NBER WORKING PAPER SERIES

ABC AT INSTEEL INDUSTRIES

V.G. Narayanan
Ratna G. Sarkar

Working Paper 7270
http://www.nber.org/papers/w7270

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 1999

We would like to thank the Insteel Industries management for generously providing us with their time and complete access, and Dave Conrad for the data. We also thank Stan Abraham, Sarah Eriksen, and Gregg Friedman of the Harvard Business School for their research assistance, the seminar participants at the April 1999 NBER conference on Organizational Change and Performance Improvement, Santa Rosa, California, and Ed Lazear, the discussant at the conference, for their comments. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research.

ABC at Insteel Industries
V.G. Narayanan and Ratna G. Sarkar
NBER Working Paper No. 7270
July 1999

ABSTRACT

In this paper, we seek to provide empirical documentation of the effect of Activity-Based Costing (ABC) information on product and customer-related decisions made by managers in a company.

Proponents of ABC argue that when an entity implements ABC, it reaps at least two important benefits: process improvements that promote more efficient use of resources and hence reduce costs, and a set of overhead cost numbers that, relative to traditional volume-based methods of costing, better represent the consumption of shared resources by the firm's products, and enable the firm to target a more profitable mix of products and customers.

While there is much anecdotal evidence about the efficacy of ABC and ABM (Activity Based Management), there has been no systematic, statistical investigation of whether ABC really influences managerial decisions. An ABC analysis may not have any impact on a firm for two reasons. (1) It may not reveal any new information to the managers who intuitively know already what an ABC system formally captures. (2) Key managers may reject the ABC numbers and be unwilling to weather the organizational change and upheaval often required for effective ABM.

In this study, we conduct a statistical analysis of firm-level data in order to shed light on whether ABC provides new information to managers and whether ABM significantly impacts product and customer-related decisions. We supplement this analysis with interviews with top managers in the company on whether and to what extent the ABC analysis influenced managerial decision making.

We do not find much support for the hypothesis that product prices reflect all costs even when a company does not have ABC information. We find that after the ABC analysis, Insteel displayed a higher propensity to discontinue or increase prices of products that were found unprofitable in the ABC study and to discontinue customers that were found unprofitable in the ABC. The changes to the portfolio of customers served were similar but not as striking as the product mix and pricing decisions. This finding is consistent with senior managers' intuition that product level decisions can be made faster than customer level decisions.

V.G. Narayanan
Harvard Business School
Boston, MA 02163
vnarayanan@hbs.edu

Ratna G. Sarkar
Harvard Business School
Boston, MA 02163
rsarkar@hbs.edu

1. Introduction

In this paper, we seek to provide empirical documentation of the effect of Activity-Based Costing (ABC) information on product and customer-related decisions made by managers in a company.

Proponents of ABC argue that when an entity implements ABC, it reaps at least two important benefits. First, its entire operation is scrutinized in great detail and its performance and efficiency analyzed and benchmarked against best practices. Employees are encouraged to be critical of the status quo and to suggest improvements. This can result in process improvements that promote more efficient use of resources and hence reduce costs. Second, ABC generally yields a set of overhead cost numbers that, relative to traditional volume-based methods of costing, better represent the consumption of shared resources by the firm's products, customers and service offerings. Evaluated in light of these new activity-based costs, particular products and customers may show up as 'loss-making.' This information may enable a firm to change the mix of products produced and customers served allowing it to focus on making profitable products and serving profitable customers.

While there are a number of teaching cases and other such anecdotal evidence about implementation of ABC and decisions impacted by ABC numbers, there has been no systematic, statistical investigation of whether ABC really influences managerial decisions. An ABC analysis may not have any impact on a firm for two reasons. (1) It may not reveal any new information to the managers who intuitively know already what an ABC system formally captures. (2) It is conceivable that outside consultants are hired to do an ABC analysis but decision makers in the firm do not accept the ABC numbers, which often differ significantly from traditional cost numbers. Effective follow-up to the ABC analysis may require managerial decisions and actions significantly different from the status quo, resulting in organizational change and upheaval, to which managers may display resistance.

In this study, we conduct a statistical analysis of firm-level data in order to shed light on whether ABC provides new information to managers and whether Activity Based Management (ABM) significantly impacts product and customer-related decisions. We supplement this analysis with interviews with top managers in the company on whether and to what extent the ABC analysis influenced managerial decision making.

We find evidence that product prices reflect the cost of raw materials and freight costs, but do not fully impound conversion costs (labor and production overhead costs). Hence there is not much support for the hypothesis that product prices reflect all costs even when a company does not have ABC information. We find that after the ABC analysis, Insteel displayed a higher propensity to:

1. Discontinue products that were found unprofitable in the ABC study compared to products found profitable in the ABC study.
2. Increase price of products that were found unprofitable in the ABC study compared to products found profitable in the ABC study.
3. Discontinue customers that were found unprofitable in the ABC study compared to customers found profitable in the ABC study.

The changes to the portfolio of customers served were similar but not as striking as the product mix and pricing decisions. This finding is consistent with senior managers' intuition that product level decisions can be made faster than customer level decisions.

The next section reviews the extant literature. Section 3 provides the company background and cost structure. Section 4 discusses the company's decision to use ABC analysis. Section 5 describes ABM (Activity-Based Management) at Insteel and analyzes whether the ABC analysis had an impact on their operations and marketing strategy. Section 6 analyzes the impact of ABM on Insteel's financial performance. Organizational issues are highlighted in Section 7, with the aid of management surveys and interviews that are presented in the Appendix. Section 8 discusses future work and concludes the paper.

2. Literature Review

The term Activity Based Costing was first used in John Deere Component Works (see March and Kaplan, 1987). It was a new system of allocating costs to products and parts using activity drivers such as setup hours and number of loads for allocating overhead related setups and materials handling costs, respectively. Traditionally in the United States, all overhead was allocated to products based on volume drivers such as labor hours, machine hours, or number of units produced. The new system recognized that it was cheaper to produce products in larger batches than smaller batches. Under ABC, managers must track separately expenses that are required to produce individual units, to process batches, to design or maintain a product, and to

keep a manufacturing facility up and running. Robin Cooper and Robert Kaplan wrote several cases about ABC system design and implementation. They also wrote a number of articles on how to design and implement ABC systems and the potential benefits of ABC systems. (See Cooper and Kaplan (1988, 1991)) The theory of a hierarchy of costs - unit, batch, product, and facility level costs was proposed in Cooper (1990). The theory of ABC (that overhead costs were related to non-volume drivers, such as batch and product level drivers) was first empirically tested by Foster and Gupta (1990). They analyzed cross-sectional data from thirty-seven facilities of an electronics company and did not find evidence that overhead costs were related to non-volume drivers. Since then, however, a number of papers have found evidence of overhead costs being positively correlated with non-volume drivers. See Anderson (1995), Datar et al. (1993), Banker and Johnston (1993), and Banker, Potter and Schroder (1995). It is our assessment that the theory of ABC is now accepted by most accounting academics.

