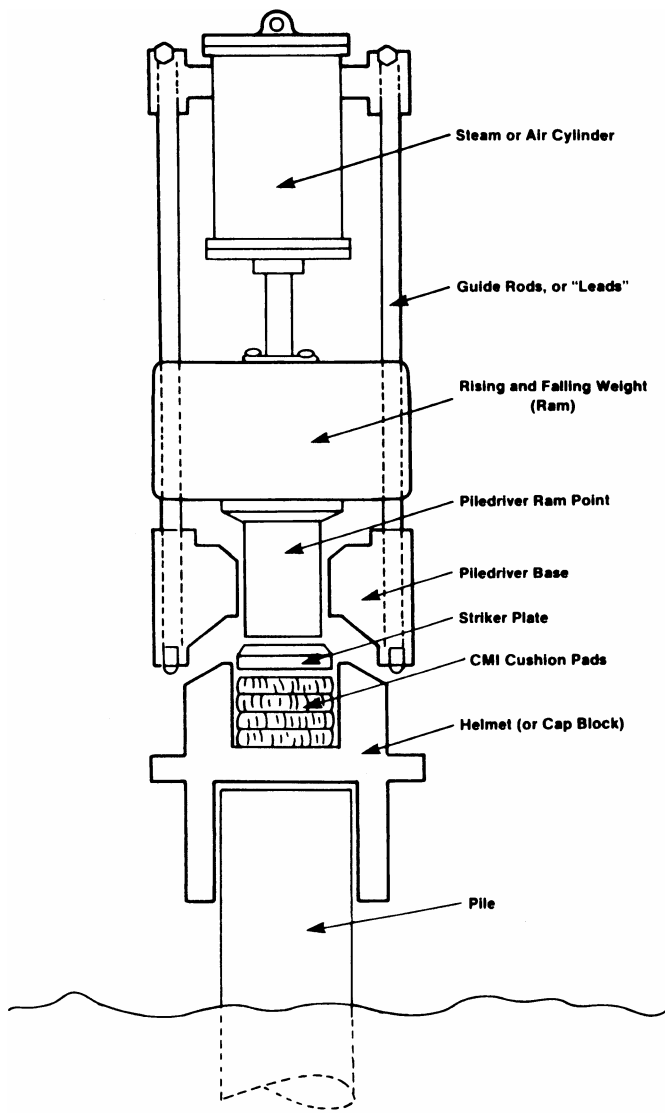


Exhibit 2 Income Statement

December 31	1979	1978
Net sales	$18,524,428	$20,465,057
Costs and expenses		
Cost of sales	11,254,927	11,759,681
Selling expenses	2,976,396	2,711,320
General and administrative expenses	2,204,291	2,362,528
	16,435,614	16,833,529
Income from operations	2,088,814	3,631,528
Other income (expense)		
Dividend income	208,952	—
Interest income	72,966	186,611
Interest expense	(40,636)	(31,376)
	241,282	155,235
Income before income taxes	2,330,096	3,786,763
Provision for income taxes	1,168,830	1,893,282
Net income	1,161,266	1,893,481
Net income per share	$1.39	$2.16

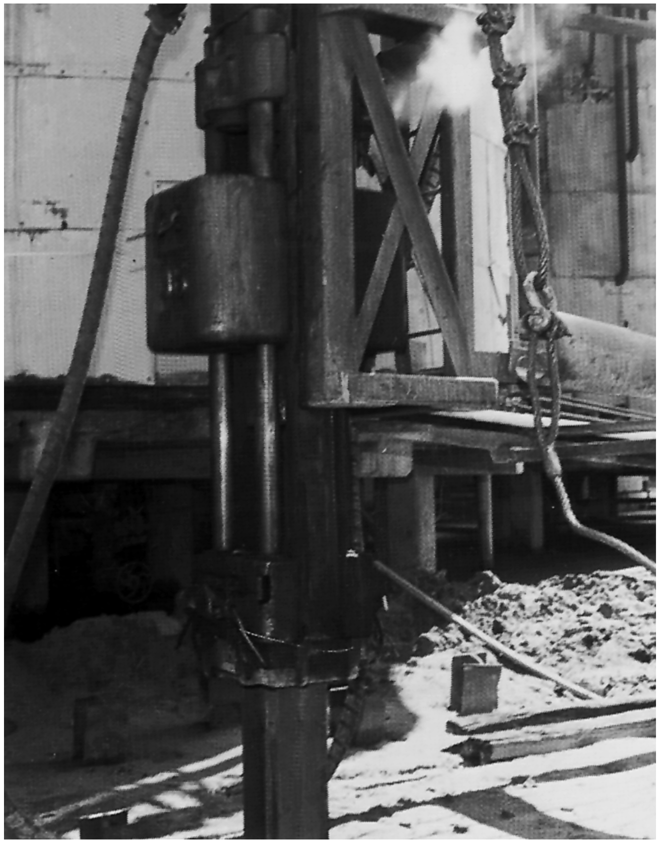
Exhibit 3 Typical Steam- or Air-Operated Pile Driver with Helmet and Cushion Pad



