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presented by

Win Gilkey Jordan

has been accepted towards fulfillment
of the requirements for

Doctor of Philosophy degree in Business Administration

Susan F Haka
Major professor

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IMPLEMENTING FINER COST ALLOCATION METHODS: IMPACT OF COMPLEXITY, COMPETITION, STRATEGY, MANAGERIAL SUPPORT, AND IMPLEMENTATION OBSTACLES

By

Win Gilkey Jordan

A DISSERTATION

Submitted to
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for the degree of

DOCTOR OF PHILOSOPHY

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1996

ABSTRACT

IMPLEMENTING FINER COST ALLOCATION METHODS: IMPACT OF COMPLEXITY, COMPETITION, STRATEGY, MANAGERIAL SUPPORT, AND IMPLEMENTATION OBSTACLES

By

Win Gilkey Jordan

This descriptive study examined whether certain firm and industry characteristics increase the likelihood of a firm's implementing finer cost allocation (FCA) methods. Characteristics examined included degree of complexity in products and processes, level of competition experienced, degree to which certain strategies are followed, strength of managerial support for FCA methods, and strength of implementation obstacles facing FCA methods.

Most data came from 124 survey responses from manufacturing plants in various industries. Through manual correlation analysis, principal components factor analysis, and item reliability analysis, 50 measures were reduced to 15 which formed four independent constructs (no construct was found for competition). Factor scores were generated for each response. The factor scores and six selected measures were analyzed against FCA methods implementation scores in a series of multivariate regression models. Depending on the measures included, missing data caused the analyses to be based on 111 or 112 observations.

Of five constructs hypothesized as influencing FCA method implementation, the constructs for three exhibited significance and correct signs: complexity (99%), implementation obstacles (95%), and managerial support (90%). The data therefore support the three associated hypotheses. An additional complexity measure (an increased number of labor rates reflecting complexity of human resource skills) was also found to be a significant variable of correct sign.

The lack of a cohesive competition construct precluded directly testing the hypothesized competition relationship. However, three competition measures (firm portion of HHI, perceived level of competition, and lower profit margins) used as variables in the regressions showed significant relationships but of mixed signs, thus indicating a lack of support for the competition hypothesis.

A partial construct for strategy was significant at the 90% confidence level and two strategy measures (process innovator and cost-based pricing) used as variables in the regressions were significant at the 95% confidence level. However, the signs for the three variables were opposite that hypothesized, thus indicating a lack of support for the strategy hypothesis.

When only derived constructs were used, the regression model explained only 7% of variation. When the additional measures for complexity, competition, and strategy were included, the model explained 27% of the variation.

I dedicate this dissertation to Valerie Neville Jordan. Her continuing support and encouragement throughout the years have given me the courage to turn my dreams into reality. As wife, mother of our children, companion, partner, advisor, and best friend, she has molded my life and made it worth living. When I have become the best that I can be, perhaps I shall begin to be worthy of her.

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My greatest acknowledgment is to those who sacrificed so much that I might successfully undertake my doctoral program: my family members. My heartfelt thanks goes to Valerie, my wife, and our children (Kendra, Kimberly, Nathan, Aaron, Jocelyn, Adam, Joshua, and Julia) for supporting me throughout the entire program. Their being uprooted so that I could enter a doctoral program, then experiencing the privations that accompany being the family of a doctoral student, were sacrifices of such magnitude that this culminating dissertation is as much theirs as mine.

I express my gratitude to my dissertation committee members — Susan Haka, Fredric Jacobs, Ronald Marshall, and Stanley Fawcett — for their insight, help, and patience throughout the dissertation process.

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My appreciation extends also to my friends and colleagues at the University of Idaho for their encouragement and support during the analysis and writing phases. Special mention goes to Christopher Williams and Kirk Steinhorst of the University of Idaho Statistical Consulting Center for their generous help during the analysis.

I express my gratitude also to my father-in-law, Joseph T. Neville, for his friendship, encouragement, and sacrifice in helping me get started on the analysis and writing of this dissertation. He served faithfully as a sounding board in exploring alternatives. Similarly, my mother-in-law, Evelyn Neville, lent her support to my efforts.

I gratefully acknowledge my parents, Don Armstrong Jordan and Louie Mae Gilkey Jordan, who sacrificed so much that I might have the opportunities they never had. Their love of truth set both the tone and the balance for my future research efforts. I hope that I may yet become half the teacher that my father was.

Finally, I acknowledge the loving support of my Heavenly Father, who has blessed me beyond measure in so many ways. From Him I have learned that the pursuit of truth is an eternal process.

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CHAPTER I

INTRODUCTION

This descriptive study examined whether type and strength of certain firm and industry characteristics increase the likelihood of a firm's implementing finer cost allocation (FCA) methods[1]. The characteristics reflected 1) market structure and the firm's struggle for sales (grouped together herein as competition), 2) strategies pursued, 3) the degree to which the firm's products consume resources in diverse and uncorrelated patterns (referred to herein as complexity), 4) the extent of managerial support offered for the implementation, and 5) the strength of implementation obstacles.

Although not directly tested in this study, cost-benefit theory [Zimmerman (1979) and Jensen and Meckling (1992)] provided the underlying rationale for implementing FCA methods by maintaining that firms expend resources only when increased benefits are expected to produce a net gain. The study proposed five hypotheses relating the implementation of FCA methods to firm and industry characteristics. The hypotheses drew on theories and models from strategic planning, economics, systems

1 FCA methods include all methods beyond a single plantwide allocation method; FCA methods include using 1) departmental allocations, 2) multiple cost pools and cost application bases, or 3) activity-based costing or other process-driven methods.

management, and managerial accounting. The five hypotheses suggest that implementation of FCA methods is increased by 1) greater complexity in indirect resource consumption, 2) greater competition, 3) following certain firm strategies, 4) greater managerial support for FCA methods, and 5) fewer and weaker obstacles to implementing FCA methods. Empirical survey and analysis were used to test the hypotheses, although the competition hypothesis was eventually untested due to a lack of item reliability for the competition measures proposed.

The results of this study are of interest to firms considering whether to implement such FCA methods as departmental application rates, multiple cost pools, or activity-based costing (ABC). Firms make strategic decisions about allocating overhead, pricing products, preparing financial statements, calculating taxes, and performing product evaluations; the accuracy of costs impacts each of these activities. Theory suggests that managers implementing FCA methods perceive the benefits to outweigh the added costs of changing systems, training personnel, and gathering and processing the required information.

The hypotheses build on four theories: theory of complexity, theory of competition, strategic planning theory, and systems management theory. The theory of complexity [Gupta (1993); Hwang, Evans, and Hegde (1993); Datar and Gupta (1994); Böer and Jeter (1993)] examines how various characteristics of manufacturing influence whether simple allocation techniques distort costs. The theory of competition shows the importance of pricing [Varian (1990, 1992)], the ways that industry structure influences competition [Scherer and Ross (1990)], and how competitive pressure varies with time and circumstances [Boston Consulting Group (1968), Porter (1980), Richardson and Gordon (1980), and Anthony and Ramesh (1992)]. Strategic planning theory addresses the ways that firms analyze and manage competition [Levitt (1965), Porter (1980), and Kotler (1991)]. Systems management theory [Yellen (1993), Martinsons (1993), Day (1994), Beatty (1992)] illustrates that widespread managerial support and the authority and effectiveness of the champion influence the scope of implementation within a firm. Systems management theory also suggests that implementations occur more frequently when the obstacles to implementation are fewer and weaker [see Campi (1992), Cooper et al (1992), and Yourdon (1989)]. These theories are used to explain 1) why some firms are willing to incur additional installation, collection, and processing costs in order to obtain more detailed costs and 2) how detailed costs are used to guide cost reductions and increase profitability or to help set product prices at levels that maximize profits and cover both fixed and variable costs.

The study used data from a cross-sectional sample of 124 plants selected at the 4-digit SIC code level. Data on industry structure and firm-SIC-code operating margins were obtained from the Standard and Poor's Compustat Industrial data base; verification of industry coverage in selected industries was obtained from Manufacturing USA [Darnay (1994)]; and information on firm beginning year was obtained from Moody's manuals [Moody's (1995)] and the CorpTech Directory of Technology Companies [Corporate Technology Information Services (1995)]. Other items of information were obtained through surveys completed by respondents in the sample plants. The surveys provided respondents' perceptions on complexity, competition, strategy, managerial support, and implementation obstacles. In addition, the surveys captured information on the cost allocation methods implemented by the plants.

Descriptive statistics were developed on each of the 47 items obtained from the surveys and on the three calculations based on Compustat data; the descriptive statistics showed the data to be nonnormal, with significant skewness and kurtosis. As explained in Johnson and Wichern (1992), the lack of normality affected the usefulness of correlation analysis; the magnitudes of Pearson correlation coefficients were still valid, but the significance of the correlations become suspect. Furthermore, the lack of normality dictated the use of principal components factor analysis (rather than maximum likelihood factor analysis) since principal components factor analysis is robust against the lack of normality.

In order to use factor analysis meaningfully on the small sample available, a ratio of 5 observations per measure analyzed necessitated reducing the number of measures from 50 to 25 or less. Some 27 measures were dropped after examining either 1) the correlations between measures or

2) the correlations between measures and the sums of the measures proposed for a group of measures, in accordance with Churchill (1979); Churchill advocated retaining measures which correlated strongly. Two additional measures were dropped because they measured essentially the same thing and did not correlate strongly with anything else; two other measures were dropped because they had so little variation that they were uninformative.

The surviving 19 measures were used in a principal components factor analysis with varimax rotation; four independent factors were found which roughly corresponded to the intended factors, although no factor emerged for competition. Each factor was then tested for item reliability by calculating Cronbach's Coefficient Alpha; this testing eliminated another four measures.

Then the data were factor analyzed with principal components factor analysis with varimax rotation (obtaining the same factors) to develop factor scores for each of the responding plants. The factor scores and six separate measures (representing competition, specific aspects of strategy, and an additional aspect of complexity), were analyzed in a series of multivariate regression models to test the proposed hypotheses. (Depending on the separate measures included in a model, missing data caused the regressions to be based on 111 or 112 observations.)

Of five constructs hypothesized as influencing FCA method implementation, the constructs for three exhibited significance and correct signs: complexity (99%), implementation obstacles (95%), and managerial support (90%). The data therefore support the three associated hypotheses. An additional complexity measure (an increased number of labor rates reflecting complexity of human resource skills) was also found to be a significant variable of correct sign.

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When only derived constructs were used, the regression model explained only 7% of variation. When the additional measures for complexity, competition, and strategy were included, the model explained 27% of the variation.

As the regression results indicate, several constructs and measures related strongly with FCA method implementation. Since only 7% to 27% of the variation was explained, the hypothesized influences did not fully explain what prompted the plants to implement FCA methods.

The remainder of this paper is organized as follows: Chapter II examines the research motivation for this study, discusses the background and development of cost allocations, and presents previous research. Chapter III presents the conceptual model and develops the hypotheses for the study. Chapter IV presents the methodology, including approach, sample selection, research design, and the measures used. Chapter V discusses the statistical tests and their results, including demographics, univariate descriptive analysis, factor analysis, item reliability testing, and multivariate regression analysis. Finally, Chapter VI discusses what contributions the study has made, the limitations on the study's practical usefulness, and directions for future research.

CHAPTER II

RESEARCH MOTIVATION, BACKGROUND, AND PRIOR RESEARCH

RESEARCH MOTIVATION

Since the early 1900's, many management accountants have increasingly argued for finer cost allocations [Johnson and Kaplan (1987), Previts and Merino (1979), Chatfield (1977)]. The variety of allocation methods developed and the concern with improper allocations leading to incorrect product costs expressed by such authors as Shank and Govindarajan (1988), Johnson and Kaplan (1987), Cooper and Kaplan (1987), and Cooper (1986) suggest that some academicians favor the use of FCA methods.

In a survey by Green and Amenkhienan (1992), 45% of respondents indicated they had implemented activity-based costing (ABC) to some degree within their firms. Notwithstanding, some firms continue to use simple allocation methods. In a survey taken by Emore and Ness (1991), 74% of firms still use labor hours or labor dollars as the allocation base and 30% of firms still use plantwide overhead allocation. Perhaps the nature of business in some firms is not appropriate for more complex allocation methods, such as ABC.

An underlying assumption of this study is that adopters and nonadopters of FCA methods are making rational choices; this study sought to learn more about what characteristics influence firms to implement FCA methods. The study examined three hypotheses about firm characteristics (complexity, competition, and strategy) that might influence the implementation decision; the study also examined two systems-related hypotheses that managerial support and implementation obstacles influence the implementation decision.

The idea underlying the study was that, since implementing and using FCA methods consumes additional scarce resources, implementation will not take place unless the perceived benefits outweigh the perceived costs. One premise of the study is that, unless resource consumption is diverse and uncorrelated between products, little additional benefit is perceived. Where consumption is diverse and uncorrelated, however, it is proposed that perceived benefits arise as firms experience increasing levels of competition and carry out their chosen marketing and pricing strategies. If the perceived increase in benefits is coupled with adequate managerial support while facing few and weak implementation obstacles, implementations of FCA methods increase.

The study problem is important because cost allocations impact several important strategic decisions. Horngren, Foster, and Datar (1994) maintain that cost allocations affect product pricing, financial statements, taxes, and performance evaluations. In each of these areas, allocations may affect perceived and/or reported product profitability.

In regular product pricing[2], some firms focus prices on what the market will bear, whereas other firms set a price which covers their current full costs. In order to sustain long-term product profitability, firms must eventually price to cover their average long-term full costs [Varian (1992); Horngren, Foster, and Datar (1994)]. Since products are often identified for discontinuance when they are no longer considered sufficiently profitable, a firm may seek to increase its overall profitability by replacing low-profit products with high-profit products. Thus, the amount of cost associated with a product can have long-lasting implications for profitability.

Cooper and Kaplan (1987, 1988) discuss how improper allocations can occur with less-refined cost allocation methods. Indirect resources consumed by one product are charged against another product because the allocation method fails to accurately match resource consumption with the consuming products. As a result, perceived levels of product profitability can be inaccurate and result in the retention of actual low-profit products (which were thought to be high-profit products) and the elimination of actual high-

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[2] Horngren, Foster, and Datar (1994) and Anderson and Sollenberger (1992) discuss special pricing which covers only out-of-pocket costs, but all agree the circumstances surrounding the sale are limited. This study focused on normal sales.

profit products (which were thought to be low-profit products). When such a combination occurs, the firm foregoes additional profit [Cooper (1986)].

As the preceding discussion indicates, using less accurate or less detailed cost information can result in economic risks. For a variety of reasons, some rational managers choose not to use FCA methods. Gupta (1993) found that reducing heterogeneity in cost pools by increasing the number of cost pools does not always result in more accurate product costs; Datar and Gupta (1994) showed that incrementally implementing FCA methods or failing to carefully select the drivers or measurement tools can lead to less accurate costs. Nevertheless, most studies, including Gupta (1993) and Datar and Gupta (1994), admit that proper use of FCA methods can lead to more accurate costs under the correct circumstances, particularly where varying production complexity occurs. The present study investigated complexity, competition, firm strategy, managerial support, and implementation obstacles as characteristics that influence managerial decisions to implement FCA methods.

BACKGROUND AND PRIOR RESEARCH

Background and Development of Finer Cost Allocations

Cost allocations spread indirect manufacturing costs (actual or estimated) over the products produced. While product costing methods vary in their procedures, the methods primarily differ in how to assign product costs that do not vary directly with production volume [Chatfield (1977) and Previts and Merino (1979)]. For example, one traditional method used by many firms allocates non-volume-driven costs to products according to the direct labor hours consumed by each product. [See Horngren, Foster, and Datar (1994) and Johnson and Kaplan (1987).] Labor-hour-based allocation was first derived in a time when firms were highly direct-labor intensive.

With new technologies, many firms have become less direct-labor intensive; these firms use increasing amounts of support labor and capital equipment. Note, however, that the shift from being labor-intensive to being machine-intensive is by no means uniform. Böer and Jeter (1993) found that some industries still are labor-intensive and have maintained constant proportions of overhead, whereas other industries have seen direct labor shrink to insignificance and overhead grow to dominant proportions.

Firms in machine-intensive industries often have overhead amounts far exceeding direct-labor amounts [Cooper and Kaplan (1987), Pattell (1987), and Green and Amenkhienan (1992)]. A machine-intensive firm has large amounts of capital-equipment-related overhead and a relatively small number of direct labor hours. Allocating the overhead based on direct labor hours means that accounting will assign a substantial amount of overhead to a department or product for each labor hour associated with that department or product. If a manager can find ways to reduce the number of direct labor hours associated with the department or product, the department or product can avoid being charged with the associated overhead. In effect, the manager can avoid substantial capital-equipment-related costs arising in running the department or producing the product by eliminating labor, which is already a less important resource.

In an effort to avoid misapplication of capital-equipment-related overhead, FCA methods were developed. Two main allocation methods evolved. In the first method, known as a multiple plantwide allocation method, plantwide overhead was broken into a few plantwide cost pools, where the costs going into each pool had a logical cause-and-effect relationship with the pool's cost driver (labor hours, machine hours, number of personnel, etc.). As a unit of the cost driver is consumed, a predetermined amount from the associated cost pool is assigned to the consuming department or product. In the second allocation method, known as a departmental allocation method, overhead costs incurred by the department are placed in a pool. As other departments or products consume a unit of the department's major cost driver, a predetermined amount from the departmental cost pool is assigned to the consuming department or product.

Both multiple plantwide allocations and departmental allocations are still primarily volume driven.

Refinements of the multiple-cost-pool approach have been developed and are referred to as some form of activity-based costing (ABC) or process-based costing. ABC is explained in *An ABC Manager's Primer* [Cokins, Stratton, and Helbling (1993)]. Each activity is examined to determine which and how much of the firm's resources it consumes. The costs associated with the consumed resources are aggregated for the activity. The activity's capacity is determined, then the costs are spread over the capacity. Subsequently, the costs are distributed to cost objects (typically parts, services, ingredients, products, customers, or distribution channels) that use the activity. Where the cost objects are used internally in support of another activity, the associated cost is passed along to the supported activity.