Taking as given the theoretical basis of ABC and its popularity with companies, accounting academics have turned to the question, "Do ABC implementations succeed in providing better information to managers and affecting their decisions in a positive way?" Shields (1995), Roberts and Silvester (1996), Anderson, Hesford, and Young (1997), Anderson and Young (1997), and Foster and Swenson (1997) have used surveys of companies implementing ABC to understand what factors explain success or failure of ABC implementation efforts. These studies have identified the level of team commitment, management support, and quality of other information systems as some of the factors that affect the success of ABC efforts. Our interviews and surveys of company management support the findings of these studies and also suggest that other factors such as market forces and compensation structures also play a significant role in the ability and willingness of the organization to implement ABM. These issues present themselves as leads for future work in the empirical investigation of ABC implementations.

In this paper, we complement the earlier surveys on ABC implementations by focusing on decisions made within one company before and after an ABC study. Using statistical analysis, we document whether product prices already impounded ABC information, even before an ABC system was introduced and, once the ABC system has been introduced, whether it affects product and customer related decisions.

3. Research Site: Company Background and Production Economics[1]

In the 1950s, Insteel operated as a manufacturer of precast concrete products for the construction industry. The company entered the wire business in the early seventies when it began manufacturing welded wire mesh in response to a shortage of this concrete reinforcing product. Over the years, it has broadened its product offering and extended its manufacturing capabilities beyond the mesh business, expanding into a range of higher value-added products. Currently Insteel Wire Products (IWP), a subsidiary of Insteel Industries, Inc., manufactures and markets concrete reinforcing products, industrial wire, bulk nails, collated fasteners, PC strand and tire bead wire. The company's primary markets are the construction, home furnishings, appliance and tire manufacturing industries. Insteel Industries is headquartered in Mt. Airy, North Carolina. The company currently operates 8 manufacturing facilities serving markets nationwide. Annual sales revenues are about $300 million.

This paper studies the managerial and organizational issues related to ABC at the Andrews, SC plant of Insteel Industries. Four product lines are produced at the Andrews plant: steel wire of different gauges (called 'bright wire or industrial wire' in the trade), galvanized wire of different gauges, wire mesh and nails. In 1996, about 477 individual products were spread across these four product lines. However, 20% of the products accounted for 85% of Andrews' annual revenues of about $60 million. Likewise, 20% of Andrews' customers accounted for 95% of all sales.

The steel and galvanized wire product lines are produced to order, the other two product lines, nails and mesh products, are produced to stock (about 20 days' inventory). While other Insteel plants also produce wire products, all of Insteel's nail products are manufactured at the Andrews plant, in Nail Mill A (commodity nails and sinkers, a large-volume, non-differentiated product line) and Nail Mill B (pallet nails, manufactured to tight tolerances on diameter, heading and threading specifications).

The primary raw material is hot-rolled steel rod purchased in large rolls of about 4,000 pounds from both domestic and foreign suppliers. There is continuing concern about the quality of foreign rod as it can significantly impact the throughput of the wire-drawing process, which is

[1] This section of the paper is drawn from Narayanan and Sarkar (1998), Harvard Business School Case, Insteel Wire Products: ABM at Andrews.

the first production stage, common to all of Andrews' products and which generally operates at capacity. See **Exhibit 1** for a graphical representation of Insteel's production process.

4. The Decision to use ABC/ABM

Before the introduction of ABC, Insteel did not have a sophisticated cost system. The price per ton of steel rod, the basic raw material, was closely monitored. This price was used to estimate the material costs of all of Insteel's products — by multiplying the weight of the product by the price of steel rod. Although freight was tracked as a separate cost on each invoice, identifiable by customer, as each truck or boxcar was shipped, customers were charged an 'average' freight charge on each shipment. Price quotations were based only on the weight of the product and estimated freight costs.

Dependent on this simple cost system, Insteel had, since its very inception, adopted a sales strategy of maximizing pounds of product sold. Bill Sronce, the plant manager at Andrews, described the 'old days': *"Before the ABM study we did not have any specific product or customer costing information. ... Our sales people were instructed to chase tons without any information about costs, available capabilities or profit."*

Insteel had, until recently, survived and grown in this industry with limited success. While other more sophisticated cost allocation methods (including ABC) had been in the practitioner literature for over a decade, there had been little impetus to adopt them. The adoption of a new allocation method and the concomitant organizational change is costly. Particular firms within an industry, and indeed, entire industries may not adopt new cost accounting methodologies if their adoption is viewed as potentially disruptive and their benefits are perceived to be limited. This situation could arise in any of the following circumstances:

- Overhead costs are small proportion of total manufacturing costs and do not justify the potential organizational upheaval. Kaplan and Cooper (1997) suggest the application of two simple rules in identifying high-potential ABC applications: (i) the Willie Sutton Rule[2]: focus on areas with large and growing expenses in indirect and support resources. (ii) the high diversity rule: focus on a situation where there is a large variety in products, customers and processes. A company or industry may, based on an explicit analysis or an implicit

[2] Willie Sutton, a successful bank robber in the US in the 1950s, was asked, "Why do you rob banks?" Willie replied, "That's where the money is!"

understanding of its cost structure, find that one or both of these conditions are not met and choose not to adopt ABC.

- Market prices may implicitly impound activity-based costs. Assuming that all the suppliers in a particular market face similar production functions and factor prices, a rational expectations equilibrium argument would suggest that market prices for their products will efficiently incorporate the true overhead costs related to product variety and variation in services demanded by customers. In such equilibrium, product market prices could serve as a substitute for the information in the internal cost systems of a firm.
- Managers may intuitively understand the true resource consumption patterns despite the use of an unsophisticated formal cost system. Simple and stable industry economics combined with long-term managerial experience could result in a good grasp of the underlying cost structure. Such a situation would constitute a mechanism for market efficiency and the rational expectations equilibrium described above.

We examine each of the above possibilities in an effort to understand the adoption of Activity-Based Costing at Insteel Industries.

High Overhead and/or Product and Customer Variety

Raw material costs can represent as much as 70% of the manufacturing costs for certain products at Andrews. Although the spread between raw material costs and selling prices, in nominal terms, had remained relatively stable over the long-term, indirect labor and other production overhead had been growing at the inflation rate. Thus there was a tremendous pressure to control overhead and labor costs by boosting productivity and spreading those costs over a larger volume of products. The company had started out with a very limited product and customer range, but over time, both had proliferated, and now there was significant product and customer variety. Product and customer range proliferation boosts not only volume but also overhead costs. While there was some understanding of these changing economics on the part of the management, our interviews suggest that they lacked quantification of the effect and a shared understanding of the resource consumption drivers in the business. It appears that the Insteel management proactively chose to adopt an ABC system, anticipating the importance of managing overhead costs. Moreover, raw materials costs were mostly uncontrollable, making labor and overhead the only controllable costs.

Did prices implicitly reflect ABC costs? Did intuitively managers understand true costs?

At Insteel, the ABC team took their first 'ABC snapshot' of operations at the Andrews plant in the summer of 1996 with the assistance of a big-six accounting firm. The ABC team analyzed Andrews' operations and identified 12 business processes. Within each business process, a number of activities were identified - a total of 146 activities. Next, 426 employees were surveyed to estimate how they allocated their time to different activities. All overhead resources were then collected in 80 cost pools and a resource-consuming activity (cost driver) was associated with each cost pool to assign the overhead costs to cost objects such as products and customers (some cost pools included multiple activities that had the same cost driver). This resulted in their first activity-based cost analysis and their first ABC database (essentially a set of linked Excel spreadsheets and Access databases), maintained by a small team led by Dave Conrad, the director of cost management, at the Mt. Airy corporate headquarters. Cost of goods sold was tabulated by products and customers and broken down into five major cost categories as described below. A second 'ABC snapshot' was developed in the summer of 1997, by which time Insteel had its own staff group collecting the data.