A schematic diagram of typical pile driver

Pile hammer inside leads driving a steel H-beam into the ground

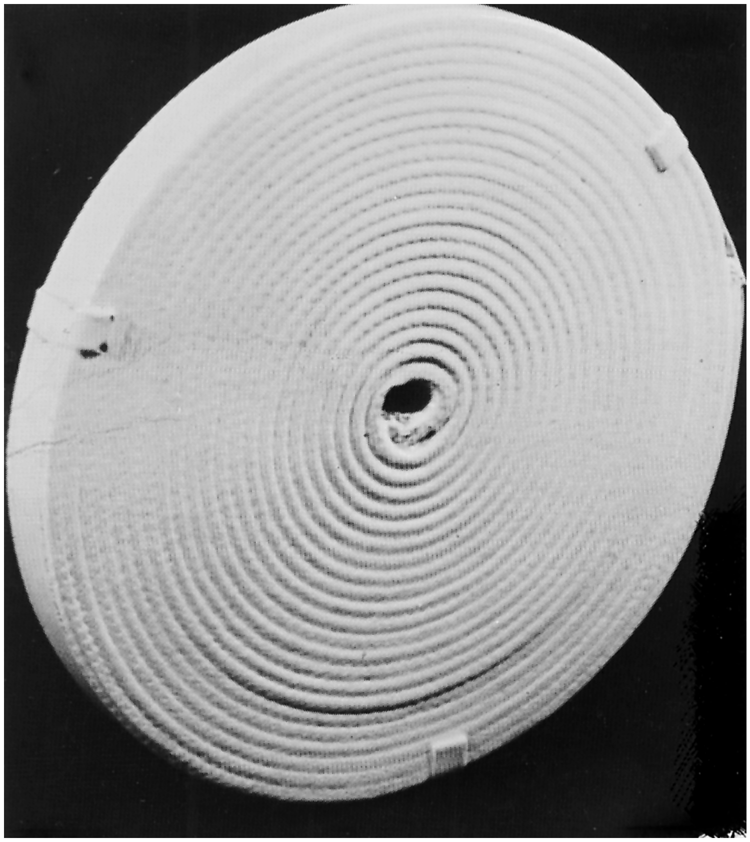
Exhibit 3 (continued)



Close-up of hammer driving pile (most of the pile is already in the ground)

CMI pile-driving pad in position in helmet

Exhibit 4 Close-up of CMI Curled Metal Cushion Pad for Pile Driving



The calendered curled metal is wound tightly around the central point of a flat metallic disk. (The disk is on the back side of the pad from this view.) Soldered tabs secure the curled metal to the disk. The entire structure is coated with polyvinyl-chloride.

Exhibit 5 Curled Metal Cushion Pad Standard Sizes

Diameter (inches)	Thickness (inches)	Weight (pounds)
11 1/2	1	15 1/2
14	1	23
17 1/2	1	36
19 3/4	1	48
23	1	64
30	1	110

Exhibit 6 Two Sets of Projected Manufacturing Costs

	Size					
	11 ½″	14″	17 ½″	19 ¾″	23″	30″
Estimates per Pad with Existing Equipment						
Variable						
Material	$15.64	$20.57	$31.81	$40.39	$53.16	$95.69
Labor	28.80	33.07	50.02	57.07	69.16	118.36
Total variable	44.44	53.64	81.83	97.46	122.32	214.05
Fixed factory overhead						
@ 360% direct labor	103.68	119.05	180.07	205.45	248.98	426.10
Total manufacturing cost	$148.12	$172.69	$261.90	$302.91	$371.30	$640.15
Estimated with Purchase of $50,000 of Permanent Tooling						
Variable						
Material	$15.64	$20.57	$31.81	$40.39	$53.16	$95.69
Labor	11.64	15.25	21.85	26.95	30.57	56.09
Total variable	27.28	35.82	53.66	67.34	83.73	151.78
Fixed factory overhead						
@ 360% direct labor	41.90	54.90	78.66	97.02	110.05	201.92
Total manufacturing cost	$69.18	$90.72	$132.32	$164.36	$193.78	$353.70

Note: Estimated volume was 250 cushion pads per month.