Proponents of ABC and other process-based costing methods believe that such methods produce more accurate product costs by tracing a larger portion of costs (including manufacturing costs, distribution costs, and other selling, general, and administrative costs) directly to the activities causing them to be incurred, then tracing the costs to the organizations or products which consume the activities. Advocates of activity- or process-based costing claim that activity-based allocation methods can identify when and where improper cost allocations occur between products or organizations [Cooper and Kaplan (1988), Johnson (1988), Shank and Govindarajan (1988), Campbell (1989), and Smith and Leksan (1991)]. In addition, firms can also use refined cost data to focus attention on activities or products that can best benefit from cost-reduction projects [Cooper and Kaplan (1991), Greenwood and Reeve (1992), Ostrenga (1990), and Shields and Young (1992)].

The global desirability of using multiple-cost-driver methods has been challenged by various researchers, including Banker and Potter (1993), Gupta (1993), and Noreen (1991). While Banker and Potter (1993) upheld the usefulness of multiple-cost-driver methods in most circumstances, the analytical model employed showed firms to be "strictly better off using a direct labor single cost driver method" when the demand for an overcosted, labor-intensive product is growing sufficiently rapidly in an oligopolistic situation [Banker and Potter (1993), p. 15]. Gupta (1993) showed where allocations of aggregated costs can be more accurate than disaggregated costs because of offsetting differences. Noreen (1991) showed that process-based methods are inappropriate when costs are nonlinear, when nonzero fixed costs occur at the cost-pool level, or when joint processes are involved.

As the discussion above points out, plants vary widely on the degree of refinement sought for cost allocations. What characteristics distinguish plants that implement FCA methods from plants that do not? This study examined several characteristics which may influence managers in choosing which allocation method to implement: complexity, competition, strategy, managerial support, and implementation obstacles.

Complexity

Research shows that, where resource consumption patterns are diverse and uncorrelated with the allocation base, using a single allocation base presents a distorted assignment of product costs [Johnson and Kaplan (1987) and Noreen (1991)]. Products using less of the allocation base are assigned less costs; nevertheless, the same products may be consuming disproportionate amounts of support resources. [See Johnson and Kaplan (1987); Frank, Fisher, and Wilke (1989); and Haka and Marshall (1994).] This distortion in product costs is referred to as "improper allocation." Horngren, Foster, and Datar (1994) advocate the use of improved cost tracing and finer cost allocations to avoid improper allocation and to obtain an increased ability to measure performance and to control operations. Kee (1995) demonstrates how ABC can be combined with the theory of constraints to identify bottlenecks and to show the impact that bottlenecks have on production.

Multiple plantwide allocation methods, departmental allocation methods, and activity-based allocation methods can reflect more closely the consumption of various resources when diverse and uncorrelated resource consumption patterns occur [Hwang, Evans, and Hegde (1993)]. Some costs are spread via direct labor (hours or dollars), others via square footage, others via machine hours, others via number of personnel, etc. [Horngren, Foster, and Datar (1994) and Green and Amenkhienan (1992)].

One adverse effect of improper allocations arises with cost-reduction efforts. If a firm is striving to reduce costs but is improperly allocating costs, cost-reduction efforts could be focused on the wrong areas. Although Fisher (1991) was not studying allocation methods, Fisher relates that implemented cost reduction measures often fail to achieve the intended results -- cost reduction efforts often do not cause firms to meet cost targets or improve return on investment. Cost-reduction effectiveness might have improved if the guiding costs truly reflected cost occurrence and profitability.

Hwang, Evans, and Hegde (1993) generally agree that multiple cost pools yield more accurate costs, but they show that care must be given to selection of appropriate cost drivers. They maintain that the bias of conventional allocations is a function of the heterogeneity of the production technology, unit input costs, and the product mix; they also have developed algorithms to help managers select cost drivers. Gupta (1993) analyzed how varying heterogeneity (complexity) in products, allocation measures, and products' resource usage affected allocated costs at different levels of aggregation (grosser versus more detailed cost allocations). He found positive correlations between heterogeneity and the magnitude of cost differences produced by grosser and more detailed allocation methods. Greater complexity increased the benefits offered by FCA methods in producing more accurate costs.

The preceding discussion suggests that increasing complexity should increase the need for and implementation of FCA methods. This study used the following measures in assessing complexity: product diversity, number of routings, the use of dedicated equipment, the use of multiple labor rates, the importance of setups, whether the plant is a job shop, the rate of new product innovation, compressing product life cycles, frequency of production technology changes, and the number of product lines within the plant. As explained in the methodology section, a subset of the complexity measures are used in factor analysis and regression analysis to test whether complexity increases FCA method implementation.

Competition

Market Structure

The neoclassical economic theory of competition associates industry structure with the profit attainable, given the interaction between supply, demand, and prices. Industry structure ranges from a single supplier receiving monopoly profits to pure competition with many competing firms pricing at marginal cost [Varian (1992)].

One indicator of competition often examined is market concentration [Scherer and Ross (1990)]. When a firm holds a very small market share, it typically experiences more competition. Conversely, when a firm holds a large (concentrated) market share, it often experiences less competition. Scherer and Ross (1990) stated that true monopolies do not exist in United States manufacturing today and that the instance of near-monopolies is rapidly declining. Conversely, Scherer and Ross maintained that nearly half of all industries can be characterized as oligopolistic, which they indicate exists where the four leading firms control 40% or more of market share.

Competitive pressures usually lead firms to become more aggressive in their attempts to gain market share from their competitors. According to Scherer and Ross, the preferred tool for assessing market structure is the Herfindahl-Hirschman Index (HHI). The HHI considers both firm numbers and inequality by squaring market shares and summing them, thus weighing more heavily the values for large firms.

As competition increases, neoclassical economics indicates that profits decrease. Firms trying to improve their profitability can do so by selling more units (as long as each unit yields a positive return), raising the prices (which is difficult under increasing competition because competitors would maintain lower prices and gain market share), or lowering costs. If firms can capture market share (especially a large share) through lower prices, they sometimes can increase total profits even though unit margins may be lower.

In firms operating under pure competition, managers need accurate costs of materials, labor, and overhead for each product in order to define the product's profit-maximizing price. As the profitability of each product becomes clear, managers focus on the more profitable products and redirect the consumption of resources away from less profitable products and toward more profitable products.

Neoclassical theory's strength for the current study lies in explaining the effects of competition. Competition impacts the prices set by management. Where prices and profits are high, other firms try to enter the market; where entry is successful and no collusion occurs, prices and profits usually lessen. When prices and profits are very low, potential entry is often avoided, but the profitability depends on understanding and controlling costs. Managers attempt to find a price low enough to forestall the entry of competitors yet high enough to make acceptable profits [Varian (1990)]. One claim of FCA advocates is that inaccurate cost allocations can lead a firm to price inappropriately, thus frustrating management's attempt to find the profit-maximizing price [Cooper (1986)].

This study used several market-share-based measures to assess competition: typical product market share, biggest market share of a product, industry competition as determined with the HHI, and the portion of the HHI held by the firm. In addition, the study used respondent subjective evaluations of the level of competition in the industry, the agressiveness of major competitors, whether competition is forcing the lowering of prices or the decreasing of profit margins, the level of foreign competition, and the level of domestic competition. As explained in the methodology and results sections, the competition measures failed to form a cohesive factor, so individual measures were regressed separately against FCA method implementation.

Life-Cycle Stages

Porter (1980) considered the industry or product life cycle, first presented by the Boston Consulting Group (1968), to be a primary result of competition; it often forms the basis for setting key strategies. BCG's theory recognized that many aspects of an industry or product change over time, going through four stages: introduction, growth, maturity, and decline. The usefulness of cost information varies over the cycle; the current study used a guideline that accurate cost information is relatively unimportant in the introduction stage, slightly important in the growth stage, and very important in the maturity and decline stages. However, costs are used in the maturity stage to remain competitive; in the decline stage, they are aimed more at maximizing profits until exiting from the industry.

Considerable research and academic discussion has examined how competition, prices, and profits change as a product goes through the various stages of the product life cycle. Wernerfelt (1985) found that prices decrease early in the life cycle, then increase later as market share is given up for increased profits. Claiming that firms go through life cycles in a manner similar to products, only over a longer period of time, Anthony and Ramesh (1992) used annual dividend as a percentage of income, percent sales growth, and age of firm to classify firms in the Compustat data base into growth, maturity, and declining stages, then used the results to test the association between accounting performance and stock prices.

The present study used product life cycle (a weighted combination of a firm's products in each stage) and firm life cycle as measures of competition. As explained in the methodology and results sections, competition failed to form any cohesive factor, so competition measures were regressed directly against FCA method implementation.

Some firms choose not to follow the general pattern of the entire product life cycle. Richardson and Gordon (1980) point out that some firms choose to remain innovators (differentiators), producing only during the introductory and growth stages while prices and profits are high, then withdrawing from the market when margins decrease. Others focus on getting down the learning curve quickly to obtain market share for the late growth, maturity, and decline stages when their lower costs and high volume bring reasonably high profits. These firms choose to become cost leaders. Hill (1991) and Murray (1988) show that firms can achieve both product differentiation and low-cost leadership. Firms have the capability to manage the product life cycle when viewed across an array of products, so the management of the product life-cycle affects the level of competition experienced by the firm.

This study used two measures in relation to life-cycles: a weighted-average product life-cycle and a firm life-cycle (a modified version of the

Anthony and Ramesh model). As explained in the methodology and results sections, neither life-cycle measure formed a factor with other competition measures or with the other life-cycle measure.

Strategic Positioning

Structural analysis of industries provides a framework for looking at the sources and degree of competition within an industry. Having assessed the level of competition, the firm may strive to position itself to take advantage of its own strengths. Porter (1980) discusses several forces constantly at work on the firm to reduce product prices or increase product costs, thus eroding product profitability and increasing competition. Porter showed that the level of competition depends on many aspects besides marginal cost.

The strategic aspects of interest to the current study include 1) whether a firm focuses on being a product differentiator, a low-cost leader, or both; 2) how important cost is in the firm's setting of prices; and 3) how intense cost reduction efforts are. Each strategic aspect is further discussed below.

Product Differentiator vs. Low-Cost Leader

Firms have a strategic choice of being a product differentiator, a low-cost leader, or both. Porter (1980) explained the ramifications of this choice. If a product is undifferentiated from that produced by other firms, prices may be lowered in order to attract customers, creating increased competition. Because new entrants to an industry bring new capacity (and sometimes substantial resources) and fight for market share, the preexisting industry may have to lower prices, increase costs (such as redesigning the product, engaging in more advertising, paying higher sales commissions, etc.), or both to maintain market share. Two approaches (not mutually exclusive) to dealing with the increased competition from new entrants are product differentiation and cost leadership.

Under product differentiation, the seller attempts to make the buyer perceive the product as being unique by changing the product, by creating different support services, or by convincing the customer that it is different through intensive advertising, special packaging, etc. Under product differentiation, the buyer sees the seller as the only source of the product bundle.

Porter (1980) advised that, to be successful as a differentiator, the firm must find ways of differentiating that lead to a price premium greater than the cost of differentiating. A differentiator cannot ignore its cost position, else it loses the benefit of higher price to the higher costs incurred. The research question suggests that differentiators become interested in more accurate cost allocations as the gap between product prices and product costs narrows or as cost reductions are sought in order to widen the gap.

When firms pursue cost reductions to widen the profit gap, firms sometimes attempt to become low-cost leaders by finding and exploiting all possible sources of cost advantage. To be successful as a cost leader, however, Porter (1980) said the firm must become *the* cost leader, not one of several vying for cost leadership; otherwise, price competition becomes too fierce and profitability disappears. As the low-cost leader, the firm has costs low enough to still make profits, yet has the price low enough to discourage new entrants that do not yet have such a cost advantage. Still, the cost leader must achieve parity or proximity in the bases of differentiation relative to its competitors, or it will not perform well.

Costs are important to both differentiators and low-cost leaders, but reductions are more extreme with the cost leader, whereas the differentiator reduces costs only to the point where profits are maximized without losing differentiation.

This study used six measures to record aspects of differentiation and low costs: new product innovation, new process innovation, production of differentiated products, focus on selling high-profit-margin products, production of commodity products, and position as industry low-cost leader. As explained in the methodology and results sections, a subset of these measures were used in factor analysis and regression analysis to test whether differentiation and low-cost leadership influence FCA method implementation.

Importance of Costs in Setting Prices or Maintaining Desired Profitability

A firm's choice of pricing process affects its strategic position. Price generally is determined in three ways: 1) finding the highest price that the market will bear (monopoly pricing), 2) adding some markup to costs incurred, or 3) accepting the competitive market prices. The latter two methods depend on having accurate costs — either to serve as the base for calculating price or to determine whether sufficient profits can be obtained at the market-set price. Thus, pricing methods also influence the need for FCA information. Bromwich (1990) points out that prices can be set either at what the market will bear or at a level covering full long-term product cost (thus erecting a barrier to entry for competitors). Monopoly pricing is fairly independent of product cost; cost-based pricing depends directly on costs; and market-set pricing requires costs be contained at a level insuring adequate profits. Monopoly costing is typical of less competition, whereas cost-based pricing and market-set pricing are typical of more competition and are more likely to generate a need for FCA methods.

To examine the relationship of pricing method to FCA method implementation, this study used a measure of how much the plant uses costs in setting prices. As explained in the methodology and results sections, using costs as a basis for setting prices did not form a cohesive factor with other strategy measures or with the group sum.

Intensity of Cost Reduction Efforts

Besides the product differentiator versus low-cost leader issue and the choice of pricing method, a firm's strategic position also depends on the intensity with which it pursues cost reductions. According to Porter (1980), cost reduction efforts are more intense among firms experiencing greater competition. When a firm needs cost reductions to survive, it will exert more effort to determine costs accurately than would a firm merely trying to widen profit margins.

This study used two measures to assess cost-reduction efforts: intensity of cost reduction efforts and use of target pricing and target costing to insure profitability. The cost-reduction measures also failed to form a factor together or with other measures.

Managerial Support

Implementing an FCA method faces many of the same problems as implementing any system; among the leading problems would be a lack of managerial support. The systems management literature suggests implementation is more likely with managerial support, as evidenced 1) by having an effective champion who can rally managerial and organizational acceptance, 2) by obtaining top management support, and 3) by having user support. Since an FCA methods are systems, successful implementation of FCA methods could be influenced by managerial support.

Kanter (1983) , Reich and Benbasat (1990), Beatty (1992), and Yellen (1993) maintain that perhaps the most important antecedent to a successful information system is a "champion" for the new system. Beatty (1992) examined successful and unsuccessful implementations of advanced manufacturing technologies at ten companies; she found that none of the companies were able to achieve their goals without a champion.

In clarifying the role of a champion, Beath (1991) pointed out that champions are different from "sponsors," who provide the authority and funding for the implementation. Lanford (1993) explained that a champion ensures that management sees the vision of the new system and understands the benefits. Beatty (1992) saw the role of the champion as facilitating others' conversion to the new methods, which helps build trust, acceptance, and commitment in those who are to use the system. The present study captured the respondents' assessments of the effectiveness and organizational level of the champion.

On a different front, Yellen (1993) said that two of the major difficulties in implementing systems arise when managers do not fully support the systems and when users are not sufficiently committed to them. Compton (1994) stated that the first and most important task in implementing an ABC system is obtaining a commitment from top management, but then pointed out that effective use also requires endorsement and support throughout the user community. Martinsons (1993) indicated that management endorsement institutionalizes an innovation and helps persuade others of its viability; such support is deemed essential to gain resources and reward results.

The present study used eight measures to capture the respondents' assessments of managerial support. Upper management support was recorded as the support of the CEO, support of the Controller, and support of other top management. Support of the users was recorded as support of middle management, support from Accounting, and support from Marketing. Assessment of the champion was recorded as the organizational level of the champion and the effectiveness of the champion. As explained in the methodology and results sections, a subset of the managerial support measures were used in factor analysis and regression analysis.

Cost-Benefit Theory

The final theory of interest in the current study is cost-benefit theory, which drives the whole issue of whether firms seek more accurate costs. Cost-benefit theory is based on the assumption that firm decision makers make rational choices. The real world, being full of choices, operates efficiently in accordance with the information and options available [Cheung (1992)]. Cost-benefit theory maintains that managers will avoid expending resources and effort unless they feel a net gain can be obtained. Implementing an FCA method costs money for software purchase or programming, retraining of the users, etc. If the perceived benefits of implementing an FCA method do not sufficiently outweigh the costs, managers should not implement the FCA methods.

Therefore, the first question for a firm to consider before implementing FCA methods is whether sufficient benefits will arise from implementing FCA methods. In some situations no benefits are apparent; in others, strong benefits occur. Horngren, Foster, and Datar (1994), in their presentation on plantwide rates versus departmental rates, discuss the situations where FCA methods provide benefits. They maintain that finer allocation rates are useful only where resource consumption patterns (by products or by organizations) are diverse and uncorrelated with the allocation base. Where the products and organizations each exhibit the same resource consumption pattern and that pattern is well correlated with the allocation base, the plantwide rate should provide the same benefits as more refined rates. In the latter situation, the firm has less incentive to implement more refined rates.

Given diversity of resource consumption patterns, managers still need to determine whether the perceived benefits of FCA methods justify the additional costs. As indicated by Yourdon (1989), all financial costs that may result from implementation will need to be examined, including the costs of analyzing, planning, building, installing, training, etc.

Acquisition and installation costs include the actual costs of building or obtaining the hardware, software, and training needed for the new techniques. These costs, together with normal operating costs, are traditionally considered in financial analyses and capital budgets; managerial accountants, MIS staff, or top management frequently base their decisions about implementing systems on the outputs from financial analyses and capital budgets. Campi (1992) points out that focusing too intently on short-term financial measures can influence a firm's management to delay or avoid implementation.