- **Material costs**: Cost of steel rod and other materials used in production. Directly traceable to products and customers, based on pounds produced.
- **Conversion costs**: Overhead resources consumed in converting steel rod to finished wire or nail products. This category includes unit-level costs (such as plant labor) and batch-level costs (such as wire-drawing set-up resources), plant-level costs (such as plant manager's salary) and product-level costs (such as the costs of special wire-drawing dies for particular products). Each component of conversion costs was allocated to products using an appropriate cost driver.
- **Customer costs**: Overhead resources consumed in serving special customer needs such as the carrying cost of receivables, packing and loading costs, order processing costs and post-sales services. Traced to each customer and allocated to products based on quantity of each product purchased by that customer.
- **Freight costs**: The actual freight charge incurred by Insteel to make each delivery. This freight cost is in contrast to the 'average' freight cost number that was used in the actual pricing and billing.

- **Corporate Overhead costs**: This includes overhead resources consumed at the corporate office level (managerial salaries, information systems, financial services, etc.). These costs are allocated down to the Andrews plant based on its share of total company assets, or its share of total company revenues. Allocation to products is based on quantity of product manufactured and to customers based on percentage of sales revenue.

On analyzing the 1996 data recast in the ABC framework, Insteel determined that fully 30% of Andrews' products and customers were generating losses when full-ABC costs were taken into account and compared to the revenues generated by each product and each customer[3]. The surprise emergence of 'bottom-feeding' customers and 'painful' products, indicates that managers did not somehow intuitively understand ABC costs before the initiative was undertaken at Insteel.

We use the composition of each of the cost categories above to formulate Hypothesis 1 regarding intuitive managerial understanding of ABC costs even when the company did not maintain a formal ABC system. Recognizing that the categorization of overhead costs between the conversion cost pool and the customer costs pool has shifted somewhat between 1996 and 1997, we consider those costs separately and also bundled together as a more robust measure of 'overhead costs' in the hypotheses below:

Hypothesis 1: *The 1996 product prices will implicitly impound the activity-based costs of producing and delivering the products. Formally, in the equations below, with prices and costs measured per pound of product, we expect* $a>0$, $\beta_m=1$, $0<\beta_{conv}<1$, $\beta_{cust}=0$, $\beta_{OH}=1$, *and* $\beta_f=1$.

$$Price_i = \alpha + \beta_m MaterialCost_i + \beta_{conv} ConversionCost_i + \beta_{cust} CustomerCost_i + \beta_f FreightCost_i + \varepsilon_i \quad (1)$$

$$Price = \alpha + \beta_m MaterialCost_i + \beta_{OH} (ConversionCost_i + CustomerCost_i) + \beta_f FreightCost_i + \varepsilon_i \quad (2)$$

[3] A common outcome of ABC analyses, surprisingly profitable and surprisingly unprofitable products and customers are referred to as "hidden profit products/customers" and "hidden loss products/customers".

Both relationships above are tested since overhead costs may have been incorrectly categorized as conversion or customer costs and also may have been categorized differently in 1996 and 1997 (we examine the relationship between 1997 prices and costs below).

Since the costs in Hypothesis 1 are all expressed on a per-pound basis (e.g., $MaterialCost_i$ is total material cost for the i^{th} product divided by pounds of product i sold), we expect that the fixed markup per pound of product that salespeople mention in their pricing strategy will manifest itself in the intercept a. The cost of materials varies with production volume and we expect that it will be reflected in a 1:1 proportion in prices. Any significant deviations from 1 would indicate (if $\beta_m<1$) that Insteel is systematically not marking up its material costs or (if $\beta_m>1$) is charging a margin on material costs, over and above the markup represented by a. For the same reason, we expect $\beta_f=1$. *FreightCost* per pound, which was levied by the trucking and railroad companies by the weight of each shipment, was available and directly traceable to each product on an invoice or shipment from Insteel. Salespeople quoted prices to customers using both material costs and estimates of freight costs.

Accepting, for the moment, their categorization of overhead costs into conversion and customer costs, if product market prices do not reflect differences in overhead consumption across products we would expect $\beta_{conv}= 0$. On the other hand if product market prices in 1996 completely captured differences in conversion resource consumption across products, we would expect $\beta_{conv}= 1$. We would expect $0< \beta_{conv} < 1$ if managers have some, but not a full, understanding of overhead consumption by different products or if the variable *ConversionCost* is significantly prone to measurement error. $\beta_{conv} < 1$ is also consistent with managers not recovering some fixed costs such as facility level costs in the short run. Since the conversion cost category includes both fixed and variable costs we expect that prices will respond significantly to these costs, but their response could be less than 1:1 in the short run. Hence, we expect that $0<\beta_{conv}<1$. If $\beta_{conv}<1$ and $\alpha = 0$, it is suggestive of managers ignoring fixed costs in short-term pricing decisions. However, $\beta_{conv}<1$ and $\alpha > 0$, is suggestive of market prices not reflecting the diversity across products in the consumption of overhead resources. We expect β_{OH} to behave similar to the β_{conv}.

We will test the relationship described in Hypothesis 1 at the *product level* i.e., the subscript i refers to the i^{th} product. We expect no relationship between product prices and customer-level costs because they have been arbitrarily allocated down to the product level based on pounds of various products purchased by each customer, and hence expect that $\beta_{cus\ i} = 0$. If, however, some products are custom made and those customers have high customer-level costs, we would expect prices and customer costs to be correlated even at the product level and we would expect $0 < \beta_{cust} < 1$. We estimated both Equations (1) and (2) using 1996 data ('before ABC') for each of the two major product types, wire products (bright and galvanized wire) and nail products[4].

Descriptive statistics for the data used in our hypothesis tests are in **Table 1.** Correlations among the variables is in **Table 2.** The estimates for Equations (1) and (2) using 1996 data are shown in **Table 3**. The intercept a is significantly different from 0 for both product categories, and either treatment of conversion and customer overhead costs. This suggests that Insteel was charging an across-the-board markup of about 7 to 8.5 cents per pound of product sold. The estimated coefficients provide limited support for the hypothesis of managers knowing ABC costs even in the absence on a formal ABC system: β_m is not significantly different from 1.0 in all the columns of Table 3, but β_{OH} is insignificant for wire products and β_f is insignificant for nail products in 1996. We note that for both product groups, β_{OH} is similar in size and significance to β_{conv}. Further, β_{cust} is always insignificant. This indicates that conversion costs, as measured in 1996, captured most of the cross-sectional variation in overhead costs correlated with product prices. As argued in the hypothesis development section, $0 < \beta_{conv} < 1$ and $\alpha > 0$, as is the case for nails, is suggestive of market prices not fully reflecting the diversity across products in the consumption of overhead resources.