In addition to these costs, however, the firm may incur other fairly significant costs. As implied by Jensen and Meckling (1992), the obstacles also include the efforts required in order to learn, adjust to, and use the new techniques. Time and effort would be spent negotiating within the firm to have the new information used, measuring the costs themselves on an ongoing basis, dealing with the changes in prestige of products as a result of allocation changes (if improper allocation is occurring), monitoring the performance of managers using the information, organizing the firm to use the information (including any changes in policies and practices to make the appropriate level of detail available), and so on. Thus, the total cost of implementing FCA methods is likely to be significantly higher than the acquisition and installation cost.

While little or no research has been performed directly on the costs of FCA methods implementations, FCA methods are really a subset of information systems. Jensen and Meckling (1992) focus on the cost-benefit aspects of obtaining, processing, and using information; their findings are applicable to FCA methods.

Jensen and Meckling examine the role that knowledge plays in organizational decision making, with special emphasis on the "bounded rationality" caused by the physical limitations specific to each individual. Because humans have limited mental capability, gathering, storing, processing, transmitting, and receiving knowledge are costly activities which use the time and effort of the individuals involved. Because of this cost, decision-makers do not seek out information unless it is pertinent and valuable.

Under cost-benefit theory, if firms do not implement finer allocations, then the total costs associated with FCA methods must exceed the perceived benefits which would accrue from their implementation.

The current study captured information about obstacles, both financial and nonfinancial, which managers in the plant might consider as negating the benefits which could derive from FCA methods. Measures of financial obstacles included cost of adequate planning, cost of bringing in consultants, cost of changing the information system, cost of training, cost of running a dual cost system for some period of time, and the cost of gathering and processing more detailed data. Measures of nonfinancial obstacles included managerial resistance to making the change, lack of high-level sponsor, focus on short-term financial measures, difficulty of quantifying costs and benefits of the change, and the difficulty of communicating the results of planning throughout the organization.

CHAPTER III

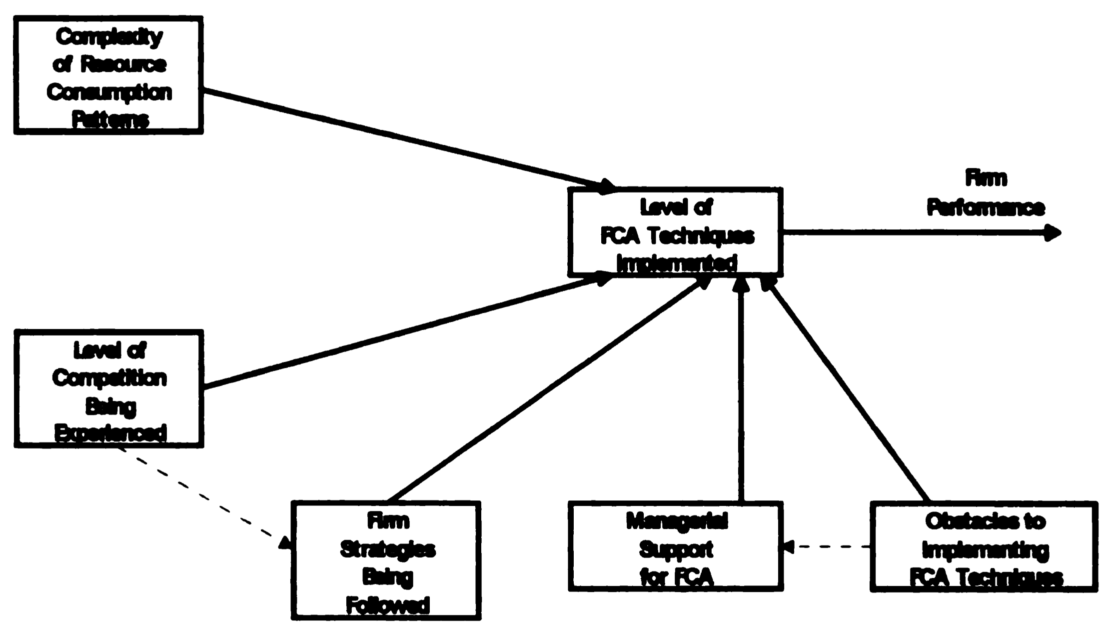
CONCEPTUAL MODEL AND HYPOTHESES

OVERVIEW AND CONCEPTUAL MODEL

This study examined why firm managers choose to implement FCA methods; the study measured several firm characteristics that might influence the implementation decision. The initial model, as shown by the solid arrows in Figure 1, assumed that five factors (complexity, competition, strategy, managerial support, and implementation obstacles) independently influence the implementation choice. Two possible interactions were foreseen as occurring between competition and strategy and between implementation obstacles and managerial support. (Although a few of the measures showed interacting correlations, the use of fewer measures in an orthogonal varimax rotation factor analysis precluded the possible interactions in the main analysis.)

Each of the five hypotheses related an area of firm characteristics to the actual level of FCA method implementation. Firms may avoid the expense of fully implementing FCA methods because collecting and processing data (as well as changing organizational practices) is not costless.

Figure 1. Basic Model of Hypothesized Relationships



Avoidance is more likely to occur where one or more of the following conditions are met: 1) resource consumption is less complex (correlated with the allocation base and not diverse), 2) competition is low, 3) specific strategies (high product differentiation, non-cost-based pricing, and little interest in cost reductions) are followed, 4) little managerial support for FCA methods exists, and 5) major or costly obstacles hinder implementing the FCA methods. The prediction underlying the study was that, once perceived benefits associated with FCA methods outweigh the perceived costs, FCA methods will be implemented. If a champion arises in a complex, competitive plant which follows specified strategies, FCA is more likely to be needed; if sufficient managerial support exists and implementation obstacles can be overcome, FCA methods are more likely to be implemented. Each of the five hypotheses is further examined below.

COMPLEXITY HYPOTHESIS

Before implementing any FCA method, firm managers consider the benefits arising from such an implementation. In some situations, no benefits are apparent; in others, strong benefits occur. Horngren, Foster, and Datar (1994), in their presentation on plantwide rates versus departmental rates, discuss favorable conditions for FCA methods. Finer allocation rates are useful where resource consumption patterns (by products or by organizations) are diverse and uncorrelated with the allocation base—that is, where complexity occurs. Complexity may be indicated in producing a variety of substantially different products, using many routings (either to make a single product or to make numerous simple products), requiring long and expensive setups, requiring many types of labor (with different hourly rates), frequently incorporating production technology changes, etc. In this study, ten measures were used to record attributes of complexity for analysis.

Where the products and organizations in a plant each exhibit the same resource consumption pattern and that pattern is well correlated with the existing allocation base, the plantwide rate (a gross allocation method) may provide the same accuracy in cost allocations as do departmental rates (an

FCA method). In the latter situation, the plant has little incentive, in terms of cost accuracy, to implement departmental rates (although departmental rates or other FCA methods may offer additional valuable insights about the plant's cost drivers).

The first hypothesis relates the complexity of resource consumption by products with the likelihood of implementing FCA methods. Three levels of complexity, represented by four different cost allocation methods, are considered. The lowest level, yielding only a gross allocation, is represented by the pattern shown in Figure 2, where consumption patterns are not diverse and are correlated with a single driver. The allocation method suggested at the least complex level is the single-cost-driver allocation method.

Two consumption patterns describe the intermediate complexity level. The first occurs when a product coming through a department consumes an equal percentage of each departmental resource but the pattern in one department is not the same as the pattern in other departments. (See example in Figure 3's upper panel.) The second occurs when consumption between departments is not different, but the consumption patterns of diverse types of resources differ. (See example in Figure 3's lower panel.) Two allocation methods suggested for the intermediate complexity level are the departmental allocation method and multiple plantwide allocation method.

Figure 2. Least Complex Resource Consumption Pattern

All Resources Used in Same Portions as a Single Cost Driver

Product	Percentage of Resource Being Consumed by Product			
	Resource 1	Resource 2	Resource 3	Resource 4
A	10%	10%	10%	10%
B	40%	40%	40%	40%
C	50%	50%	50%	50%
Total	100%	100%	100%	100%
Driver*	Driver 1	Driver 1	Driver 1	Driver 1

* Any driver could work equally well in this situation.

The highest level of complexity occurs when each product coming through a department consumes different percentages of the resources associated with diverse activities regardless of the departments where they are located. (See Figure 4 for an illustration of this situation.) The allocation method suggested for the highest complexity level is the activity- or process-based allocation method.

A firm may have different plants operating at different levels of complexity, so more than one resource consumption pattern may be pertinent to a firm or even to a single plant. Conceivably, one portion of the organization may experience a more complex pattern, generating a need for FCA data within just that portion. The organization as a whole, however, may exhibit less complex resource consumption patterns and not need more complex FCA methods.

Figure 3. Moderately Complex Resource Consumption Patterns

All Resources in Same Department Used in Same Portions as a Single Cost Driver

Product	Percentage of Resource Being Consumed by Product							
	Department X				Department Y			
	Res. 1	Res. 2	Res. 3	Res. 4	Res. 5	Res. 6	Res. 7	Res.8
A	10%	10%	10%	10%	25%	25%	25%	25%
B	40%	40%	40%	40%	60%	60%	60%	60%
C	50%	50%	50%	50%	15%	15%	15%	15%
Total	100%	100%	100%	100%	100%	100%	100%	100%
Driver*	Driver 1	Driver 1	Driver 1	Driver 1	Driver 2	Driver 2	Driver 2	Driver 2

* Each department uses one driver; may be different between departments.

Groups of Resources Throughout Plant Used in Same Portions as Single Cost Drivers Associated With the Groups

Product	Percentage of Resource Being Consumed by Product							
	Labor-Related Resources				Machining-Related Resources			
	Res. 1	Res. 2	Res. 3	Res. 4	Res. 5	Res. 6	Res. 7	Res. 8
A	10%	10%	10%	10%	25%	25%	25%	25%
B	40%	40%	40%	40%	60%	60%	60%	60%
C	50%	50%	50%	50%	15%	15%	15%	15%
Total	100%	100%	100%	100%	100%	100%	100%	100%
Driver*	Driver 1	Driver 1	Driver 1	Driver 1	Driver 2	Driver 2	Driver 2	Driver 2

* Resource group throughout plant uses single driver; different groups use different drivers.

At complexity levels higher than that appropriate to a single plantwide allocation method, the inaccuracies of cost allocation might cause products to be assigned incorrect costs. Where the threat of improper allocation is high,

Figure 4

Most Complex Resource Consumption Pattern

Each Activity/Process in Each Department Used in Different Portions

Product	Percentage of Resource Being Consumed by Product							
	Department X				Department Y			
	Res. 1	Res. 2	Res. 3	Res. 4	Res. 5	Res. 6	Res. 7	Res. 8
A	30%	70%	25%	40%	10%	20%	40%	25%
B	35%	20%	60%	45%	45%	45%	30%	25%
C	35%	10%	15%	15%	45%	35%	30%	50%
Total	100%	100%	100%	100%	100%	100%	100%	100%
Driver*	Inches Cut	Holes Drilled	Angles Bent	Parts Primed	Wires Cut	Wires Spliced	Units Formed	Units Shipped

* Each activity uses only one driver, which is specific to that activity. The drivers shown are only examples.

firms are more likely to perceive the benefits of FCA methods as outweighing the implementation costs. In view of the preceding discussion, Hypothesis 1 relates complexity to implementation of FCA methods:

H_1: As consumption of resources by various products becomes increasingly complex, plants are more likely to implement FCA methods. That is, greater *complexity* increases FCA method implementation.

COMPETITION HYPOTHESIS

FCA information may be especially useful to managers who need precise cost information in order to be competitive. Knowing total costs may become important to managers as their firms' margins decrease under increasing competition; this need for knowledge may lead to a desire for more accurate costs. The second hypothesis concerns the relationship between competition and the implementation of FCA methods. Three aspects of competition were investigated: 1) product or firm life-cycle stage, 2) market share, and 3) respondents' assessments of competition.

Product and industry life-cycle theory recognizes that many aspects of an industry or product change over time, going through four stages: introduction, growth, maturity, and decline. Typically, competition is low during the introduction stage, increases progressively during the growth and maturity stages, then declines somewhat during the decline stage. In this study, firms and their products were classified into life-cycle stages (two separate measures); the measures were assigned competition values consistent with theory and were regressed individually against implementation of FCA methods.

As competition increases, market share typically decreases. In this study, four market-share-based measures were used to record the market-share aspect of competition and were regressed individually against implementation of FCA methods.

The people within a plant or firm often have assessed the level of competition in their market. In this study, five measures were used to record the respondents' subjective opinions on competition and were regressed individually against implementation of FCA methods.

Hypothesis 2 relates competition to implementation of FCA methods:

H_2: Greater *competition* increases FCA method implementation.

Hypothesis 2 is broken down to match the three approaches to assessing competition:

H_{2a}: When competition is greater in the product or plant life cycle, FCA method implementation increases.

H_{2b}: As market share decreases, FCA method implementation increases.

H_{2c}: As the perception of competition increases, FCA method implementation increases.

STRATEGY HYPOTHESIS

Almost every viable firm coordinates its activities according to a conscious strategy. The third hypothesis concerns how the firm's and plant's strategies influence the implementation of FCA methods. The strategic aspects considered include 1) whether a firm focuses on being a product differentiator or a low-cost leader, 2) how important cost is in the firm's setting of prices, 3) and the intensity of cost reduction efforts.

As explained by Porter (1980), a firm strategy of being a product differentiator leads to little emphasis on costs, other than to make sure price is higher than the total cost and to enhance profits -- survival is not an issue. If, however, the firm strategy is to attain low-cost leadership, great importance is placed on having accurate costs -- inaccurate costs could result in firm failure. While both product differentiators and low-cost leaders could decide to implement FCA methods, the low-cost leader is more likely to implement such methods. In this study, six measures were used to record aspects of differentiation and low-cost leadership (thus allowing for a plant to be pursuing both differentiation and low-cost leadership); the measures were used in further analysis of the relationship to implementation of FCA methods.

Pricing methods also influence demand for FCA. Bromwich (1990) points out that prices can be set either at what the market can bear or at a level covering full long-term product cost (thus erecting a barrier to entry for competitors). Pricing at what the market can bear is more typical of less competition, whereas cost-based pricing (or even market-set pricing) is typical of more competition and is more likely to result in implementation of FCA methods. In this study, the degree to which prices were based on costs were recorded in a measure which was individually regressed against implementation of FCA methods.

According to Porter (1980), cost reduction efforts are more intense among firms experiencing greater competition. In this study, the intensity of cost reduction efforts and the degree which target pricing is being used (which often forces cost reductions) were recorded and individually regressed against implementation of FCA methods.

In view of the preceding discussion, Hypothesis 3 relates firm strategies to expected use of FCA methods:

H_3: As firms 1) move away from product differentiation, 2) use costs as the basis for product pricing, and 3) increasingly pursue cost reductions, those firms are more likely to implement FCA methods. That is, certain types of firm *strategy* increase FCA method implementation.

Because Hypothesis 3 actually represents multiple strategies, it is further separated into three subhypotheses:

H_{3a}: Low differentiation in product and process increases FCA method implementation.

H_{3b}: Basing prices on costs increases FCA method implementation.

H_{3c}: Intense cost reduction efforts increases FCA method implementation.

MANAGERIAL SUPPORT HYPOTHESIS

The fourth hypothesis concerns the relationship between managerial support for implementing FCA methods and the actual implementation of FCA methods. The study examined whether widespread support for implementing FCA methods increases the likelihood of implementation; to record managerial support, eight measures were used. The measures cover the respondents' perceptions of support at various levels of management and among certain users. The measures also identify the level and effectiveness of the champion. Hypothesis 4, therefore, relates managerial support to the implementation of FCA methods:

H_4: As managerial support for FCA methods increases, FCA implementations become more likely. That is, *managerial support* increases FCA method implementation.

IMPLEMENTATION OBSTACLES HYPOTHESIS

The fifth hypothesis concerns the relationship between the strength of implementation obstacles and the implementation of FCA methods. The higher the incurred implementation costs (financial or nonfinancial), the less likely that FCA methods implementation will be completed. Compared to the first four hypotheses that revolve around increasing benefits, this hypothesis focuses on decreasing overall costs.

If decision makers view the benefits of FCA knowledge obtained from a specified FCA method as outweighing the costs associated with gathering, processing, assimilating, and using the data, the FCA method will be implemented. Otherwise, it will not be implemented. The current study suggests that individuals in firms will make the effort to implement FCA methods only if that effort is viewed as the least costly means of providing desired benefits. To record implementation obstacles, the study used 11 measures. Six measures recorded financial obstacles, whereas the other five measures investigated nonfinancial obstacles.

Hypothesis 5 relates these obstacles to the likelihood of FCA method implementation:

H_5: As implementation obstacles become more numerous and stronger, managers will be less likely to implement FCA methods. That is, *implementation obstacles* decrease FCA methods implementation.

The five hypotheses presented above explain the overall characteristics this study examined in relation to FCA methods implementation. The details of what measures were used and how the research was conducted are related in the next section.

CHAPTER IV

METHODOLOGY

APPROACH

Research was directed along three fronts: ascertaining the level of competition from externally reported data; ascertaining the levels of complexity, competition, strategic measures, managerial support, and implementation obstacles from plant surveys; and determining from survey responses the degree to which finer cost allocation techniques had been implemented.

External information on competition was gathered from the Standard and Poor's Compustat Industry data base, Moody's manuals [Moody's Investors Services (1995)], CorpTech Directory of Technology Companies [Corporate Technology Information Services (1995)], and *Manufacturing USA* [Darnay (1994)]. Compustat data were used to form the pool for firm selection. Whether the firms from Compustat adequately represented the industry as to number and market share was verified using

Manufacturing USA. The data obtained were used to identify and classify industries and firms as to the levels of competition being experienced.