It is interesting to compare the evidence that the market prices were somewhat rational even without a formal ABC system in place, with the fact that Insteel, on analyzing the 1996 ABC data, found fully 30% of all its products and customers to be loss-making. These findings suggest that the mark-up being charged by Insteel was insufficient to cover customer and

[4] Grouping the products into the three groups, bright wire, galvanized wire and nails yielded similar results. Significantly different error variances for the wire and nail product groups suggest that pooling all the data into one product group is inappropriate.

business-sustaining costs in cases of products and customers that made unusual demands on their resources. Further, the coefficient on conversion costs is significantly less than 1 indicating that Insteel did not reflect differences in conversion costs fully through changes in prices. Observe that β_{conv} is nearly 0 for the wire group, but is about 0.7 for nails. Insteel appears to be recovering more of the conversion costs for nails which, as Exhibit 1 shows, are produced from wire after further processing. This finding fits with Insteel management's own discovery from the initial ABC study that many nail products were surprisingly profitable.

In 1997, a full year after the first ABC 'snapshot' at the Andrews plant, another ABC 'snapshot' was developed, resulting in a 1997 set of product and customer-based profit and loss analyses, similar to the 1996 data. Since Insteel had better cost information and organizational awareness in the period between the 1996 and 1997 data collection effort, we also hypothesize that if anything, product prices in 1997 should reflect costs better than it did in 1996. Specifically,

***Hypothesis 2**: In the price/ABC cost relationship for 1997, we expect strong evidence that prices incorporate ABC costs. Formally, in Equation (1) and (2) estimated using 1997 data, we expect* $\alpha = 0, \beta_m = 1, \beta_{conv}=1, \beta_{cust}= 0, \beta_{OH} =1, \beta_f =1.$

We test Hypothesis 2 by estimating the relationship between product prices and ABC costs using 1997 data ('after ABC'). The results are outlined in the **Table 4**. We find a stronger relationship between costs and prices in 1997. The standard markup (α) is now insignificant, and there is a significant margin of about 40 cents on each dollar of material costs. While β_{cust} is now marginally significant, β_{OH} continues to mimic β_{conv} in size and significance. The coefficient on freight costs is not significantly different from 1 for both product groups, but is a very noisy estimate (β_f for nails is neither significantly different from 0 nor from 1). It is possible that many of the decisions based on 1996 data were not reflected in 1997 data till very late in the year.

Assuming that the ABC study is technically correct[5], the regression results provide only mild support for the notion that Insteel's managers understood the underlying activity-based

[5] Insteel used experienced consultants and the results seemed to make sense to company management. The new cost system is being extended to all the other Insteel plants. All these factors indirectly vouch for management's belief about the technical correctness of ABC data.

economics of their business even when the old cost system was in place. We must conclude that with increasing pressure on prices for its products and capacity constraints at various locations, Insteel's management recognized the need for a cost system which would guide managerial decisions about various choices and tradeoffs facing the firm. They decided to adopt an activity-based cost system that would potentially provide a better understanding of resource consumption by products and by customers than a traditional volume-based cost system. However, we find only limited support for the hypothesis that in the post ABC period, prices fully reflect ABC costs. We expect the relationship between costs and prices to increase in the future as the ABC culture becomes institutionalized.

Wishing to limit the upheaval caused by a change in the status quo, and also to maximize the possibility of enthusiastic adoption, Insteel's management selected the Andrews plant as its first ABC site. The plant had had a history of good communications between plant management and workers and supervisors, it was independent, with little operational overlap with other plants and was run by Bill Sronce, a willing and enthusiastic champion of the process. He communicated the objective and the process of the ABC study to all employees of the plant. Dave Conrad, the director of cost management, was also assigned full-time to the project. He worked in close coordination with the consultants to implement the technology and do the analysis. Simultaneously, they trained Insteel staff on the ABC methodology.

5. Activity-Based Management at Insteel

In this section we analyze the impact of the new ABC system on decision making at Insteel. Process improvements appear to be the first benefit of the new ABC system at Insteel. The company estimates that within a year of the first ABC study, $1.8 million had been saved in Quality costs, mainly through a reduction of scrap and problem reactive maintenance costs. Non-value added activities such as rework, movement of materials, and locating lost inventory were reduced from 22% of activity costs to 17%. Freight costs, which was one of the first process improvement opportunities pursued, have been reduced $555,000 in a year in the Andrews plant alone. The Andrews plant was able to ship heavier loads on each truck by changing the layout of boxes within each truck. Subsequently, all of Insteel's other manufacturing facilities have also converted to heavier loads emulating the results achieved at Andrews. These savings were

significant given Insteel's after-tax income of $4.2 million in 1996. It is hard to estimate how much of these savings would have been realized had Insteel not conducted an ABC analysis. From interviews with Insteel managers and sitting-in on senior management meetings, it appears that the activity analysis gave them an appreciation of the scope and quantified the magnitude of the improvement potential, thereby allowing them to prioritize among various process improvement possibilities.

ABC data is typically used for making product line decisions such as discontinuation of unprofitable products, changing prices, and introduction of new products similar to existing profitable products. We conduct simple univariate statistical analysis to test these hypotheses on product line decisions. We supplement these tests with interviews with Insteel managers.

Products are discontinued for various reasons such as changes in customer requirements, general changes in particular market segments, such a down turn in the home building industry, changes in availability of raw materials, and shifting of production to other plants. We can observe order patterns for various products before ABC and after ABC. We cannot tell for sure why a product that was sold before ABC was not sold after ABC. It may be that the customer who used to order that product no longer sources with the company, or the customer did not wish to place an order in the one year period following the ABC study, but may do so at a later point in time. The company may take longer than a year's time to decide whether to discontinue a product. The company may have raised prices on unprofitable products rather than discontinue them. For these reasons, we formulate our hypothesis as follows:

***Hypothesis 3**: Products found to be unprofitable in the 1996 ABC analysis are more likely to have been discontinued in the following year of ABM, than products found to be profitable.*

We conduct a simple chi-squared test to examine whether unprofitable products are more likely to be discontinued (defined as zero sales in 1997, the year following the first ABC analysis) than profitable products. **Table 5** reports the results of these comparisons.

We see that 78% of products profitable in '96 were also sold in 1997, versus 58% for those that were unprofitable in '96. The χ^2 test statistic is 24.11 (p=0.01%) indicating that the likelihood of continuing a profitable product is significantly higher and lending considerable

support to Hypothesis 3. Analysis by product lines, namely nails and wire products, leads to similar results.

Although a higher proportion of unprofitable products seem to have been discontinued, the company can expect to improve overall profitability only if the resources and capacity freed from not producing these unprofitable products are re-deployed in selling more of existing products or in offering new products. Alternately, these resources can be eliminated, thus removing the costs associated with these resources. The company has chosen the former strategy and just in the '96-'97 time period, after its first ABC analysis, it had introduced about 40 new nail products, and over a 100 wire products[6]. In the nail product group they focused largely on high-value added specialized products such as pallet nails, which require precision machining and cutting-edge packaging technology. Since nails are manufactured only at the Andrews facility, the company could move quickly on these findings, and by early 1997 had installed new manufacturing capacity for some of these products (see Narayanan and Sarkar (1998) for a description of one of these initiatives). Decisions and actions related to wire products are intertwined with capacity and utilization issues at other plants, and are therefore harder to characterize. An interesting question is whether the new products introduced are more likely to be profitable for Insteel than the set of old products, and whether their degree of profitability is higher. Many of the new products are in the ramp-up stage; this issue will be better analyzed when some sort of 'steady state' has been reached, both operationally and in the marketplace.