Following firm selection, plants within the firms were surveyed about firm and industry characteristics and practices. Information gathered included data on complexity, competition, strategic measures, managerial support, implementation obstacles, and cost allocation schemes employed. Surveys of the first mailing were addressed to plant managers. Since the 29 surveys received from the first mailing mainly came from controllers, surveys of the second mailing were addressed to controllers or head accountants.

The data gathered were analyzed using descriptive statistics, manual examination of correlations to reduce the number of measures, principal components factor analysis to establish independent factors, Cronbach's Alpha to determine item reliability (which further reduced the number of measures), factor analysis to obtain factor scores, and multivariate regression analysis to test the hypotheses. These analyses tested whether survey and calculated items adequately represented the five independent variables and whether significant relationships existed between the dependent and independent variables.

SAMPLE SELECTION

The current study used a sample drawn from a number of industries for which market structures indicated various levels of competition (degrees of monopoly power, oligopolistic power, or pure competition.) Sample selection began with a search of the Standard and Poor's Compustat Industry data base using a selected range (3000-3999) of primary Standard Industrial Classification (SIC) codes. While firms in one category often contain business from other SIC codes, treating the entire firm by its primary SIC code offers the best approach to using the data that are publicly reported and is a common practice (see *Manufacturing USA* [Darnay (1994)], the *1987 Census of Manufactures* [U.S. Department of Commerce (1992)], and Anthony and Ramesh [1992].) Using the primary SIC code identifies each firm with one and only one SIC code. Working at the 4-digit level provides a balance between underdefining and overdefining industries with comparable firms. The first pass through the data base selected 2,091 firms with 1992 sales data.

Next, firms were eliminated if necessary data were not available for the time period in question. The desired data included the following from the Compustat Industry annual data base: item 117 (Sales (Restated)) for the years 1986-1992 and items 18 (Income Before Extraordinary Items) and 21 (Dividends - Common) for the years 1987-1992, as well as item 12 (Sales

(Net)) for 1992. In addition, the firm's first year of operations (BYEAR) was taken from Moody's manuals [Moody's Investors Services (1995)] or CorpTech Directory of Technology Companies [Corporate Technology Information Services (1995)] to allow a calculation of firm Age. Failure to find a BYEAR resulted in deleting 272 firms, while other data missing from Compustat for one or more years resulted in deleting 609 firms. Thus, the calculations requiring Compustat data and BYEAR were based on 1,209 firms, from which the survey firms and their plants were also drawn.

The study examined industries with various structures, as identified through HHI values calculated from the 1992 values for net sales from *Manufacturing USA* [Darnay (1994)]. Some industries selected for survey had high HHIs, whereas others had low HHIs; in addition, selected industries had to contain three or more firms previously identified on the list from Compustat. Besides the HHI itself, the firm's portion of its industry HHI was calculated to indicate the level of competitive pressure experienced by a firm within its SIC code.

In selecting firms, the attempt was made to insure that the industry was adequately represented as far as the number of firms and their sizes since both aspects affect the HHI calculated. (Note that *Manufacturing USA* indicates some firms as having slightly different primary SIC codes than does Compustat; in these instances, the *Manufacturing USA* codes were used.) Since different plants within a firm could use different allocation methods, surveys were directed at 1,071 specific plants chosen from *Dun's Industrial Guide: The Metalworking Directory™ 1994/95* (Dun & Bradstreet 1994). For firms with numerous plants, no more than eight plants were chosen; when such selections were necessary, the plants were chosen at random. The number of plants to which surveys were sent was limited by the budget available for printing and mailing. Names of individual plant managers and plant addresses were taken from Dun's Industrial Guide. Although Dun's listed only plants with metalworking, plants across most manufacturing SIC codes are represented due to the prominence of at least some metalworking in most plants.

Following firm selection, firms were surveyed about firm and industry characteristics and practices. To encourage response, three incentives were offered: first, the respondent could request the general results of the survey; second, firms submitting multiple surveys were offered the results coming from each plant in the firm, provided that each plant agreed; and third, two $75 certified checks were sent to two respondents selected by a random drawing.

The first-mailing survey was addressed to the plant manager; the cover letter requested that the survey be completed by an appropriate individual, such as the plant manager or the controller. The respondent needed a good understanding of the plant's products, processes, and costs, as well as of its overhead allocation practices. Since 25 of 38 first-mailing responses were from controllers or head accountants, the second mailing one month later was addressed to such individuals, which resulted in 87 additional responses, one of which was from a plant which had answered the first mailing while the second mailing was in transit.

Of the 1,071 plants on the mailing list, 116 had invalid addresses and 22 responded that they had no real manufacturing activities, reducing the potential pool of respondents to 933. Of the 125 completed surveys, 15 were found to contain self-contradictory information about the dependent variable. Since one of these was the duplicate response, it was dropped from the sample. The remaining 14 respondents were contacted and the discrepancies resolved; thus these plants were retained in the sample. The 124 responding plants served as the study's sample, representing a response rate of 13.3 percent. An additional 21 plants responded that it was against their firm's policy to answer surveys; if these plants are removed, the response rate becomes 13.6 percent.

RESEARCH DESIGN AND DATA MEASURES

The cross-sectional research design of this study used several measures to record characteristics hypothesized as influencing FCA method implementation. A few of the measures were calculated from Compustat data, but most were gathered from the firm survey (see the Appendix for a copy of the survey). This section discusses the individual measures, their ranges, and the source from which they were obtained. For five of the measures, explanations of how they were calculated are also given.

After initial survey development, the survey was reviewed by nine former Executive MBA participants, six of whom had constructive comments to improve it. Following that, individuals in two local plants site-tested the survey and provided additional feedback. The suggestions improved both the wording and content of the survey.

Several demographic items of information were gathered for each responding plant; two items proved to be of interest: 4-digit SIC code and years in the company. Since the survey was developed to represent many industries, the 4-digit SIC code was gathered for each responding plant. If Porter (1980) is correct about the competitive forces acting on industries, it was possible that some industries would show a greater tendency to implement FCA methods than other industries. The number of years the respondent had been in the company should have little to do with FCA method implementation, but it was highly correlated with FCA method implementation. Both of these items are discussed further in the results section.

The dependent variable, OVERALL, was an 11-point Likert scale wherein the respondent indicated the plant's level of implementation of more detailed cost allocation methods. A ranking of "1" indicated the overall level of implementation to be that of single plantwide allocation methods; a ranking of "11" indicated the overall level of implementation to be that of very detailed methods. Since a plant could have implemented multiple methods in various portions of the plant or for different purposes, the overall implementation level could fall anywhere from 1 to 11.

Tables 1 through 5 present the measures associated with complexity, competition, strategy, managerial support, and implementation obstacles, respectively. Each table shows the measure name, a description of the measure, the source of the item (survey item number or calculation source), whether the measure is normal (shown as recorded by the respondent) or reversed (making low responses high and high responses low), and the range of values the measure may take. The item numbers indicated refer to the survey (see the Appendix) and show the major item number and, where needed, a letter to indicate which question under that item. Thus, item 4d is the fourth question under item 4.

The meanings of most items shown in the tables are clear since they represent either 7-point Likert scales, Likert reflections (8 minus the value), or simple calculations (described in the tables). Seven calculations (Number of Product Lines, Typical Product Market Share, Largest Product Market Share, Industry Competition Level, Firm Portion of the Industry HHI, Life-Cycle Stage, and Plant Life-Cycle Stage) are more involved and are discussed further.

Table 1 shows the ten measures used to record complexity information; the measures record manufacturing attributes which show consumption patterns to be diverse and uncorrelated with the allocation base. The

Table 1. Measures Designed to Assess Complexity

Measure Name	Description	Source	Normal or Reversed	Final Range
Product	*Average Product Line Diversity* represents the degree to which firm products made within a plant are similar in their manufacture; higher means more diverse.	Item 5a	Normal	1-7
Routings	*Average Routing Diversity* represents the degree to which firm products made within a plant use different routings in their manufacture; higher means more diversity.	Item 5b	Normal	1-7
Ded_Eq	*Dedicated Equipment* represents the degree to which equipment is dedicated to a single product line; higher means greater level of dedication to one product line.	Item 5c	Normal	1-7
Labor	*Uniformity of Direct Labor Costs* represents the extent to which direct labor is costed at the same rate (as opposed to many rates); higher means more rates used.	Item 5d	Normal	1-7
Setups	*Proportion of Setup Time* represents the relative time spent on setups; higher means a greater portion is spent on setups.	Item 5e	Normal	1-7
Job_Shop	*Job Shop* represents the extent to which the plant operates as a job shop (as opposed to a process flow); higher means more like a job shop.	Item 5f	Reversed	1-7
Innovate	*New Product Innovation* represents the rate at which new products are introduced; higher means new products are introduced more quickly over a given period of time.	Item 5g	Normal	1-7
Compress	*Product Life Cycle Compression* represents the extent to which the length of the product life cycle is compressing; higher means more compression.	Item 5h	Reversed	1-7

Table 1. (Cont'd)

Measure Name	Description	Source	Normal or Reversed	Final Range
Change	*Changes in Production Technologies* represents the frequency with which production technologies are changing; higher means changes occur more frequently.	Item 5i	Reversed	1-7
Lines	*Number of Product Lines* represents how many different product lines are being produced in the same plant; the higher the number, the more lines that were produced relative to the other responding plants.	Calculated from Item 6c	Normal	1-10

measure Product is included because the more product lines a plant makes, the more likely it is that not all products will consume resources in the same proportions. The measure Lines quantifies the number of product lines produced in the plant and is included because the more product lines a plant makes, the more likely it is that not all products will consume resources in the same proportions. Similarly, Routings is included because each routing specifies the production resources, sequence of use, and duration of use that are needed to make the product; greater diversity of routings may result in disproportionate use of support resources. The measure Setups is included because lengthy setups increase the overhead cost, which is then spread over the units made using the setups; depending on the size of the run, the consumption of resources may be uncorrelated with the allocation base. The measure Labor indicates whether the number of labor rates is small or large; many rates indicate that products are consuming different resources, which may be occurring in disproportionate amounts between products. Dedicated equipment (measure Ded_Eq) reduces the need for setups and simplifies associating cost with the consuming product, whereas a job shop (measure Job_Shop) uses the same equipment for many products, thus increasing the likelihood of having resource consumption be uncorrelated with the allocation base. The remaining measures (Innovate, Compress, and Change) show the rate of change in the manufacturing environment; change complicates the ability to capture costs and intensifies the effects of such measures as Product, Routings, and Setups. Product, Routings, Setups, and Labor turn out to be of particular in interest in subsequent analysis.

As mentioned previously, Lines is a calculated value and was obtained as follows. The survey responses were ordered based on the number of product lines, were ranked in ascending order, and were divided into ten groups. Those in the first group (fewest product lines) were assigned "1"; those in the next group were assigned "2"; and so on until those in the last group (most product lines) were assigned "10."

Table 2 shows the 11 measures used to record competition information. As discussed in Chapter II, four measures (Typ_Shar, Big_Shar, Ind_Comp, and Firm_HHI) were market-share-based measures, two measures (Plan_Cyc and Life_Cyc) related product and plant life-cycle stages, and the remaining five measures (Per_Comp, Agress, Lower, Foreign, and Domestic) were respondents' perceptions of competitive pressures in their industries. The calculations for the market-share based measures and the life-cycle measures are discussed below.

Typ_Shar and Big_Shar related to the typical and biggest market shares of a plant's products; both measures were calculated following a common method. Each measure was recorded by the respondent as a percentage and entered as a two-decimal-place fraction of 1. Each was multiplied by ten (to yield a number between 0 and 10), then subtracted from 10 to reflect the suggestion that higher market share might be associated with less competition.

Table 2. Measures Designed to Assess Competition

Measure Name	Description	Source	Normal or Reversed	Final Range
Per_Comp	The *Perceived Level of Competition* represents the respondent's perception of the level of competition existing in the industry; higher means more competition.	Item 2a	Normal	1-7
Agress	The *Perceived Level of Competitor Agression* represents the respondent's perception of the level of agressiveness exhibited by competitors in the industry; higher means more competition.	Item 2b	Normal	1-7
Lower	*Lower Prices or Profit Margin* represents the firm's reducing prices or profit margins as competition increases; higher means more competition.	Item 2c	Reversed	1-7
Foreign	*Challenge by Foreign Competitors* represents the firm's facing foreign competitors with differential advantages; higher means more competition.	Item 2d	Reversed	1-7
Domestic	*Challenge by Domestic Competitors* represents the firm's facing domestic competitors with differential advantages; higher means more competition.	Item 2e	Reversed	1-7
Plan_Cyc	*Plant Life-Cycle Stage* represents a linear combination of where the respondent places the plant's products in various life-cycle stages; higher means more competition.	Calculated from Items 3a, 3b, 3c and 3d	Normal	1-7
Typ_Shar	*Typical Product Market Share* is a reflection of the typical domestic market share held by the firm for products made in that plant; higher means more competition.	Item 6g	Reversed	0-10

Table 2. (Cont'd)

Measure Name	Description	Source	Normal or Reversed	Final Range
Big_Shar	*Largest Product Market Share* is a reflection of the largest domestic market share held by the firm for a product made in that plant; higher means more competition.	Item 6h	Reversed	0-10
Ind_Comp	The *Industry Competition Level* is based on a reversal of the industry's HHI; higher means more competition.	Calculated from Mfg USA	Reversed	1-7
Firm_HHI	The *Firm Portion of the Industry HHI* is the firm's portion of its industry HHI reflected so that a greater number indicates greater competition.	Calculated from Mfg USA	Reversed	1-10
Life_Cyc	The *Life-Cycle Stage* represents the level of competitive pressure on the firm as a result of which life-cycle stage it is in; higher means more competition.	Calculated from Compustat	Normal	1-7

Industry Competition Level (Ind_Comp) was based on the market HHI for that 4-digit SIC code, which can range from 10,000 (indicating no competition) to near zero (indicating intense competition in an atomistic industry); Ind_Comp was calculated from the *Manufacturing USA* [Darnay (1994)] data. Ind_Comp was the same for each firm in the 4-digit SIC code and reflects a comparison across industries. The HHIs for the various SIC codes were numerically ranked such that the values representing greatest competitive pressure (the smallest HHIs) were at the top, then the ranking was divided into seven groups, with the firms in the top group (most competitive industries) being assigned "7" and the firms in the bottom group (least competitive industries) being assigned "1." The categories were used to avoid having outliers; some firms had very large HHI values, whereas many other firms had near-zero HHI values.

In calculating Firm Portion of the Industry HHI (Firm_HHI), the firm's market share (expressed as a percentage) was squared, then divided by its industry HHI and multiplied by 10. The product was subtracted from 10 so that larger values represent greater competitive pressure. Values range from "0" to "10." Here again, the artificial categories were used to permit distinctions to be made between plants with low portions of their industry's HHI.

Life-Cycle Stage (measure Life_Cyc) was based on the levels of pressure generally theorized as existing within each life-cycle stage. The approach used here generally followed that of Anthony and Ramesh (1992) which used sales growth (SG), dividends as a percentage of income (DP), and Age to divide firms into five life-cycle stages (LCS)[3]. Four exceptions to the approach taken by Anthony and Ramesh were as follows: First, SG was based on restated sales in case acquisitions, discontinued operations, or accounting changes had occurred during the six years. Second, calculations were performed only once for each firm since the present study's focus was on the pressures currently felt by the firm as it chooses which FCA methods to use. Third, new firms with at least 1992 data available were classed as introductory firms. Fourth, the interpretation placed on the resulting groups was slightly different, with the first two groups treated as introductory/growth stages and the last three as maturity/decline stages, as explained in the next paragraph.

When splitting the firms into the five groups for life-cycle stages, two groups were assigned to the maturity stage since previous research had

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[3] Anthony and Ramesh began by calculating annual values for SG, DP, and AGE, as follows:

$DP_t = (DIV_t/IBED_t) \times 100$,
$SG_t = ((SALES_t - SALES_{t-1})/SALES_{t-1}) \times 100$,
AGE = Current Year - BYEAR.

After repeating this process for each of the last five years, the means of SG (MSG) and DP (MDP) were calculated. Then all firms were ranked on each variable individually, divided into three groups, and each firm was assigned a score as follows:

DP Score:	1 = Low, 2 = Medium, 3 = High,
SG Score:	1 = High, 2 = Medium, 3 = Low,
AGE Score:	1 = Young, 2 = Adult, 3 = Old.

Subsequently, the three scores for each firm were combined in TOTAL, then sorted in ascending order and divided into five life-cycle groups. The firms in each group were then assigned a value (Life_Cyc) for the life-cycle stage in which they fell.

found the majority of firms falling in this stage. Then, since the purpose of identifying life cycles was to associate the competitive pressure theorized for each stage with firms in that stage and their choice of FCA methods, values for Life_Cyc were assigned as follows: "1" for the introductory firms (group 1), "3" for the growth firms (group 2), "7" for the maturity firms (groups 3 and 4), and "5" for the declining firms (group 5). These assignments were in accordance with the pattern of competition over the life cycle, as described by Porter (1980) and other researchers.

Plant Life-Cycle Stage (measure Plan_Cyc) represents the plant's overall product life-cycle stage as perceived by the respondent. It was calculated as a weighted average by using the percentages of products reported for each life-cycle stage by the respondent weighted by values for the life-cycle stages. The final weighted values range from "1" to "7," with products receiving the following weights for the various stages: "1" (introductory stage), "3" (growth stage), "7" (maturity stage), and "5" (decline stage).

Table 3 shows the ten measures used to record plant strategy information. As discussed in Chapter II, six measures (Prod_Inn, Proc_Inn, Differen, Hi_Prof, Commod, and Low_Cost) were used to record respondents' perceptions about the plant's strategies to differentiate itself and/or become a low-cost leader. The plant's ability to differentiate itself from its competitors by having unique products (Differen), by innovating new products

Table 3. Measures Designed to Assess Strategy

Measure Name	Description	Source	Normal or Reversed	Final Range
Prod_Inn	*Product Innovator* represents the respondent's perception of the extent to which the plant is not a product innovator; higher means more competitive strategy.	Item 4a	Normal	1-7
Proc_Inn	*Process Innovator* represents the respondent's perception of the extent to which the plant is not a process innovator; higher means more competitive strategy.	Item 4b	Normal	1-7
Differen	*Product Differentiator* represents the respondent's perception of the extent to which the plant's products are not highly differentiated or unique when compared to those of competitors; higher means a more competitive strategy.	Item 4c	Normal	1-7
Hi_Prof	*High Profit Margin Seller* represents the respondent's perception of the extent to which the plant is not a high profit margin seller; higher means a more competitive strategy.	Item 4d	Normal	1-7
Commod	*Commodity Producer* represents the respondent's perception of the extent to which the plant produces undistinquished, commodity products; higher means a more competitive strategy.	Item 4e	Reversed	1-7
Low_Cost	*Low-Cost Leader* represents the respondent's perception of the extent to which the plant is the low-cost leader in the industry; higher means a more competitive strategy.	Item 4f	Reversed	1-7

Table 3. (Cont'd)

Measure Name	Description	Source	Normal or Reversed	Final Range
Cost_Bas	*Cost-Based Pricer* represents the respondent's perception of the extent to which the plant bases its product prices on costs incurred; higher means a more competitive strategy.	Item 4g	Reversed	1-7
Target	*Target Coster* represents the respondent's perception of the extent to which the plant sets a target cost for its product and then tries to adjust costs to meet the target; higher means a more competitive strategy.	Item 4h	Reversed	1-7
Intense	*Intensity of Cost Reduction Efforts* represents the respondent's perception of the intensity with which the plant pursues cost reductions; higher means a more competitive strategy.	Item 4i	Reversed	1-7
Service	*Focus on Customer Service* represents the respondent's perception of the intensity with which the plant focuses on providing high-quality customer service; higher means a more competitive strategy.	Item 4j	Normal	1-7

(Prod_Inn), or by innovating production processes (Proc_Inn) turned out to be of particular interest in subsequent analysis. One measure (Cost_Bas) records the degree to which the plant prices its products based on cost. Two measures (Target and Intense) show the plant's focus on cost-reduction efforts, either through direct cost-reduction campaigns or through using target pricing to set a price and reduce costs to allow the desired profits. The last measure (Service) was added at the suggestion of a survey reviewer because providing high-quality service is an important strategy for many firms; the Service measure could also help the plant to differentiate itself.

Table 4 shows the eight measures used to record managerial support for FCA method implementation. As discussed in Chapter II, three measures (CEO, Control, and Top) record respondent perceptions of upper management support, three measures (Middle, Account, and Market) record the user support, and two measures (Level and Effect) record the organizational level and perceived effectiveness of the FCA method champion. While all of these measures group together well, Control, Top, and Level are of particular interest in subsequent analysis.

Table 5 shows the 11 measures used to record implementation obstacles which would impede FCA method implementation. As was discussed in Chapter II, five measures (Resist, Sponsor, Sht_Term, Quant_CB, and Commun) record nonfinancial obstacles to implementation, whereas the remaining six measures (C_Plan, C_Consul, C_IS_Chg, C_Train,

Table 4. Measures Designed to Assess Managerial Support

Measure Name	Description	Source	Normal or Reversed	Final Range
CEO	*Degree of CEO Support* represents the respondent's perception of how strongly the CEO supports implementing FCA methods within the firm; higher means more support.	Item 8a	Normal	1-7
Control	*Degree of Controller Support* represents the respondent's perception of how strongly the controller supports implementing FCA methods within the firm; higher means more support.	Item 8b	Normal	1-7
Top	*Degree of Top Management Support* represents the respondent's perception of how strongly the other top managers support implementing FCA methods within the firm; higher means more support.	Item 8c	Normal	1-7
Middle	*Degree of Middle Management Support* represents the respondent's perception of how strongly the middle managers support implementing FCA methods within the firm; higher means more support.	Item 8d	Normal	1-7
Account	*Degree of Accounting Support* represents the respondent's perception of how strongly the accounting function supports implementing FCA methods within the firm; higher means more support.	Item 8e	Normal	1-7

Table 4. (Cont'd)

Measure Name	Description	Source	Normal or Reversed	Final Range
Market	*Degree of Marketing Support* represents the respondent's perception of how strongly the marketing function supports implementing FCA methods within the firm; higher means more support.	Item 8f	Normal	1-7
Level	*Level of Champion* represents the respondent's perception of the level of authority held by the champion for finer cost allocations; higher means more support.	Item 9	Normal	1-7
Effect	*Level of Champion's Effectiveness* represents the respondent's perception of how effective the champion has been in obtaining the support of top management and users for finer cost allocations; higher means more support.	Item 10	Normal	1-7

Table 5. Measures Designed to Assess Implementation Obstacles

Measure Name	Description	Source	Normal or Reversed	Final Range
Resist	*Managerial Resistance* represents the respondent's perception of how strongly management resists changing to FCA methods; higher means a stronger obstacle.	Item 12a	Normal	1-7
Sponsor	*Lack of Sponsor* represents the respondent's perception of the extent to which FCA methods have no sponsor in the plant; higher means a stronger obstacle.	Item 12b	Normal	1-7
Sht_Term	*Focus on Short-Term Financial Measures* represents the respondent's perception of the extent to which a focus on short-term financial measures hinders FCA method implementation; higher means a stronger obstacle.	Item 12c	Normal	1-7
Quant_CB	*Quantifying Costs and Benefits* represents the respondent's perception of the extent to which the effort of quantifying costs and benefits of changing to an FCA method hinders implementation; higher means a stronger obstacle.	Item 12d	Normal	1-7
Commun	*Communicating Results of Planning* represents the respondent's perception of the extent to which the effort of communicating throughout the organization the results of planning hinders FCA method implementation; higher means a stronger obstacle.	Item 12e	Normal	1-7
C_Plan	*Cost of Planning* represents the respondent's perception of the extent to which the costs associated with adequate planning for FCA method implementation hinders that implementation; higher means a stronger obstacle.	Item 12f	Normal	1-7

Table 5. (Cont'd)

Measure Name	Description	Source	Normal or Reversed	Final Range
C_Consul	*Cost of Consultants* represents the respondent's perception of the extent to which the costs associated with bringing in consultants about FCA method implementation hinders that implementation; higher means a stronger obstacle.	Item 12g	Normal	1-7
C_IS_Chg	*Cost of Information Systems Change* represents the respondent's perception of the extent to which the costs associated with changing the information system during the implementation of an FCA method hinders that implementation; higher means a stronger obstacle.	Item 12h	Normal	1-7
C_Train	*Cost of Training* represents the respondent's perception of the extent to which the costs associated with training all users hinders FCA method implementation; higher means a stronger obstacle.	Item 12i	Normal	1-7
C_Dual	*Cost of Dual System* represents the respondent's perception of the extent to which the costs associated with running dual cost systems over a period of time hinders FCA method implementation; higher means a stronger obstacle.	Item 12j	Normal	1-7
C_Data	*Cost of Data* represents the respondent's perception of the extent to which the costs associated with gathering and processing more detailed data hinders FCA method implementation; higher means a stronger obstacle.	Item 12k	Normal	1-7

C_Dual, and C_Data) recorded financial obstacles. While all of these measures grouped together well, Sponsor, Quant_CB, C_Plan, C_IS_Chg, and C_Data were of particular interest in subsequent analysis.

CHAPTER V

STATISTICAL TESTS AND THEIR RESULTS

DESCRIPTIVE ANALYSIS

In the descriptive analysis, two interesting demographic variables are discussed, then univariate descriptive statistics (number of observations, minimum, maximum, range, median, mean, variance, standard deviation, standard error, skewness, and kurtosis) are presented for each of the 50 measures, as well as for the dependent variable's measure, OVERALL. These statistics provided information which influenced the choice of factor analysis rotation to be used in subsequent analysis.

Demographic Data

While the demographic data were not used for testing the hypotheses, they were used to look for biases in survey responses. A number of demographic characteristics were collected, including information on the respondent's position, area of expertise, background, educational level, years in the company, and years in the industry, as well as the mailing answered, the degree of choice the plant has in choosing its allocation method, and the firm's 4-digit SIC code. Each characteristic was analyzed by performing a MANOVA, using OVERALL as the dependent and the characteristic as the class variable. Only two characteristics — the respondent's years with the company and the firm's 4-Digit SIC code — showed any significant relationship with the dependent variable.

As shown in Table 6, a significant relationship (at the 99% level) exists between the respondent's years with the company and the level of FCA method implementation. The longer the respondent had been with the company, the higher the level of implementation reported. While the relationship is interesting, it scarcely seems to offer a cause-and-effect relationship. The number of years a respondent has been with the company is not likely to affect the FCA method implemented. The fact the relationship exists does not offer any reason why the survey should be biased.

The firm's 4-digit SIC code also showed a significant relationship (at the 95% level) with OVERALL. In all, 34 4-digit SIC codes were represented in the survey; Table 7 shows the industry breakdown of responding plants by 2-digit SIC codes, the MANOVA results on the 4-digit SIC codes, and a few of the 4-digit SIC code industries with the highest or lowest means for OVERALL. Given 1) that firms were selected to represent industries with different market structures and levels of competition and 2) that different industries vary in their dynamics, industry bias is not an unexpected finding.

Table 6. Respondents' Years in Company and Its Relation to OVERALL

Years Experience in Company	Number of Respondents	Group Mean for OVERALL
1-3	22	4.1
4-6	18	6.8
7-9	13	4.5
10-12	24	5.8
13-15	11	6.7
16-20	16	6.3
21-30	14	6.5
over 30	4	8.0
Unreported	2	--
Total	124	5.8
Average Years	11.6	

MANOVA Results:

Multiple R^2: 0.154

F-Ratio: 2.975

Two-Tailed Probability: 0.007

In fact, industry bias supports the rationale behind the study and should not adversely affect the study.

Univariate Descriptive Analysis

In order to survey responses, univariate descriptive analysis was performed on each of the measures; the results are shown in Table 8.

Table 7. Industries Represented in Survey and Their Relation to OVERALL

Breakdown of Responding Plants by 2-Digit SIC Code Industry:

2-Digit SIC Code Group	Industry Description	Number of Respondents
33	Primary Metals	19
34	Metal Fabrication	11
35	Machinery (Except Electrical)	29
36	Electrical & Electronic Machinery	19
37	Transportation Equipment	14
38	Measuring Instruments (Including Medical)	21
39	Miscellaneous Manufacturing	1
	Total Plants Responding	124

MANOVA Results for 4-Digit SIC Codes:

Multiple R^2:	0.368
F-Ratio:	1.589
Two-Tailed Probability:	0.045

4-Digit SIC Code Industries With Highest Or Lowest Means for OVERALL:

4-Digit SIC Code Group	Industry Description	Number of Respondents	Group Mean for OVERALL
3523	Farm Machinery	3	10.3
3546	Power Driven Tools	1	9.0
3651	Household Audio/Video Eq.	1	9.0
3711	Motor Vehicles & Car Bodies	3	7.5
3452	Bolts, Nuts, Rivets, Washers	3	7.3
3411	Metal Cans	4	3.5
3561	Pumps & Pumping Equip.	7	3.3
3634	Electric Housewares & Fans	1	2.0
3716	Motor Homes	2	1.5
3572	Computer Storage Devices	1	1.0
3751	Motorcycles, Bicycles, Parts	1	1.0
	Total Plants Responding	124	5.8

Table 8 shows how many responses (N) there were for each measure. For example, for the measure Effect (effectiveness of the champion), only 94 of the possible 124 respondents provided the information, so approximately 25% of the responses are missing. Missing responses indicate (among other possibilities) either that respondents do not like disclosing this information, that they do not know the information, or that they do not understand the question.

Table 8 also reveals the minimum and maximum values of the measure (MIN and MAX), the ranges of responses, and the medians and means of the measures. The table further reveals important information about the variation experienced in the measures and shows this variation in the columns for variance (VAR), standard deviation (S.D.), standard error (S.E.), skewness, and kurtosis.

The measurement for skewness (SKEW) is adjacent to the z-value (Z) for skewness, and the measurement for kurtosis (KURT) is adjacent to the z-value (Z) for kurtosis. In both instances, the z-value indicates whether or not the measurement is significantly different from normal. Only seven of the 50 measures are reasonably normal; the others exhibit too much skewness and/or kurtosis to be considered normal. As explained in Johnson and Wichern (1992), the lack of normality affects the usefulness of correlation analysis; the magnitudes of Pearson correlation coefficients are still valid, but the significance of the correlations become suspect. The lack of normality, therefore, has major implications as far as choosing a method

Table 8. Descriptive Statistics on 50 Measures and OVERALL

	Basic Descriptors						Variation			Skewness		Kurtosis	
MEASURE	N	MIN	MAX	RANGE	MEDIAN	MEAN	VAR	S.D.	S.E.	SKEW	Z	KURT	Z
Complexity Measures													
Product	123	1.0	7.0	6.0	5.0	4.220	3.468	1.862	0.168	-0.162	-0.733	-1.319	**-2.986**
Routings	124	1.0	7.0	6.0	4.0	3.992	3.845	1.961	0.176	0.063	0.286	-1.393	**-3.166**
Ded_Eq	124	1.0	7.0	6.0	5.0	4.444	3.826	1.956	0.176	-0.275	-1.250	-1.301	**-2.957**
Labor	123	1.0	7.0	6.0	6.0	4.707	5.323	2.307	0.208	-0.577	**-2.612**	-1.292	**-2.925**
Setups	124	1.0	7.0	6.0	4.0	4.056	3.371	1.836	0.165	-0.052	-0.236	-1.263	**-2.871**
Job_Shop	124	1.0	7.0	6.0	2.0	3.274	5.615	2.370	0.213	0.447	**2.032**	-1.420	**-3.228**
Innovate	124	1.0	7.0	6.0	4.0	3.903	3.226	1.796	0.161	0.078	0.355	-1.251	**-2.844**
Compress	124	1.0	7.0	6.0	4.0	4.032	3.284	1.812	0.163	0.075	0.341	-1.177	**-2.675**
Change	124	1.0	7.0	6.0	4.0	3.903	2.625	1.620	0.145	0.076	0.346	-0.947	**-2.153**
Lines	116	1.0	10.0	9.0	6.0	5.853	7.970	2.823	0.262	-0.071	-0.312	-1.199	**-2.636**

Note: Bold z-values under Skewness or Kurtosis signify a level that precludes normality. Due to the robust nature of principal components factor analysis, lack of normality does not invalidate the analysis (Johnson and Wichern 1992).

Table 8. (Cont'd)

	Basic Descriptors						Variation			Skewness		Kurtosis	
MEASURE	N	MIN	MAX	RANGE	MEDIAN	MEAN	VAR	S.D.	S.E.	SKEW	Z	KURT	Z
Competition Measures													
Per_Comp	124	2.0	7.0	5.0	6.0	6.016	1.203	1.097	0.098	-1.665	**-7.569**	3.100	**7.046**
Agress	124	2.0	7.0	5.0	6.0	6.105	1.217	1.103	0.099	-1.814	**-8.247**	3.657	**8.312**
Lower	124	1.0	7.0	6.0	5.0	4.766	2.717	1.648	0.148	-0.530	**-2.409**	-0.715	-1.625
Foreign	124	1.0	7.0	6.0	4.0	4.153	3.562	1.887	0.169	-0.244	-1.109	-1.195	**-2.716**
Domestic	124	1.0	7.0	6.0	5.0	5.008	2.350	1.533	0.138	-0.789	**-3.587**	-0.078	-0.177
Plan_Cyc	103	1.4	7.0	5.6	4.9	4.924	1.697	1.303	0.128	-0.166	-0.688	-0.651	-1.349
Typ_Shar	113	0.0	9.9	9.9	7.1	6.833	5.391	2.322	0.218	-0.771	**-3.346**	0.080	0.174
Big_Shar	108	0.0	9.9	9.9	5.0	4.679	9.625	3.102	0.299	-0.053	-0.225	-1.248	**-2.647**
Ind_Comp	123	1.0	7.0	6.0	4.0	4.276	3.923	1.981	0.179	-0.171	-0.774	-1.214	**-2.748**
Firm_HHI	123	0.2	10.0	9.8	9.8	8.207	8.758	2.959	0.267	-1.636	**-7.407**	1.224	**2.771**
Life_Cyc	101	1.0	7.0	6.0	5.0	5.436	3.328	1.824	0.182	-1.157	**-4.747**	0.621	1.274

Note: Bold z-values under Skewness or Kurtosis signify a level that precludes normality. Due to the robust nature of principal components factor analysis, lack of normality does not invalidate the analysis [Johnson and Wichern (1992)].

Table 8. (Cont'd)

	Basic Descriptors						Variation			Skewness		Kurtosis	
MEASURE	N	MIN	MAX	RANGE	MEDIAN	MEAN	VAR	S.D.	S.E.	SKEW	Z	KURT	Z
Strategy Measures													
Prod_Inn	124	1.0	7.0	6.0	3.0	3.500	2.837	1.684	0.151	0.251	1.141	-1.034	**-2.350**
Proc_Inn	124	1.0	7.0	6.0	3.0	3.395	2.273	1.508	0.135	0.452	**2.055**	-0.682	-1.550
Differen	124	1.0	7.0	6.0	3.0	3.331	2.743	1.656	0.149	0.499	**2.268**	-0.699	-1.589
Hi_Prof	123	1.0	7.0	6.0	4.0	3.943	2.808	1.676	0.151	-0.099	-0.448	-0.875	**-1.981**
Commod	123	1.0	7.0	6.0	3.0	3.089	3.557	1.886	0.171	0.621	**2.812**	-0.768	-1.739
Low_Cost	124	1.0	7.0	6.0	3.0	3.371	2.609	1.615	0.145	0.210	0.955	-1.101	**-2.503**
Cost_Bas	124	1.0	7.0	6.0	4.0	3.871	3.138	1.771	0.159	0.038	0.173	-1.240	**-2.819**
Target	123	1.0	7.0	6.0	5.0	4.341	2.505	1.583	0.143	-0.429	-1.942	-0.904	**-2.047**
Intense	123	1.0	7.0	6.0	6.0	5.520	2.104	1.451	0.131	-1.130	**-5.116**	0.810	1.834
Service	123	1.0	6.0	5.0	2.0	2.171	1.602	1.266	0.114	1.114	**5.044**	0.676	1.530

Note: Bold z-values under Skewness or Kurtosis signify a level that precludes normality. Due to the robust nature of principal components factor analysis, lack of normality does not invalidate the analysis [Johnson and Wichern (1992)].