We next analyze whether Insteel's pricing decisions were affected by the 1996 ABC study. Products found to be unprofitable in the 1996 ABC study are likely to be more costly to manufacture on average than previously thought by Insteel. Likewise, products found to be profitable in the 1996 ABC study are likely to be less costly on average than previously thought by Insteel. Based on this assumption, we formulate the following hypothesis.

Hypothesis 4: *Prices of products found to be unprofitable in the 1996 ABC analysis are more likely to have increased than prices of products found to be profitable.*

[6] Working with the available data, we define 'new' as any product that was in the 1997 ('after') database, but not in the 1996 (before) data set. Therefore, some of these new products may have been 'recycled' from prior years, and some could be minor variations of old products. However, interviews with company managers suggest that several products have been introduced or re-introduced as a result of the ABC analysis.

From Table 5 we know that products found unprofitable in the 1996 ABC study are more likely to be discontinued than profitable products. It's conceivable that Insteel discontinued products by raising their prices to a level that would take them off the market. Unfortunately, we are unable to observe the price quoted, if any, for products not sold in 1997. If it is true that products were discontinued by raising prices it will bias our tests against finding support for Hypothesis 4. We conduct a simple chi-squared test to examine whether prices of unprofitable products are more likely to have decreased than prices of profitable products. The results are in **Table 6.**

We see that 44% of products profitable in 1996 and sold in 1997, were sold at a higher price in 1997 compared to the price in 1996. However, 58% of the products unprofitable in 1996 and sold in 1997, were sold at a higher price in 1997 compared to the price in 1996. The χ^2 test statistic is 5.44 (p=.02%) indicating that the likelihood of decreasing prices for a profitable product is significantly higher and lending considerable support for Hypothesis 4.

We next analyze customer level data. Similar to the hypothesis on products, we formulate the following hypothesis on customers. Defining customers who appear in the 1996 and the 1997 data as 'continuing' customers, and 1996 customers that dropped out of Insteel's 1997 customer list as 'discontinued' customers.

***Hypothesis 5**: Customers found to be unprofitable in the ABC study are more likely to be discontinued than customers found to be profitable.*

The data we have on wire customers needs additional decomposition before it can be used for a test of this hypothesis, hence we restrict attention to customers for nail products. The results are summarized in **Table 7.**

We see that 66% of customers who were profitable in '96 were continuing customers in 1997, versus 53% for those that were unprofitable in '96. The χ^2 test statistic of 2.1 is significant only at the 15% level, indicating that the company has been reluctant to 'fire' customers. Interviews with Insteel managers also suggest that consolidations and vertical integration within the industry during the period of interest limited Insteel's ability to jettison unprofitable customers. Some of the best customers were bought by competitors, excess capacity was

available in the short to medium term and contribution margin from some unprofitable customers helped cover the cost of that capacity.

6. Impact of ABM on Insteel's Financial Performance

It is hard to isolate the financial impact of ABC on Insteel's performance:

1. Insteel is still very early in its ABC implementation. While we have provided evidence consistent with Insteel taking several product and customer related decisions based on ABC information, the effect of these decisions on the bottom line may not be felt for a few years.
2. The ABC project was piloted in the Andrews plant at Insteel in 1996 and 1997 and was subsequently rolled out to the other plants at Insteel in 1998. Our data analysis in the preceding sections is confined to the Andrew's plant. Financial data for Insteel as a whole in 1996 and 1997 would not reflect the performance of just the Andrews plant.
3. Several industry level factors would have affected Insteel's financial performance. It is hard to attribute any change in Insteel's performance to ABC while several other factors are changing at the industry and company level.

For these reasons the evidence that we will provide on ABM's impact on Insteel's financial performance will only be suggestive. However, we take comfort from the fact that evidence, sketchy as it is, is entirely consistent with the opinion of the senior management of Insteel.

First we compare the performance of the Andrews plant with those of other Insteel Plants. **Table 8** provides the gross profit as a percentage of sales. Gross profit is sales, less all costs, including materials, conversion, customer, and facility level costs, but excluding allocated corporate overheads. The financial performance of Andrews plant appears to have improved relative to six other plants that adopted ABC only in 1998. Details of financial performance in 1998 at the plant level are not yet available.

Next we compare the financial performance of Insteel with that of other firms in the industry. Insteel's four digit SIC code is 3310. We found fourteen other firms with the same SIC code. We collected financial performance information from Standard and Poor's Compustat database. Since Insteel Introduced ABC to its non-Andrew plants only in 1998, we can think of the financial performance in 1998 and 1999 (first two quarters) as being post ABC and the financial performance in 1996 and 1997 as pre ABC. Five firms did not have any of the relevant financial data available for any of the periods during 1996-1999. We deleted these firms. We can

analyze financial performance using accounting measures of performance and/or stock market returns. We used Return on Equity, Return on Assets, and Stock returns as three measures of financial performance. We expect Stock returns to be leading indicators of performance and accounting measures (ROE and ROA) to be lagging indicators of financial performance. This is because anticipated improvements would be reflected in stock returns when initiatives such as ABC are announced, while accounting measures would reflect these improvements, if and when, they are realized.

Measured by ROE (see **Table 9A**), Insteel's performance has lagged the median industry performance throughout the period 1996-1999. It's hard to discern any patterns in Insteel's financial performance in 1998-1999, relative to the industry median. In **Table 9B** we compare Insteel's performance, measured by Return on Assets, to that of other firms in its industry. Measured by ROA, Insteel has lagged its industry median till 1998. However, it appears to have out performed the industry median in 1999. In **Table 9C** we compare Insteel's performance, measured by stock returns, to that of other firms in its industry. Insteel's stock appears to have outperformed the industry median for the last thirty months. The three measures taken together provides some indication of improving financial performance at Insteel, relative to the industry median in 1998-99. Any attribution of this improvement to ABC would be highly speculative. However, this evidence is not inconsistent with senior management's opinion that ABC has contributed to Insteel's improvement in financial performance.

7. Organizational Issues

The adoption of ABC at Insteel has developed from a 'project' in one location in 1996 to a company-wide managerial tool in 1999. Interviews with the management indicate that they consider this effort to have been successful in terms of the improvement to the bottom-line relative to the cost of analysis, implementation, and managerial energy invested in the effort. Judging from our own observations at five other companies, readings of case histories of similar projects, observations of Insteel managerial and worker meetings, and the input from Insteel managers, several factors played a role in this success:

- The ABC initiative was seeded in a controlled setting - the Andrews plant. The plant had a successful history and plant management was enthusiastic and supportive. Those managers

spent a great deal of their time communicating the goals of the project and getting buy-in for the intensive interviewing and data gathering process.

- Insteel acted quickly in 'gathering up low-hanging fruit' i.e., implementing process improvements with a *quantifiable* payback; these tactical improvements got employees at all levels involved and excited about the project, while management debated and planned more strategic, longer-term actions. Quick wins were shared and celebrated with all associates (a term that includes plant-floor workers).
- The ABC initiative was given a high level of visibility within Insteel's upper management. This translated, in part, to adequate levels of financial support, computing resources and managerial attention during the early project phases.
- Although not highlighted in our discussions with Insteel managers, we must also point out that Insteel's sales-force compensation is composed mainly of straight salary. This means that they are usually willing to give a new sales strategy a try even at the risk of losing some volume. While the motivational effects of such a wage scheme are debatable, we observed a high level of conviction and enthusiasm for the market actions suggested by the ABC analyses among the sales managers.