Table 8. (Cont'd)

MEASURE	Basic Descriptors						Variation			Skewness		Kurtosis	
	N	MIN	MAX	RANGE	MEDIAN	MEAN	VAR	S.D.	S.E.	SKEW	Z	KURT	Z
Managerial Support Measures													
CEO	100	1.0	7.0	6.0	5.0	4.950	2.311	1.520	0.152	-0.401	-1.637	-0.329	-0.672
Control	122	1.0	7.0	6.0	6.0	5.516	2.384	1.544	0.140	-1.255	**-5.659**	0.965	**2.176**
Top	117	1.0	7.0	6.0	5.0	4.932	1.909	1.382	0.128	-0.428	-1.890	-0.051	-0.113
Middle	115	1.0	7.0	6.0	5.0	4.739	1.440	1.200	0.112	-0.436	-1.909	0.700	1.532
Account	121	1.0	7.0	6.0	6.0	5.223	2.325	1.525	0.139	-1.004	**-4.509**	0.739	1.659
Market	109	1.0	7.0	6.0	4.0	4.450	1.361	1.167	0.112	0.052	0.222	0.968	**2.063**
Level	121	1.0	7.0	6.0	6.0	4.711	4.074	2.018	0.183	-0.987	**-4.432**	-0.579	-1.300
Effect	94	1.0	7.0	6.0	5.0	5.032	2.569	1.603	0.165	-0.808	**-3.198**	-0.252	-0.499

Note: Bold z-values under Skewness or Kurtosis signify a level that precludes normality. Due to the robust nature of principal components factor analysis, lack of normality does not invalidate the analysis [Johnson and Wichern (1992)].

Table 8. (Cont'd)

	Basic Descriptors						Variation			Skewness		Kurtosis	
MEASURE	N	MIN	MAX	RANGE	MEDIAN	MEAN	VAR	S.D.	S.E.	SKEW	Z	KURT	Z
Implementation Obstacles Measures													
Resist	120	1.0	7.0	6.0	3.0	3.308	2.971	1.724	0.157	0.416	1.860	-0.782	-1.749
Sponsor	120	1.0	7.0	6.0	3.0	3.283	3.482	1.866	0.170	0.370	1.655	-1.149	**-2.569**
Sht_Term	117	1.0	7.0	6.0	4.0	3.803	3.280	1.811	0.167	-0.046	-0.203	-1.083	**-2.391**
Quant_CB	120	1.0	7.0	6.0	4.0	3.942	3.013	1.736	0.158	-0.026	-0.116	-0.928	**-2.075**
Commun	119	1.0	7.0	6.0	4.0	3.639	2.521	1.588	0.146	0.160	0.713	-0.538	-1.198
C_Plan	120	1.0	7.0	6.0	3.0	3.417	2.380	1.543	0.141	0.274	1.225	-0.452	-1.011
C_Consul	119	1.0	7.0	6.0	4.0	4.109	4.285	2.070	0.190	-0.095	-0.423	-1.269	**-2.826**
C_IS_Chg	120	1.0	7.0	6.0	5.0	4.767	3.306	1.818	0.166	-0.476	**-2.129**	-0.821	-1.836
C_Train	120	1.0	7.0	6.0	4.0	3.833	3.249	1.803	0.165	0.130	0.581	-0.899	**-2.010**
C_Dual	120	1.0	7.0	6.0	4.0	4.192	3.467	1.862	0.170	-0.109	-0.487	-1.067	**-2.386**
C_Data	120	1.0	7.0	6.0	5.0	4.683	2.991	1.730	0.158	-0.463	**-2.071**	-0.628	-1.404
OVERALL	124	1.0	11.0	10.0	6.0	5.798	7.532	2.744	0.246	-0.254	-1.155	-0.648	-1.473

Note: Bold z-values under Skewness or Kurtosis signify a level that precludes normality. Due to the robust nature of principal components factor analysis, lack of normality does not invalidate the analysis [Johnson and Wichern (1992)].

of factor analysis. Maximum likelihood factor analysis assumes normality of the measures and will not work with nonnormal data. Fortunately, the desired method, principal component factor analysis, is robust enough to work with nonnormal data [Johnson and Wichern (1992)].

Clearly, the measures Per_Comp and Agress are the worst skewed and have the greatest kurtosis. Further examination reveals that nearly all respondents scored both these measures with very high values (the maximum value possible was a "7"). Of the 124 responses for Per_Comp, only eight were less than "5," and 99 were "6" or "7." Similarly, of the 124 responses for Agress, only 15 were less than "5," and 104 were "6" or "7." With so little variation and such extreme skewness and kurtosis, Per_Comp and Agress become uninformative and may contribute to an inadequate measure of competition for the analysis.

Descriptive statistics also were used to examine whether plants with less-fine cost allocation methods exhibit different characteristics than do plants which have implemented FCA methods. The plants were ranked in descending order on OVERALL and divided into rough thirds. The means of the upper and lower thirds were tested to see whether the means were different, as follows. The pooled estimates for the standard deviation for both populations were calculated and adjusted for their pooled sizes. The result was divided into the difference of their means, producing the t-value. Since the comparison being tested was directional (whether the FCA group was higher than the less-fine allocation methods group), a one-tailed test was appropriate. Using 120 d.f., t-values greater than 2.358, 1.658, and 1.289 indicated significance at 99%, 95%, and 90% confidence levels, respectively. As shown in Table 9, four measures (Routings, Labor, Change, and Proc_Inn) were significantly different at the 99% confidence level. Eight measures (Product, Lower, Foreign, Cost_Bas, Top, Quant_CB, Commun, and C_Plan) were significantly different at the 95% confidence level. Another ten measures (Setups, Job_Shop, Compress, Lines, Plan_Cyc, Firm_HHI, Middle, Effect, C_IS_Chg, and C_Train) were significantly different at the 90% confidence level.

CONSTRUCT DEVELOPMENT

The approach proposed for testing the hypotheses was to use factor analysis to form constructs, to test the constructs for item reliability via Cronbach's Coefficient Alpha, then to perform regression analysis using the final constructs. This approach needed to be modified somewhat because of the small sample size obtained.

In order for factor analysis to work correctly, a "large" sample and "high" observations-to-measures ratio are needed. Gorsuch (1974) maintains 1) that at least 100 observations are needed and 2) that a ratio of at least five observations per variable included in the factor analysis is required. Other authors, such as Nunnally (1978) and Lawrence and Yeh (1996), prefer to have 10 observations per variable included in the factor analysis. All agree

Table 9. t-Tests for Mean Differences Between Plants With Implemented FCA Methods and Plants Using Less-Fine Allocation Methods

Measure	Calculating Significance of Difference in Means			
	Difference of Means	SD of Difference	1-Tailed t-value	Confidence Level
Product	0.913	0.493	1.853	95%
Routings	1.216	0.497	2.445	99%
Ded_Eq	0.047	0.549	0.086	–
Labor	2.175	0.589	3.695	99%
Setups	0.768	0.482	1.593	90%
Job_Shop	-0.841	0.584	-1.440	90%
Innovate	0.259	0.464	0.559	–
Compress	0.640	0.487	1.314	90%
Change	1.401	0.365	3.841	99%
Lines	1.009	0.754	1.338	90%
Per_Comp	-0.283	0.278	-1.018	–
Agress	0.108	0.278	0.388	–
Lower	0.758	0.437	1.733	95%
Foreign	0.889	0.523	1.698	95%
Domestic	0.017	0.427	0.040	–
Plan_Cyc	-0.521	0.371	-1.403	90%
Typ_Shar	-0.095	0.596	-0.159	–
Big_Shar	0.737	0.831	0.887	–
Ind_Comp	-0.118	0.501	-0.235	–
Firm_HHI	-1.095	0.755	-1.449	90%
Life_Cyc	0.085	0.620	0.137	–
Prod_Inn	-0.526	0.436	-1.207	–
Proc_Inn	-0.960	0.405	-2.368	99%
Differen	-0.474	0.439	-1.081	–
Hi_Prof	-0.474	0.465	-1.018	–
Commod	-0.026	0.538	-0.048	–
Low_Cost	0.071	0.421	0.169	–
Cost_Bas	-0.737	0.438	-1.684	95%
Target	0.054	0.398	0.136	–
Intense	-0.071	0.375	-0.190	–
Service	0.010	0.338	0.030	–

Table 8. (Cont'd)

Measure	Calculating Significance of Difference in Means			
	Difference of Means	SD of Difference	1-Tailed t-value	Confidence Level
CEO	0.371	0.467	0.794	--
Control	0.522	0.412	1.266	--
Top	0.706	0.353	2.003	95%
Middle	0.452	0.326	1.386	90%
Account	0.411	0.409	1.005	--
Market	0.112	0.341	0.328	--
Level	0.319	0.474	0.674	--
Effect	0.800	0.510	1.569	90%
Resist	0.125	0.437	0.286	--
Sponsor	-0.472	0.460	-1.026	--
Sht_Term	0.381	0.495	0.769	--
Quant_CB	-0.980	0.428	-2.292	95%
Commun	-0.647	0.385	-1.679	95%
C_Plan	-0.650	0.369	-1.764	95%
C_Consul	-0.534	0.553	-0.965	--
C_IS_Chg	-0.647	0.487	-1.329	90%
C_Train	-0.625	0.437	-1.430	90%
C_Dual	-0.509	0.471	-1.081	--
C_Data	-0.491	0.431	-1.139	--
OVERALL	7.437	0.244	30.419	99.9%

that the 5:1 ratio is a minimum. Meeting the minimum ratio necessitated reducing the number of measures to less than 25 prior to performing the factor analysis.

Manual Reduction of Measures

Churchill (1979) discusses reducing a larger number of measures to a smaller number by examining 1) the correlations between measures or 2) the correlations between measures and some aggregate measure (such as the sum of the individual measures) proposed for a group of measures. When using either approach, Churchill advocated retaining measures which correlated strongly. Manual examination of 1) the correlations between the measures, 2) the correlation between management support measures and the sum of the management support measures, and 3) the correlation between implementation obstacles and the sum of the implementation obstacles measures resulted in dropping 27 measures. Table 10 shows the correlations which were used in the reduction process.

First, 18 measures were dropped which did not correlate with at least one other measure at a magnitude of 0.35. The measures dropped in this manner are shown in the upper part of Table 11. Note that Labor is dropped because it did not correlate with any other measure, but it is brought back at the regression analysis stage because it had the highest correlation with OVERALL (0.340) of any of the 50 measures.

Table 10. Pearson Correlation Matrix for All Measures

	Product	Routings	Ded_Equip	Labor	Setups	Job_Shop	Innovate	Compress	Change	Lines
Product	1.000									
Routings	0.718	1.000								
Ded_Equip	0.199	0.260	1.000							
Labor	0.149	0.141	-0.086	1.000						
Setups	0.355	0.258	0.102	0.167	1.000					
Job_Shop	0.089	0.105	0.166	0.024	0.165	1.000				
Innovate	0.172	0.189	0.174	0.006	-0.099	-0.267	1.000			
Compress	0.034	0.076	0.003	-0.146	0.051	-0.169	0.428	1.000		
Change	0.147	0.230	0.088	0.105	0.048	-0.110	0.416	0.450	1.000	
Lines	0.320	0.256	0.341	0.272	0.181	0.157	0.163	-0.134	0.063	1.000
Per_Comp	0.115	0.042	0.080	0.070	0.052	0.008	0.228	0.069	0.248	0.148
Agress	0.033	-0.037	-0.022	-0.039	0.045	-0.185	0.255	0.303	0.188	-0.138
Lower	0.010	0.015	0.053	-0.123	0.031	0.069	0.025	0.228	0.256	-0.083
Foreign	0.106	0.106	0.191	0.190	0.145	0.045	0.000	0.018	0.042	0.223
Domestic	0.206	0.141	0.129	-0.047	-0.064	-0.036	0.110	-0.006	0.112	0.067
Plant_LC	-0.117	-0.139	-0.022	-0.055	0.045	-0.020	-0.216	-0.129	-0.127	-0.062
Typ_Shar	0.002	-0.017	0.308	-0.111	0.000	0.017	0.108	0.058	-0.066	0.015
Big_Shar	-0.155	-0.095	0.072	-0.107	-0.077	-0.096	0.097	0.015	-0.058	-0.152
Ind_Comp	0.054	0.027	0.085	0.066	0.125	-0.014	0.073	-0.066	0.071	0.169
Firm_HHI	-0.166	-0.140	0.038	-0.047	-0.024	0.013	0.059	-0.034	0.015	0.138
Life_Cycle	0.148	0.164	0.030	0.107	0.098	0.095	-0.212	-0.007	-0.081	-0.066

Table 10. (Cont'd)

	Product	Routings	Ded_Equip	Labor	Setups	Job_Shop	Innovate	Compress	Change	Lines
Prod_Inn	-0.092	-0.038	-0.038	0.088	0.049	0.055	-0.564	-0.304	-0.244	-0.042
Proc_Inn	-0.103	-0.071	-0.026	-0.007	0.071	0.203	-0.414	-0.196	-0.343	-0.058
Differen	-0.276	-0.197	-0.003	-0.081	0.021	0.018	-0.282	-0.180	-0.255	-0.193
Hi_Prof	-0.130	-0.095	-0.047	-0.042	0.217	0.097	-0.271	-0.096	-0.002	-0.099
Commod	-0.236	-0.204	0.054	-0.102	-0.089	-0.169	-0.104	-0.094	-0.029	-0.117
Low_Cost	-0.149	0.004	0.079	-0.100	-0.013	-0.040	-0.024	-0.079	0.048	0.034
Cost_Bas	-0.042	-0.028	0.120	0.042	0.052	0.175	-0.142	-0.293	-0.044	0.092
Target	-0.014	-0.166	0.079	0.165	-0.019	0.158	0.032	-0.011	-0.167	0.169
Intense	0.101	0.019	0.039	0.046	0.189	-0.093	-0.055	-0.109	-0.075	0.026
Service	0.015	0.049	0.034	-0.128	-0.095	0.016	-0.103	0.103	0.059	0.046
CEO	-0.016	0.031	-0.047	0.015	0.131	-0.031	-0.003	0.093	-0.114	0.041
Control	0.171	0.120	-0.008	0.061	0.047	-0.201	0.069	0.003	-0.018	0.071
Top	0.054	0.058	-0.075	0.070	-0.011	-0.299	0.193	0.110	0.030	0.094
Middle	-0.041	0.021	-0.109	-0.015	-0.034	-0.118	0.094	0.056	0.038	-0.032
Account	0.098	0.017	-0.079	-0.045	-0.070	-0.210	0.033	0.028	-0.044	0.031
Market	0.026	0.080	-0.073	-0.070	-0.004	0.040	0.053	-0.013	0.003	0.220
Level	0.163	0.068	0.054	-0.176	0.098	-0.070	0.019	0.100	0.051	0.015
Effect	0.072	0.037	-0.044	-0.041	0.163	-0.082	-0.025	0.084	0.046	-0.103

Table 10. (Cont'd)

	Product	Routings	Ded_Equip	Labor	Setups	Job_Shop	Innovate	Compress	Change	Lines
Resist	0.090	0.088	0.100	-0.069	0.120	0.021	-0.042	0.182	0.153	0.062
Sponsor	-0.122	-0.066	0.086	0.056	-0.043	0.055	-0.006	0.107	0.113	0.050
Sht_Term	0.146	0.127	0.175	0.063	0.132	0.096	-0.132	0.137	0.059	-0.017
Quant_CB	0.051	0.105	0.088	-0.054	0.139	0.104	-0.070	0.175	-0.002	-0.105
Commun	-0.095	-0.117	0.017	-0.056	0.067	0.214	-0.165	0.269	0.066	-0.139
C_Plan	-0.085	-0.033	0.102	0.040	-0.029	0.065	-0.038	0.220	0.120	-0.115
C_Consul	-0.050	-0.003	0.029	0.183	-0.120	-0.012	-0.117	0.007	-0.067	0.032
C_IS_Chg	-0.004	0.088	0.110	0.064	0.068	0.144	-0.071	0.091	0.039	0.057
C_Train	-0.087	-0.004	-0.003	0.139	-0.037	0.031	-0.114	0.138	0.078	0.020
C_Dual	-0.123	-0.056	0.008	0.029	-0.127	-0.079	0.011	0.058	0.089	-0.006
C_Data	0.102	0.114	0.086	0.001	0.035	0.067	-0.047	0.055	-0.020	0.074
OVERALL	0.204	0.249	0.002	0.340	0.146	-0.129	0.045	0.101	0.264	0.130

	Per_Comp	Agress	Lower	Foreign	Domestic	Plant_LC	Typ_Shar	Big_Shar	Ind_Comp	Firm_HHI	Life_Cycle
Per_Comp	1.000										
Agress	0.388	1.000									
Lower	0.070	0.076	1.000								
Foreign	-0.048	-0.055	0.179	1.000							
Domestic	0.116	0.201	0.274	0.143	1.000						
Plant_LC	0.073	-0.086	-0.124	-0.020	-0.009	1.000					
Typ_Shar	0.092	0.112	0.031	0.041	0.049	0.105	1.000				
Big_Shar	-0.043	0.012	0.135	-0.148	-0.030	-0.087	0.581	1.000			
Ind_Comp	0.081	0.054	-0.055	-0.117	0.005	0.118	-0.014	-0.142	1.000		
Firm_HHI	-0.051	-0.016	-0.051	-0.264	-0.112	0.131	-0.013	0.040	0.338	1.000	
Life_Cycle	-0.163	0.061	-0.123	0.303	0.027	0.005	-0.203	-0.316	0.014	-0.155	1.000