All Insteel managers (including ex-employees) in production, sales, and finance consider the ABC project at Insteel a success. At the current time, almost three years after the start of the ABC initiative, a full roll-out to all plants is underway, supported by a new Oracle ERP relational database system. While the use of outside consultants has been discontinued, more staff and IT resources have now been devoted to the ABC project. Automated data collection and analysis on a monthly basis provides real-time feedback to managers as they implement new market strategies and pursue operational improvements. Looking back, those most closely involved with the ABC project feel that the initiative should have been rolled out earlier to the other plants.

8. Conclusions

In this study we sought answers to the following two questions:

1) Do managers intuitively know ABC costs even in the absence of an ABC system?

2) Do managers change decisions based on ABC information?

We regress product prices on various cost elements and find that prices do not fully reflect cost categories other than materials cost and freight costs. Thus overhead costs are not fully impounded in prices. This finding leads us to conclude that market prices are some what efficient in reflecting the diversity across products in the consumption of overhead resources but they do not fully capture this diversity. Likewise, we conclude that managers perhaps had some understanding of the diversity across products in the consumption of overhead resources but they probably did not have a complete understanding of ABC costs intuitively before the ABC study was done.

Interviews with managers and our statistical analysis lend some support to the hypothesis of changes in managerial decisions at Insteel following the ABC study. Rationalizing the product portfolio and pricing decisions appear to have been influenced by the ABC study. Customers are now billed for freight in a more direct way. The company has made several process changes attributable to the ABC study. The company has introduced new product lines. However, rationalizing the customer portfolio, although initiated by the company, cannot be statistically detected. These strategy changes will, we suspect, be reflected in the data in the following two years.

9. References

1. Anderson, S., "Measuring the Impact of Product Mix Heterogeneity on Manufacturing Overhead Cost," *Accounting Review*, July 1995, V 70 N 3, pp. 363-387.
2. Anderson, S. and S. Young, "Evaluation of Activity Based Costing Systems: The Impact of Contextual and Procedural Factors," University of Michigan Ann Arbor, Working paper. September 1997.
3. Anderson, S., J. Hesford, and S. Young, " Implementing Activity Based Costing: A Field Study of ABC Development Teams in Two U.S. Automobile Firms," University of Michigan Ann Arbor, Working paper. October 1997.
4. Banker, R. and H. Johnston, "An Empirical Study of Cost Drivers in the US Airline Industry," *Accounting Review*, July 1993, V 68 N 3, pp. 576-601.
5. Banker, R., G. Potter, R. Schroder, " An Empirical Analysis of Manufacturing Overhead Cost Drivers," *Journal of Accounting and Economics* V 19, 1995, pp. 115-137.
6. Cooper, R., "Cost Classifications in Unit-Based and Activity-Based Manufacturing Cost Systems," *Journal of Cost Management* (Fall 1990) 4-14.
7. Cooper, R. and R. Kaplan, "Measure Costs Right: Make the Right Decisions," *Harvard Business Review* (September-October 1988), 97-98.
8. Cooper, R. and R. Kaplan, "Profit Priorities from Activity-Based Costing," *Harvard Business Review* (May-June 1991).
9. Datar, S., S. Kekre, T. Mukhopadhyay, and K. Srinivasan, "Simultaneous Estimation of Cost Drivers," *Accounting Review*, July 1993, V 68, N 3, pp. 602-614.
10. Foster, G. and M. Gupta, "Manufacturing Overhead Cost Driver Analysis," *Journal Of Accounting & Economics* 1990. Vol. 12 (1-3) pp. 309-337.
11. Foster, G. and D. Swenson, "Measuring the Success of Activity Based Cost Management and Its Determinants," *Journal of Management Accounting Research* Vol. 9. 1997.
12. March, A. and R. Kaplan, "John Deere Component Works," Harvard Business School Case 187-107, 1987.
13. Narayanan, V. and R. Sarkar, "Insteel Wire Products: ABM at Andrews," Harvard Business School Case 198-087, 1998.

14. Roberts, M.W. and Silvester, K., " Why ABC Failed and How it May Yet Succeed," *Journal of Cost Management Research* Winter 1998 pp. 23-35.

15. Shields, M. " An Empirical Analysis of Firms' Implementation Experiences with Activity Based Costing," *Journal of Management Accounting Research*, V 7, Fall 1995.

</ref_section>

Appendix I: Interviews

Questionnaire for Insteel Management

Name: Michael Gazmarian **Position/Title:** CFO and Treasurer

1. **Management Support**

Has the ABC effort been successful at Insteel? Do you think the effort will be continued? Expanded? (Use other side of this sheet if necessary).

I believe that the ABM effort has already yielded some significant successes at Insteel and we will continue to expand the program and further develop our capabilities going forward.

2. **Organizational Factors**

How has the ABC effort at Insteel been different from other initiatives implemented at Insteel? (EVA, TQM, JIT, etc.) What factors have contributed to or hindered the success of ABC implementation at Insteel? (Use other side of this sheet if necessary).

The ABM effort has been well received by Insteel's management team as it has produced a tremendous amount of insight in comparison to the historical performance measurement tools that were in existence. It has served to facilitate the communication between manufacturing and sales and break down any functional barriers that may have existed. ABM has supplemented the EVA implementation by providing managers with a tool that can be utilized to model the impact of their decisions on EVA drivers and ultimately, shareholder value.

3. **Impact on Decisions**

Has the adoption of ABC at Insteel, influenced any decision-making in your organization? If so, how? (Use other side of this sheet if necessary).

ABM has provided us with a valuable tool to utilize in making a range of business decisions, including: (1) identification of process improvement opportunities, (2) optimization of customer and product mixes, (3) assessing the profitability of product lines, products of customers and determining appropriate actions that can be taken to enhance the company's financial performance, (4) analyzing the financial impact of product line expansions and (5) performing a multitude of "what-if" analysis to determine the financial impact of manufacturing as well as commercial decisions.

Questionnaire for Insteel Management
Name: John Calcagni Position/Title: Product Sales Manager—Industrial wire

1. Management Support

Has the ABC effort been successful at Insteel? Do you think the effort will be continued? Expanded? (Use other side of this sheet if necessary).

ABC has been successful. We have already expanded the effort to begin including plants other than SC.

2. Organizational Factors

How has the ABC effort at Insteel been different from other initiatives implemented at Insteel ? (EVA, TQM, JIT, etc.) What factors have contributed to or hindered the success of ABC implementation at Insteel? (Use other side of this sheet if necessary).

An up front commitment from sales, manufacturing and finance have insured the moving forward of ABC. Most past initiatives did not include certain departments, particularly finance. The assigning of a Financial Advisor to each division has in my opinion, been key our moving forward.

Impact on Decisions

Has the adoption of ABC at Insteel, influenced any decision-making in your organization? If so, how? (Use other side of this sheet if necessary).

ABC has certainly clarified and identified areas of improvement as it relates to individual customers and products. I feel, however, our greatest strides are being made presently by applying ABC properly to what is a volume sensitive business. We are beginning to MODEL our business with all the factors being considered (i.e., volume, labor, product mix) and seeing financial results that largely conform to our suppositions.