Table 10. (Cont'd)

	Per_Comp	Agress	Lower	Foreign	Domestic	Plant_LC	Typ_Shar	Big_Shar	Ind_Comp	Firm_HHI	Life_Cycle
Prod_Inn	-0.242	-0.256	-0.078	0.004	-0.036	0.096	0.103	0.068	0.028	-0.017	0.014
Proc_Inn	-0.137	-0.188	-0.165	-0.035	0.032	0.124	0.168	0.015	0.002	0.082	0.020
Differen	-0.218	-0.308	-0.079	0.064	-0.216	0.160	0.135	0.264	-0.276	-0.043	-0.028
Hi_Prof	0.067	-0.010	0.185	-0.044	0.019	0.222	0.233	0.201	-0.076	-0.062	0.107
Commod	-0.011	-0.067	0.051	0.101	-0.136	0.012	0.121	0.192	-0.129	-0.097	0.030
Low_Cost	-0.003	-0.141	0.097	0.109	-0.225	0.142	-0.011	0.082	0.138	0.017	-0.042
Cost_Bas	-0.225	-0.180	-0.027	-0.016	-0.137	-0.082	-0.057	-0.074	-0.064	0.108	0.198
Target	-0.052	0.154	0.051	0.208	0.049	-0.132	0.050	-0.083	-0.114	-0.126	0.124
Intense	-0.082	0.104	0.221	0.111	-0.079	-0.063	-0.050	0.088	-0.036	-0.185	-0.002
Service	-0.078	0.057	-0.058	-0.027	0.135	-0.088	0.026	0.015	-0.113	0.123	0.050
CEO	-0.123	0.152	-0.053	0.195	-0.212	-0.032	-0.040	-0.097	-0.067	-0.050	0.030
Control	-0.066	0.057	-0.118	0.129	-0.128	0.129	-0.066	-0.004	-0.034	0.058	0.108
Top	-0.029	0.087	-0.079	0.161	-0.272	0.066	-0.059	0.008	-0.065	0.007	-0.143
Middle	0.031	0.036	-0.093	0.126	-0.223	0.192	0.024	0.035	0.036	-0.079	-0.110
Account	-0.016	0.037	-0.155	0.102	-0.123	0.222	-0.042	-0.033	-0.128	-0.067	0.055
Market	-0.009	-0.015	-0.033	0.035	-0.101	0.054	0.006	0.031	0.024	0.033	-0.033
Level	-0.069	0.006	0.012	0.066	-0.102	0.105	0.018	-0.025	-0.066	0.116	0.047
Effect	-0.133	0.125	-0.043	0.084	-0.008	-0.049	-0.124	-0.125	-0.055	-0.047	0.050

Table 10. (Cont'd)

	Per_Comp	Agress	Lower	Foreign	Domestic	Plant_LC	Typ_Shar	Big_Shar	Ind_Comp	Firm_HHI	Life_Cycle
Resist	-0.057	-0.047	0.080	0.048	0.161	0.006	-0.191	-0.059	0.143	0.022	-0.019
Sponsor	0.021	-0.111	-0.009	0.114	0.020	-0.054	-0.127	-0.039	0.016	-0.029	0.024
Sht_Term	-0.139	-0.030	0.021	0.138	0.068	-0.041	0.069	0.084	-0.097	-0.096	0.110
Quant_CB	-0.062	-0.006	0.012	0.023	0.084	-0.088	0.055	0.039	0.051	-0.121	0.024
Commun	-0.107	-0.101	0.010	0.032	-0.130	-0.073	-0.022	0.031	-0.009	0.107	0.124
C_Plan	-0.099	-0.097	-0.087	0.017	-0.087	-0.046	-0.112	-0.115	0.009	-0.013	0.217
C_Consul	-0.119	-0.169	-0.011	-0.081	-0.028	0.112	0.050	0.092	0.008	-0.015	-0.052
C_IS_Chg	-0.050	-0.076	0.092	0.173	0.048	0.028	0.071	-0.016	-0.016	0.044	0.085
C_Train	-0.085	-0.150	0.048	0.034	-0.044	-0.132	-0.154	-0.182	0.076	-0.061	0.115
C_Dual	-0.062	-0.015	0.028	0.022	0.054	-0.016	0.024	-0.052	0.049	0.058	0.094
C_Data	-0.031	0.000	-0.150	-0.016	0.177	-0.042	0.056	-0.038	0.081	-0.055	0.042
OVERALL	-0.077	0.023	0.148	0.175	-0.003	-0.094	-0.011	0.078	-0.050	-0.192	0.021

	Prod_Inn	Proc_Inn	Differen	Hi_Prof	Commod	Low_Cost	Cost_Bas	Target	Intense	Service
Prod_Inn	1.000									
Proc_Inn	0.620	1.000								
Differen	0.372	0.382	1.000							
Hi_Prof	0.231	0.274	0.314	1.000						
Commod	0.140	0.033	0.447	0.195	1.000					
Low_Cost	0.158	-0.047	0.249	0.201	0.344	1.000				
Cost_Bas	0.084	-0.005	0.106	0.155	0.031	0.113	1.000			
Target	-0.115	-0.043	-0.088	0.035	0.005	-0.111	-0.061	1.000		
Intense	0.099	-0.111	0.118	0.196	0.226	0.174	0.058	0.198	1.000	
Service	0.282	0.309	0.214	0.128	0.141	0.136	0.060	-0.212	-0.198	1.000

Table 10. (Cont'd)

	Prod_Inn	Proc_Inn	Differen	Hi_Prof	Commod	Low_Cost	Cost_Bas	Target	Intense	Service
CEO	-0.002	-0.075	0.046	0.008	-0.058	0.013	0.047	0.224	0.262	-0.259
Control	-0.049	-0.030	0.053	-0.080	-0.089	0.017	0.070	-0.035	0.123	-0.095
Top	-0.078	-0.133	0.134	-0.126	0.090	0.094	-0.006	0.000	0.224	-0.108
Middle	-0.037	-0.088	0.098	-0.033	0.064	0.058	-0.100	0.011	0.114	-0.057
Account	-0.034	-0.056	0.035	-0.065	-0.047	0.012	0.023	0.077	0.006	-0.016
Market	0.028	-0.099	-0.003	0.049	0.034	0.047	0.171	0.025	0.157	-0.087
Level	-0.014	-0.001	0.042	0.068	-0.028	0.088	0.067	-0.066	0.169	-0.001
Effect	-0.086	-0.171	-0.042	-0.216	0.098	-0.105	-0.084	-0.001	-0.074	-0.115
Resist	0.129	0.219	-0.046	-0.026	-0.139	0.064	-0.161	-0.040	-0.021	0.101
Sponsor	0.078	0.116	-0.023	-0.151	-0.067	-0.048	0.000	-0.049	-0.134	0.126
Sht_Term	0.217	0.163	0.110	-0.003	-0.024	-0.056	-0.061	-0.115	0.103	0.182
Quant_CB	0.103	0.203	0.003	0.008	-0.177	-0.111	-0.011	-0.062	-0.023	0.086
Commun	0.163	0.275	0.144	0.093	-0.075	-0.087	0.052	-0.120	-0.087	0.173
C_Plan	0.073	0.060	0.040	-0.123	-0.111	-0.093	0.071	-0.047	-0.114	0.112
C_Consul	0.136	0.129	0.163	0.011	-0.053	-0.018	0.023	0.014	-0.027	0.082
C_IS_Chg	0.088	0.211	0.032	0.041	-0.090	-0.044	0.064	-0.015	0.038	0.109
C_Train	0.152	0.156	0.016	-0.053	-0.090	-0.017	0.061	0.027	0.004	0.154
C_Dual	-0.038	0.019	-0.041	-0.045	-0.080	-0.001	0.111	0.082	-0.047	0.149
C_Data	0.102	0.225	-0.015	-0.099	-0.229	-0.137	-0.053	0.037	-0.094	0.198
OVERALL	-0.081	-0.213	-0.099	-0.094	-0.014	0.009	-0.187	0.009	0.088	-0.058

Table 10. (Cont'd)

	CEO	Control	Top	Middle	Account	Market	Level	Effect
CEO	1.000							
Control	0.628	1.000						
Top	0.675	0.798	1.000					
Middle	0.556	0.562	0.737	1.000				
Account	0.533	0.760	0.703	0.679	1.000			
Market	0.455	0.435	0.447	0.453	0.439	1.000		
Level	0.461	0.617	0.465	0.293	0.411	0.228	1.000	
Effect	0.206	0.075	0.201	0.116	0.183	0.224	0.062	1.000
Group Sum	**0.719**	**0.805**	**0.810**	**0.692**	**0.692**	**0.538**	**0.736**	**0.362**
Resist	-0.209	-0.154	-0.283	-0.384	-0.293	-0.246	-0.046	-0.176
Sponsor	-0.407	-0.308	-0.338	-0.288	-0.296	-0.249	-0.223	-0.319
Sht_Term	-0.111	-0.036	-0.079	-0.065	-0.099	-0.255	0.083	-0.194
Quant_CB	-0.097	-0.116	-0.253	-0.238	-0.217	-0.357	-0.140	-0.228
Commun	-0.050	-0.108	-0.158	-0.106	-0.109	-0.184	0.063	-0.245
C_Plan	-0.197	-0.140	-0.186	-0.158	-0.179	-0.375	-0.001	-0.169
C_Consul	-0.231	-0.066	-0.123	-0.128	-0.048	-0.206	-0.254	-0.294
C_IS_Chg	-0.151	-0.030	-0.098	-0.105	-0.154	-0.116	0.003	-0.289
C_Train	-0.132	-0.033	-0.111	-0.105	-0.150	-0.200	-0.064	-0.197
C_Dual	-0.207	-0.099	-0.101	-0.112	-0.227	-0.176	-0.017	-0.185
C_Data	-0.179	-0.083	-0.209	-0.216	-0.256	-0.214	-0.060	-0.220
OVERALL	0.138	0.098	0.181	0.091	0.069	0.026	0.054	0.190

Note: Group Sum shows the correlation of the measure at the top of the column with the sum of the measures across the page. This is used for reducing the number of managerial support measures, which all correlate highly with other measures in the group.

Table 10. (Cont'd)

	Resist	Sponsor	Sht_Term	Quant_CB	Commun	C_Plan	C_Consul	C_IS_Chg	C_Train	C_Dual	C_Data
Resist	1.000										
Sponsor	0.533	1.000									
Sht_Term	0.411	0.415	1.000								
Quant_CB	0.456	0.411	0.487	1.000							
Commun	0.383	0.385	0.404	0.408	1.000						
C_Plan	0.297	0.531	0.423	0.469	0.636	1.000					
C_Consul	0.190	0.333	0.201	0.276	0.142	0.347	1.000				
C_IS_Chg	0.279	0.411	0.386	0.447	0.355	0.385	0.453	1.000			
C_Train	0.295	0.447	0.267	0.485	0.409	0.628	0.616	0.617	1.000		
C_Dual	0.149	0.288	0.114	0.293	0.151	0.476	0.453	0.551	0.567	1.000	
C_Data	0.406	0.368	0.377	0.505	0.207	0.368	0.384	0.540	0.488	0.606	1.000
Group Sum	**0.574**	**0.677**	**0.608**	**0.708**	**0.587**	**0.743**	**0.615**	**0.735**	**0.799**	**0.633**	**0.704**
OVERALL	0.023	-0.097	0.080	-0.198	-0.125	-0.149	-0.130	-0.160	-0.157	-0.144	-0.146

Note: Group Sum shows the correlation of the measure at the top of the column with the sum of the measures across the page. This is used for reducing the number of implementation obstacles measures, which all correlate highly with other measures in the group.

Table 11. Measures Identified and Dropped While Reducing Number of Measures

18 Measures Which Did Not Have a Correlation of at Least 0.35 With Any Other Measure:

Ded_Eq	Domestic	Low_Cost
Labor*	Plan_Cyc	Cost_Bas
Job_Shop	Ind_Comp	Target
Lines	Firm_HHI	Intense
Lower	Life_Cyc	Service
Foreign	Hi_Prof	Effect

* Note that Labor did not correlate with any other measures, but it had the highest correlation (0.340) with OVERALL of any measure. It is later added as a separate variable in the regression model.

9 Measures in Managerial Support and Implementation Obstacles Which Correlated Least Strongly With the Appropriate Group Sum:

CEO	Market	Sht_Term
Middle	Resist	C_Consul
Account	Commun	C_Dual

2 Nearly Identical Measures Which Did Not Correlate With Other Measures:

Typ_Shar	Big_Shar

2 Measures Correlated Only With Each Other:

Per_Comp	Agress

4 Measures Dropped Later During Item Reliability Testing With Cronbach's Coefficient Alpha:

Commod	Innovate
Compress	Change

Since seven of the eight managerial support measures and all the implementation obstacle measures survived this examination but more measures needed to be dropped, correlations of these two groups of measures with their aggregates were examined. By dropping some of the measures with the weakest correlations with the aggregates, the nine measures shown in the lower part of Table 11 were identified and dropped.

Two additional measures (Typ_Shar and Big_Shar) were dropped because they measured essentially the same thing and did not correlate strongly with anything else; two other measures (Per_Comp and Agress) were dropped because they correlated only with each other.

As will be explained below, the remaining 19 measures were used in a principal components factor analysis with varimax rotation; four factors were found which roughly corresponded to the intended factors, although no factor emerged for competition. Each factor was then tested for item reliability by calculating Cronbach's Coefficient Alpha; this test resulted in the elimination of another four measures (Commod, Innovate, Compress, and Change).

Factor Analysis, Item Reliability Testing, and Generation of Factor Scores

Hypothesis testing had been designed to use five constructs: COMPLEX, COMPET, STRATEGY, SUPPORT, and OBSTACLES. The primary measures contributing to each construct were to be identified through factor analysis and proven reliable by calculating Cronbach's Coefficient Alpha. Values of the constructs for regression analysis were to be factor scores generated by multiplying standardized scoring coefficients (not factor loadings) by the associated raw scores of the measures used in the factor analysis to produce an optimally weighted linear combination of model measures.

The approach described above had to be modified somewhat because of the small sample size obtained. As discussed previously, proper functioning of factor analysis required that an observations-to-measures ratio of at least 5:1 be maintained. When the number of variables had been reduced to 19 (which met the 5:1 ratio requirement), analysis proceeded in accordance with the approach described above.

The data were factor analyzed using principal components factor analysis with varimax rotation. Factor analysis was used to verify that measures within a construct belonged together for measuring an underlying cause; the principal components approach was used because it is robust in dealing with nonnormal data [Johnson and Wichern (1992)]. Varimax rotation of the factors was used to produce an orthogonal solution in which the constructs are independent, and the nature of the hypotheses assumes independence of the five constructs. Due to missing data, the factor analysis (as well as the regression analysis) was based on 112 observations.

The factor analysis yielded four factors. One factor matched well with complexity and contained Product, Routings, Setups, and Commod. A second factor had measures from both the complexity and strategy groups and contained Innovate, Compress, Change, Prod_Inn, Proc_Inn and Differen. A third factor matched well with managerial support and contained Control, Top, and Level. The fourth factor matched well with Implementation Obstacles and contained Sponsor, Quant_CB, C_Plan, C_IS_Chg, C_Train, and C_Data. No factor emerged for competition; the measures did not correlate well enough.

With the individual measures grouped through factor analysis, the measures in each factor were suggested as measuring one latent variable. The item reliability of the measures in each factor was examined by calculating Cronbach's Coefficient Alpha to see if the measures in the factor formed reliable constructs. For a construct to be reliable, an alpha of approximately 0.7 or higher was desirable. The factors for managerial support and implementation obstacles both had alphas above the threshold, but the first two factors did not. By eliminating measures identified as correlating least strongly with other measures in the group, the first two factors also became reliable constructs. Results of item reliability analysis for the four constructs are shown in Table 12. Table 12 contains the construct overall alpha, how well each measure correlates with the construct total, and the value to which the construct alpha would change if that measure were dropped.

With the constructs identified and tested, the data on each plant were processed in a factor analysis package to calculate scoring coefficients and to

Table 12. Item Reliability Testing Results for the Four Factors Identified in Factor Analysis

Complexity Construct

Cronbach Coefficient Alpha for STANDARDIZED variables: 0.710122

Deleted Variable	Correlation with Total	Alpha if dropped
PRODUCT	0.671636	0.432258
ROUTINGS	0.603312	0.524274
SETUPS	0.340447	0.835553
COMMOD	(DROPPED)	(DROPPED)

Strategy Construct

Cronbach Coefficient Alpha for STANDARDIZED variables: 0.715454

Deleted Variable	Correlation with Total	Alpha if dropped
PROD_INN	0.597127	0.547533
PROC_INN	0.601591	0.541777
DIFFEREN	0.415911	0.764974
INNOVATE	(DROPPED)	(DROPPED)
COMPRESS	(DROPPED)	(DROPPED)
CHANGE	(DROPPED)	(DROPPED)

Managerial Support Construct

Cronbach Coefficient Alpha for STANDARDIZED variables: 0.845865

Deleted Variable	Correlation with Total	Alpha if dropped
CONTROL	0.822227	0.636045
TOP	0.710469	0.787365
LEVEL	0.600577	0.888956

Implementation Obstacles Construct

Cronbach Coefficient Alpha for STANDARDIZED variables: 0.846922

Deleted Variable	Correlation with Total	Alpha if dropped
SPONSOR	0.565542	0.833610
QUANT_CB	0.607573	0.825656
C_PLAN	0.638262	0.819759
C_IS_CHG	0.643148	0.818814
C_TRAIN	0.721229	0.803435
C_DATA	0.594967	0.828057

generate factor scores for each observation. Table 13 shows the factor loadings associated with each measure and the standardized scoring coefficient for each measure as generated for each construct. Scoring coefficients related measures to the constructs and represented optimal weights on a plant's data to produce linear composites known as estimated factor scores. In this study, estimated factor scores were to be calculated for the constructs COMPLEX, COMPET, STRATEGY, SUPPORT, and OBSTACLE, although the COMPET construct failed to emerge from the analysis and was not calculated. Factor scores were computer-generated using the following equation:

$$F'_j = \Sigma b_{ji} v_j,$$

where

F'_j = the estimated factor score for factor j

b_{ji} = the scoring coefficient for measure i of factor j

v_j = the respondent's score for measure i.