Questionnaire for Insteel Management

Name: Richard Wagner **Position/Title: VP-GM**

1. Management Support

Has the ABC effort been successful at Insteel? Do you think the effort will be continued? Expanded? (Use other side of this sheet if necessary).

YES. ABC has brought information to the management which has enabled stronger strategic marketing decisions with regard to customer and product mix selection, as well as help target areas for process improvement.

2. Organizational Factors

How has the ABC effort at Insteel been different from other initiatives implemented at Insteel ? (EVA, TQM, JIT, etc.) What factors have contributed to or hindered the success of ABC implementation at Insteel? (Use other side of this sheet if necessary).

In my opinion, EVA is the benchmark for operating the business successfully, but realistically, ABC is the tool which enables better decisions in support of improving EVA. To me EVA is the destination and ABC the roadmap. Information systems have been the biggest roadblock for ABC so far, and the next biggest, getting it understood by managers making decisions.

3. Impact on Decisions

Has the adoption of ABC at Insteel, influenced any decision-making in your organization? If so, how? (Use other side of this sheet if necessary).

ABC has affected our decision-making. Our three largest improvement in concrete products have been product mix, standardization of products in pipe fabric, and firing a significant customer who was dominating our order book at net selling values that were killing us. Over the years, we thought that volume justified it, but ABC gave us the information to decide to go no longer. Since then, they are back at about 2/3 the previous business level at prices that can earn acceptable profit levels (above our EVA hurdle).

	N	Mean	StdDev	Min	Q1	Median	Q3	Max
1996 WIRE:								
Price	224	0.276	0.037	0.181	0.245	0.278	0.299	0.392
MaterialCost	224	0.175	0.018	0.145	0.155	0.175	0.185	0.228
ConversionCost	224	0.038	0.020	0.010	0.023	0.032	0.049	0.123
CustomerCost	224	0.023	0.018	0.005	0.013	0.017	0.023	0.099
OverheadCost	224	0.061	0.025	0.015	0.043	0.053	0.071	0.140
FreightCost	224	0.023	0.011	0.001	0.016	0.278	0.030	0.063
1996 NAILS:								
Price	170	0.386	0.094	0.226	0.345	0.393	0.430	0.690
MaterialCost	170	0.232	0.055	0.177	0.188	0.220	0.246	0.380
ConversionCost	170	0.105	0.056	0.009	0.071	0.100	0.134	0.291
CustomerCost	170	0.011	0.006	0.000	0.006	0.010	0.014	0.034
OverheadCost	170	0.117	0.058	0.012	0.078	0.113	0.145	0.296
FreightCost	170	0.011	0.011	0.000	0.007	0.010	0.016	0.033
1997 WIRE:								
Price	289	0.262	0.036	0.192	0.235	0.259	0.285	0.390
MaterialCost	289	0.150	0.010	0.139	0.140	0.149	0.159	0.179
ConversionCost	289	0.055	0.034	0.000	0.027	0.044	0.080	0.172
CustomerCost	289	0.021	0.020	0.006	0.012	0.014	0.021	0.203
OverheadCost	289	0.076	0.042	0.013	0.041	0.064	0.102	0.232
FreightCost	289	0.022	0.010	0.000	0.015	0.023	0.030	0.050
1997 NAILS:								
Price	160	0.373	0.090	0.228	0.313	0.375	0.416	0.644
MaterialCost	160	0.168	0.024	0.145	0.154	0.160	0.181	0.311
ConversionCost	160	0.165	0.088	0.045	0.113	0.145	0.207	0.529
CustomerCost	160	0.019	0.010	0.004	0.012	0.017	0.022	0.050
OverheadCost	160	0.183	0.091	0.054	0.126	0.173	0.225	0.565
FreightCost	160	0.016	0.006	0.000	0.012	0.016	0.019	0.036

TABLE 1: Univariate Statistics for Regression Variables

Notes:

1. All variables are in dollars per pound.
2. Zero values are due to rounding.

1996 Wire:	Price	MaterialCost	ConversionCost	CustomerCost	OverheadCost	FreightCost
Price	1.000	0.517 ***	0.373 ***	0.000	0.299 ***	0.394 ***
MaterialCost	0.517 ***	1.000	0.639 ***	-0.271 ***	0.318 ***	0.095
ConversionCost	0.373 ***	0.639 ***	1.000	-0.136 **	0.704 ***	0.103
CustomerCost	0.000	-0.271 ***	-0.136 **	1.000	0.607 ***	0.373 ***
OverheadCost	0.299 ***	0.318 ***	0.704 ***	0.607 ***	1.000	0.350 ***
OverheadCost	0.394 ***	0.095	0.103	0.373 ***	0.350 ***	1.000

1996 Nails:	Price	MaterialCost	ConversionCost	CustomerCost	OverheadCost	FreightCost
Price	1.000	0.628 ***	0.450 ***	0.292 ***	0.465 ***	0.073
MaterialCost	0.628 ***	1.000	0.041	0.188 **	0.060	-0.035
ConversionCost	0.450 ***	0.041	1.000	0.296 ***	0.995 ***	0.292 ***
CustomerCost	0.292 ***	0.188 **	0.296 ***	1.000	0.394 ***	-0.053
OverheadCost	0.465 ***	0.060	0.995 ***	0.394 ***	1.000	0.275 ***
OverheadCost	0.073	-0.035	0.292 ***	-0.053	0.275 ***	1.000

1997 Wire:	Price	MaterialCost	ConversionCost	CustomerCost	OverheadCost	FreightCost
Price	1.000	0.448 ***	0.524 ***	0.037	0.434 ***	0.336 ***
MaterialCost	0.448 ***	1.000	0.265 ***	-0.021 *	0.201 ***	0.078
ConversionCost	0.524 ***	0.265 ***	1.000	0.205 ***	0.891 ***	0.251 ***
CustomerCost	0.037	-0.021 *	0.205 ***	1.000	0.627 ***	0.195 ***
OverheadCost	0.434 ***	0.201 ***	0.891 ***	0.627 ***	1.000	0.290 ***
OverheadCost	0.336 ***	0.078	0.251 ***	0.195 ***	0.290 ***	1.000

1997 Nails:	Price	MaterialCost	ConversionCost	CustomerCost	OverheadCost	FreightCost
Price	1.000	0.646 ***	0.716 ***	0.286 ***	0.723 ***	-0.022
MaterialCost	0.646 ***	1.000	0.493 ***	0.191 **	0.497 ***	0.016
ConversionCost	0.716 ***	0.493 ***	1.000	0.264 ***	0.995 ***	-0.113
CustomerCost	0.286 ***	0.191 **	0.264 ***	1.000	0.360 ***	-0.185 **
OverheadCost	0.723 ***	0.497 ***	0.995 ***	0.360 ***	1.000	-0.129
OverheadCost	-0.022	0.016	-0.113	-0.185 **	-0.129	1.000

Table 2: Correlations among variables by product category and year

*** Indicates significance at 99% level

** Indicates significance at 95% level

* Indicates significance at 90% level

	BEFORE ABC (1996 data)			
	Wire Products		Nail Products	
α_I	0.083***	0.076***	0.069***	0.070***
	(3.50)	(3.94)	(2.90)	(2.95)
β_m	0.934***	0.978***	1.028***	1.030***
	(6.35)	(8.55)	(11.63)	(11.86)
Sig. diff from 1.0?	No	No	No	No
β_{conv}	0.088	N/A	0.703***	N/A
	(0.68)		(7.45)	
Sig. less than 1.0?	Yes		Yes	
β_{cust}	0.000	N/A	0.809	N/A
	(0.00)		(1.01)	
β_{OH}	N/A	0.043	N/A	0.708***
		(0.48)		(8.30)
Sig. less than 1.0?		Yes		Yes
β_f	1.147***	1.123***	-0.405	-0.424
	(5.94)	(6.03)	(0.47)	(0.50)
Sig. diff from 1.0?	No	No	No	No
Adj.R^2	38%	38%	57%	57%
N	224	224	170	170

Table 3: Tests of Hypothesis 1: Price/ABC relationship in '96 (t-stats in parentheses)

*** Indicates that the estimates are significantly different from zero with p values less than .01

	AFTER ABC (1997 data)			
	Wire Products		Nail Products	
α_I	0.043	0.017	0.0253	0.030
	(1.64)	(0.64)	(0.75)	(0.89)
β_m	1.208***	1.388***	1.396***	1.400***
	(6.91)	(7.73)	(6.69)	(6.73)
Sig. diff from 1.0?	No	Yes (p=10%)	Yes (p=10%)	Yes (p=10%)
β_{conv}	0.422***	N/A	0.527***	N/A
	(8.16)		(8.97)	
Sig. less than 1.0?	Yes		Yes	
β_{cust}	-0.150*	N/A	0.823*	N/A
	(1.76)		(1.69)	
β_{OH}	N/A	0.249***	N/A	0.537***
		(5.89)		(9.56)
Sig. less than 1.0?		Yes		Yes
β_f	0.801***	0.782***	0.694	0.626
	(4.82)	(4.49)	(0.92)	(0.84)
Sig. diff from 1.0?	No	No	No	No
Adj.R^2	42%	36%	63%	63%
N	289	289	160	160

Table 4: Tests of Hypothesis 2: Price/ABC relationship in '97 (t-stats in parentheses)

*** Indicates estimates significant with p values less than .01

* Indicates estimates significant with p values less than .1

Description	No. of **profitable products** in 1996	No. of **unprofitable products** in 1996
No. of products that were sold in '96 and also in 1997 **"Continued Products"**	**203** (78%)	**125** (58%)
No. of products that were sold in '96 but discontinued in 1997 **"Discontinued Products"**	**53** (22%)	**89** (42%)
Total	**256** (100%)	**214** (100%)

Table 5: Frequency Distribution of Products, by 1996 profitability and 1997 availability for sale

Description	No. of **profitable products** in 1996	No. of **unprofitable products** in 1996
No. of products that were sold in '96 and also in 1997 for which **prices were decreased** in 1997 relative to 1996	**113** (56%)	**53** (42%)
No. of products that were sold in '96 and also in 1997 for which **prices were increased** in 1997 relative to 1996	**90** (44%)	**72** (58%)
Total	**203** (100%)	**125** (100%)

Table 6: Frequency Distribution of Product by 1996 profitability and 1997 price changes relative to 1996.

Description	No. of **profitable nail customers** in 1996	No. of **unprofitable nail customers** in 1996
No. of customers that purchased from Insteel '96 and also in 1997 **"Continuing Customers"**	**66** (66%)	**20** (53%)
No. of customers that purchased from Insteel in '96 but not in 1997 **"Discontinued Customers"**	**34** (34%)	**18** (47%)
Total	**100** (100%)	**38** (100%)

Table 7: Frequency Distribution of nail customers, by '96 profitability and '97 purchases

	% Gross Profit on Sales	
Site	Oct 1995-Jun 1996	Oct 1996-Jun 1997
Andrews Plant	8.28	8.43
6 Non-Andrews plants combined	7.99	6.94
Median of 6 Non-Andrews plants	10.18	6.07

Table 8: Gross Profit scaled by sales revenue at Insteel's plants

	1996	1997	1998	99Q1	99Q2
Cold Metal Products Inc.	9.56	6.53	@NA	@NA	@NA
Friedman Industries	15.93	18.69	@NA	@NA	@NA
Gibraltar Steel Corp.	13.12	11.72	12.38	12.54	12.54
Haynes International Inc.	1.37	-38.46	-2.70	-1.20	-1.18
MMI Products Inc.	22.21	-37.07	-84.03	-99.24	@NA
National Standard Co.	-64.32	38.81	20.64	20.53	14.35
Niagara CP	6.85	7.64	@NA	@NA	@NA
Steel Technologies	11.53	7.81	8.62	9.03	9.45
Worthington Industries	13.04	10.55	@NA	@NA	@NA
Industry Median	**11.53**	**7.81**	**8.62**	**9.03**	**10.99**
Insteel Industries	**5.76**	**3.56**	**0.47**	**5.00**	**8.90**
Relative Performance of Insteel	**-5.77**	**-4.26**	**-8.15**	**-4.03**	**-2.09**

Table 9A: ROE of Insteel and other firms in its industry

	1996	1997	1998	99Q1	99Q2
Cold Metal Products Inc.	2.20	1.55	-10.23	-10.23	@NA
Friedman Industries	9.52	10.45	@NA	@NA	@NA
Gibraltar Steel Corp.	7.18	5.84	4.53	4.65	4.65
Haynes International Inc.	-1.10	16.79	1.18	0.52	0.52
MMI Products Inc.	4.68	5.06	4.96	5.86	@NA
National Standard Co.	7.72	-7.94	-5.82	-5.69	-3.97
Niagara CP	2.25	2.39	@NA	@NA	@NA
Steel Technologies	5.38	3.30	3.68	3.64	3.96
Worthington Industries	5.98	4.47	@NA	@NA	@NA
Industry Median	**5.38**	**4.47**	**2.43**	**2.08**	**2.24**
Insteel Industries	**2.91**	**1.48**	**0.22**	**2.48**	**4.32**
Relative Performance of Insteel	**-2.47**	**-2.99**	**-2.21**	**0.40**	**2.08**

Table 9B: ROA of Insteel and other firms in its industry

	1996	1997	1998	99Q1	99Q2
Cold Metal Products Inc.	-4.65	-12.20	-61.11	@NA	@NA
Friedman Industries	65.53	34.52	-39.55	@NA	@NA
Gibraltar Steel Corp.	116.49	-24.76	15.19	-0.12	@NA
Haynes International Inc.	@NA	@NA	@NA	@NA	@NA
MMI Products Inc.	@NA	@NA	@NA	@NA	@NA
National Standard Co.	-43.52	-2.47	-57.98	-0.08	0.04
Niagara CP	-2.78	125.71	-41.14	0.08	@NA
Steel Technologies	26.02	0.37	-41.19	-0.06	0.17
Worthington Industries	-6.38	-1.98	-24.08	@NA	@NA
Industry Median	**-2.78**	**-1.98**	**-41.14**	**-0.07**	**0.11**
Insteel Industries	**-5.41**	**23.31**	**-37.02**	**0.03**	**0.17**
Relative Performance of Insteel	**-2.64**	**25.29**	**4.12**	**0.10**	**0.06**

Table 9C: Stock Returns of Insteel and other firms in its industry

Exhibit 1 (the manufacturing process at Andrews)