The estimated factor scores are the values of the independent variables in the multivariate regression analyses used to test the hypotheses. Table 14 shows the estimated factor scores for a few of the responding plants. Note that, where any values of the individual measures composing a factor are missing, the whole observation is dropped from analysis. Twelve observations were dropped, leaving 112 observations to be used for the analysis.

Table 13. Factor Loadings and Standardized Scoring Coefficients for the Constructs

Rotated Factor Pattern

OBSTACLE	SUPPORT	COMPLEX	STRATEGY	
PRODUCT	-4	8	82 *	-16
ROUTINGS	11	3	78 *	-10
SETUPS	1	2	40 *	8
PROD_INN	7	-7	3	69 *
PROC_INN	13	-8	6	72 *
DIFFEREN	-2	12	-19	50 *
CONTROL	-10	89 *	10	-5
TOP	-15	82 *	-1	-5
LEVEL	-7	65 *	4	4
SPONSOR	60 *	-28	-8	-2
QUANT_CB	63 *	-17	14	10
C_PLAN	70 *	-9	-15	-3
C_IS_CHG	71 *	6	11	9
C_TRAIN	80 *	1	-8	5
C_DATA	62 *	-8	17	9

NOTE: Printed values are multiplied by 100 and rounded to the nearest integer.
Values greater than 0.3 have been flagged by an '*'.

Standardized Scoring Coefficients

OBSTACLE	SUPPORT	COMPLEX	STRATEGY	
PRODUCT	-0.02368	-0.01608	0.49030	-0.07536
ROUTINGS	0.02753	-0.02805	0.36191	-0.01265
SETUPS	-0.00232	0.01066	0.10069	0.04823
PROD_INN	-0.02904	-0.00056	0.03984	0.36475
PROC_INN	0.00365	-0.00637	0.05987	0.42270
DIFFEREN	-0.01387	0.03439	-0.02525	0.19961
CONTROL	0.06401	0.55606	0.02582	-0.01657
TOP	-0.00810	0.29648	-0.06418	0.00585
LEVEL	0.01084	0.14808	0.00185	0.04320
SPONSOR	0.14821	-0.04824	-0.03708	-0.04914
QUANT_CB	0.15651	-0.04153	0.07060	0.03273
C_PLAN	0.22676	0.04805	-0.08884	-0.06181
C_IS_CHG	0.20896	0.07167	0.05240	0.01919
C_TRAIN	0.32022	0.05567	-0.06569	-0.02728
C_DATA	0.15531	0.01687	0.04525	0.01761

Table 14. Factor Scores Calculated for Constructs of 10 Observations

OBSERVATION	OBSTACLE	SUPPORT	COMPLEX	STRATEGY	
18	0.61185	0.53898	0.45502	-0.38267	
19	0.48885	-0.26316	1.23050	-0.72356	
20	-0.27707	0.46768	1.20343	0.26033	
21	0.39591	0.67268	-0.32788	-0.73173	
22	.	.	.	.	(Missing Data)
23	-0.25657	0.80836	0.93625	-0.91673	
24	-1.30105	0.86135	-0.15359	-0.87234	
25	-0.38575	1.18918	1.31309	1.15749	
26	-0.87283	0.18857	-1.06576	1.46196	
27	0.34228	-2.39622	-0.43336	-0.89093	

Note: Where any measures needed for the factor analysis were missing, no factor score was calculated for that observation. Missing data occurred 12 times, leaving 112 observations for analysis.

MULTIVARIATE REGRESSION ANALYSIS

Various regression models were used to test the data. These models varied in the number of constructs used and in the inclusion of some combination of Labor, Proc_Inn, Cost_Bas, Per_Comp, Lower, and Firm_HHI as separate independent variables. Since the STRATEGY construct was usually only marginally significant, the individual measures were also tried in models to see if they performed better than the construct. Proc_Inn correlated highly with the construct STRATEGY and was substituted for that construct; Proc_Inn was never used in a model including STRATEGY. Cost_Bas, on the other hand, did not correlate highly with STRATEGY and was used in addition to that construct. Since no cohesive factor was found for the competition construct, the individual measures were included in models to add the influence of competition, which appeared to be nonmonolithic. Three measures were found to improve the model: Per_Comp, Lower, and Firm_HHI. Labor was used separately because it seemed to represent a different type of complexity and correlated very highly with OVERALL; since Labor did not correlate with COMPLEX, it was used in addition to the COMPLEX construct. The models took one of two major forms, depending on whether or not Proc_Inn was substituted for STRATEGY. Within either major model, some of the independent variables could be omitted. The two major models were as follows:

$$\begin{aligned}\mathrm{OVERALL}_i = \quad & \beta_0 + \beta_1\mathrm{COMPLEX}_i + \beta_2\mathrm{STRATEGY}_i + \beta_3\mathrm{SUPPORT}_i \\ & + \beta_4\mathrm{OBSTACLE}_i + \beta_5\mathrm{Labor}_i + \beta_6\mathrm{Cost\_Bas}_i \\ & + \beta_7\mathrm{Firm\_HHI}_i + \beta_8\mathrm{Per\_Comp}_i + \beta_9\mathrm{Lower}_i + \beta_{10}\varepsilon_i\end{aligned}$$

and

$$\begin{aligned}\mathrm{OVERALL}_i = \quad & \beta_0 + \beta_1\mathrm{COMPLEX}_i + \beta_2\mathrm{Proc\_Inn}_i + \beta_3\mathrm{SUPPORT}_i \\ & + \beta_4\mathrm{OBSTACLE}_i + \beta_5\mathrm{Labor}_i + \beta_6\mathrm{Cost\_Bas}_i \\ & + \beta_7\mathrm{Firm\_HHI}_i + \beta_8\mathrm{Per\_Comp}_i + \beta_9\mathrm{Lower}_i + \beta_{10}\varepsilon_i\end{aligned}$$

As indicated earlier, regressions based solely on the constructs used 112 observations. The other models used either 111 or 112 observations; models with Firm_HHI had one fewer observation.

The constructs and separate measures used as variables were independent, as illustrated in Table 15, which shows the Pearson Correlation Matrix of the constructs, the separate measures, and OVERALL. Note that Proc_Inn and STRATEGY had a very high correlation (0.876). This single high correlation posed no problem because the two variables were not used in the same model; rather, Proc_Inn was substituted for STRATEGY. Table 15 also shows the simple statistics (including the number of observations (N), means, standard deviations, sums of variation (Sum), minimum value and maximum value) for the constructs, separate measures, and OVERALL. As the zero means and sums of variation show, the constructs OBSTACLE, SUPPORT, COMPLEX, and STRATEGY were all standardized, whereas the separate measures and OVERALL were not standardized.

Table 16 shows the results for the eight regression models, including the F-value, Prob > F, the adjusted R2, and the test of first and second moment specification's Prob > Chi-Square (White's Test); Table 16 also shows the confidence level of each independent variable in the model ("--" indicates that the construct or separate measure was not included in the model). Table 17 shows more detail on assessing the models, including the variable coefficients, the standard errors of the coefficients, the t-values of the

Table 15. Pearson Correlation Matrix and Simple Statistics of Constructs and Separate Measures Used in Regression Analyses

Pearson Correlation Matrix

	OBSTACLE	SUPPORT	COMPLEX	STRATEGY	LABOR	COST_BAS	PROC_INN
OBSTACLE	1.000						
SUPPORT	-0.036	1.000					
COMPLEX	0.014	0.021	1.000				
STRATEGY	0.037	-0.012	-0.041	1.000			
LABOR	0.077	0.036	0.157	0.019	1.000		
COST_BAS	0.007	0.016	-0.030	-0.024	0.042	1.000	
PROC_INN	0.146	-0.089	0.063	0.876	-0.015	-0.104	1.000
FIRM_HHI	-0.067	0.092	-0.200	0.034	-0.047	0.108	0.078
PER_COMP	-0.034	-0.062	0.123	-0.211	0.070	-0.225	-0.137
LOWER	0.027	-0.085	-0.012	-0.081	-0.123	-0.027	-0.156
OVERALL	-0.150	0.137	0.225	-0.103	0.340	-0.187	-0.209

	FIRM_HHI	PER_COMP	LOWER	OVERALL
FIRM_HHI	1.000			
PER_COMP	-0.051	1.000		
LOWER	-0.051	0.070	1.000	
OVERALL	-0.192	-0.077	0.148	1.000

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
OBSTACLE	112	0	0.919	0	-2.18	2.16
SUPPORT	112	0	0.924	0	-2.98	1.23
COMPLEX	112	0	0.884	0	-1.90	1.56
STRATEGY	112	0	0.827	0	-1.55	2.38
LABOR	123	4.707	2.307	579	1.00	7.00
PROC_INN	124	3.395	1.508	421	1.00	7.00
COST_BAS	124	3.871	1.771	480	1.00	7.00
PER_COMP	124	6.016	1.097	746	2.00	7.00
LOWER	124	4.766	1.648	591	1.00	7.00
FIRM_HHI	123	8.207	2.959	1009	0.17	10.00
OVERALL	124	5.798	2.744	719	1.00	11.00

Table 16. Assessment of Models Used in Regression Analyses

Model Assessment:	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
F-Value	2.905	3.580	3.999	3.404	5.984	5.024	5.399	5.527
Prob > F	0.025	0.016	0.010	0.012	0.000	0.000	0.000	0.000
Adj. R-Square	0.064	0.065	0.075	0.080	0.152	0.153	0.265	0.270
White's Prob > Chi-Square	0.122	0.180	0.154	0.266	0.138	0.095	0.675	0.736
Significance of Variables:								
OBSTACLE	94%	95%	92%	91%	97%	97%	99%	98%
SUPPORT	91%	91%	–	none	90%	90%	94%	91%
COMPLEX	99%	99%	99%	99%	97%	97%	99%	98%
STRATEGY	none	–	–	–	–	none	94%	–
Labor	–	–	–	–	99.9%	99.9%	99.9%	99.9%
Proc_Inn	–	–	96%	95%	–	–	–	96%
Cost_Bas	–	–	–	–	–	–	98%	98%
Per_Comp	–	–	–	–	–	–	98%	99%
Lower	–	–	–	–	–	–	97%	97%
Firm_HHI	–	–	–	–	–	–	97%	96%

coefficients, and the one-tailed probabilities for the variables to be used in testing hypotheses.

As shown in Table 16, the Prob > F indicated that each of the eight models was significant at the 97% or higher confidence level. Since the White's Prob > Chi-Square was greater than 0.05 for each model, White's test identified no problems with heteroskedasticity or model specification for any of the models [White (1980)].

When the constructs were taken alone (models 1 and 2), STRATEGY was not significant; OBSTACLE, SUPPORT, and COMPLEX were significant

Table 17. Assessment of Independent Variables Used in Regression Models

Model	Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	1-Tailed Prob > |T|
Model 1					
	INTERCEP	5.688	0.249	22.885	0.0000
	OBSTACLE	-0.431	0.272	-1.583	0.0582
	SUPPORT	0.372	0.271	1.374	0.0861
	COMPLEX	0.680	0.283	2.405	0.0090
	STRATEGY	-0.285	0.302	-0.943	0.1740
Model 2					
	INTERCEP	5.688	0.248	22.897	0.0000
	OBSTACLE	-0.441	0.272	-1.621	0.0540
	SUPPORT	0.374	0.270	1.385	0.0845
	COMPLEX	0.691	0.282	2.447	0.0080
Model 3					
	INTERCEP	6.693	0.624	10.725	0.0000
	OBSTACLE	-0.384	0.273	-1.407	0.0812
	COMPLEX	0.729	0.281	2.594	0.0054
	PROC_INN	-0.292	0.166	-1.755	0.0411
Model 4					
	INTERCEP	6.631	0.624	10.619	0.0000
	OBSTACLE	-0.377	0.273	-1.382	0.0850
	SUPPORT	0.336	0.269	1.248	0.1074
	COMPLEX	0.720	0.281	2.566	0.0059
	PROC_INN	-0.274	0.166	-1.645	0.0515
Model 5					
	INTERCEP	4.015	0.536	7.492	0.0000
	OBSTACLE	-0.510	0.260	-1.964	0.0261
	SUPPORT	0.342	0.258	1.327	0.0937
	COMPLEX	0.544	0.272	1.999	0.0241
	LABOR	0.359	0.103	3.477	0.0004

Table 17. (Cont'd)

Model	Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	1-Tailed Prob > |T|
Model 6					
	INTERCEP	4.003	0.536	7.474	0.0000
	OBSTACLE	-0.500	0.260	-1.926	0.0284
	SUPPORT	0.339	0.257	1.316	0.0956
	COMPLEX	0.531	0.272	1.950	0.0269
	STRATEGY	-0.308	0.288	-1.072	0.1430
	LABOR	0.362	0.103	3.504	0.0004
Model 7					
	INTERCEP	8.722	1.761	4.951	0.0000
	OBSTACLE	-0.573	0.246	-2.331	0.0109
	SUPPORT	0.378	0.243	1.553	0.0618
	COMPLEX	0.495	0.263	1.886	0.0311
	STRATEGY	-0.441	0.276	-1.595	0.0569
	LABOR	0.408	0.098	4.165	0.0000
	COST_BAS	-0.280	0.132	-2.123	0.0181
	FIRM_HHI	-0.159	0.081	-1.954	0.0267
	PER_COMP	-0.634	0.210	-3.016	0.0016
	LOWER	0.269	0.136	1.983	0.0250
Model 8					
	INTERCEP	9.622	1.889	5.094	0.0000
	OBSTACLE	-0.517	0.248	-2.087	0.0131
	SUPPORT	0.339	0.244	1.389	0.0840
	COMPLEX	0.552	0.263	2.099	0.0192
	LABOR	0.400	0.098	4.096	0.0000
	PROC_INN	-0.280	0.153	-1.827	0.0353
	COST_BAS	-0.297	0.132	-2.250	0.0133
	FIRM_HHI	-0.144	0.082	-1.760	0.0407
	PER_COMP	-0.615	0.207	-2.976	0.0018
	LOWER	0.255	0.136	1.880	0.0315

but adjusted R^2 was very low (6% to 6.5%), indicating that the constructs accounted for only about 6% of the variation. Substituting Proc_Inn for STRATEGY (see models 3 and 4) made a slight improvement in the adjusted R^2 (to 8%), but adding Labor (see models 5 and 6) caused a notable increase in the adjusted R^2 (to 15%). When Cost_Bas was added (not shown), adjusted R^2 increased to nearly 19%. When the competition measures Per_Comp, Lower, and Firm_HHI were added, the adjusted R^2 made another notable increase to 27%. Adding the additional measures also helped stabilize the original constructs' significance, since all constructs were significant at a 91% or higher confidence level. In Model 7, the four constructs were significant at the 94% or higher confidence level; the separate measures were each significant at the 97% or higher confidence level.

HYPOTHESES TEST RESULTS

Testing each of the hypotheses depended on two indicators. The first was whether the sign of the parameter estimate agreed with that hypothesized. The second was whether the parameter was significant.

The parameter signs consistently supported the hypotheses for complexity (H_1), managerial support (H_4), and implementation obstacles (H_5) since each had the hypothesized sign (positive for H_1 and H_4 and negative for H_5). In addition, the sign for Labor (a complexity measure) was always positive, as hypothesized. The negative parameter for strategy (H_3), however, was consistently opposite of that hypothesized. Similarly, the signs for Proc_Inn and Cost_Bas (strategy measures) were consistently negative. No construct emerged for competition (H_4), but the three competition measures used in regressions, Firm_HHI, Per_Comp, and Lower, had mixed results, with Firm_HHI and Per_Comp having opposite signs from that expected and Lower having the anticipated positive sign.

The complexity hypothesis (H_1) is supported by COMPLEX's significance at the 97% to 99% confidence level in all models. The competition hypothesis (H_2) cannot be supported directly since COMPET failed to emerge, but the three separate measures were significant at the 96% to 99% confidence level. The strategy hypothesis (H_3) was not supported in the constructs-only model but was significant at the 94% confidence level when the competition measures were added to the model. The managerial support hypothesis (H_4) was weakly supported at the 90% to 94% confidence level. The implementation obstacles hypothesis (H_5) was supported at the 92% to 99% confidence level.

In view of the sign and significance indicators, the data strongly supported the complexity hypothesis (H_1) and the implementation obstacles hypothesis (H_5). The data weakly supported the managerial support (H_4) hypothesis. Unless the separate competition measures were included in the model, the data did not support the strategy hypothesis (H_3); with the separate competition measures, the strategy hypothesis was weakly supported. Considered with or without the separate competition measures, the strategy hypothesis is supported only at the 82% to 94% confidence level. The data could not directly support the competition hypothesis (H_2) since no cohesive construct emerged for competition. However, separate competition measures were highly significant but mixed in sign, which indicated that the competition hypothesis was not supported.

DISCUSSION

Demographic Analysis

Examination of demographic data in comparison to the dependent measure by using MANOVA procedures revealed only two demographic data items with significant differences. The first demographic data item, respondents' years in company, may be a result of the positions to which the surveys were sent, but there was no reason to suspect that this possibility biased the results. The second demographic data item was 4-digit SIC code. Differences between industries were expected; there was no reason to think industry differences adversely affected the study.

Measures, Factors, Item Reliability, and Constructs

Review of the descriptive statistics revealed major problems of skewness and kurtosis in all but seven measures. Nearly all the measures had set minimum and maximum values, eliminating the possibility of outliers. However, the skewness and kurtosis showed the measures to be nonnormal, precluding the use of maximum likelihood factor analysis since it required normal data. Principal components factor analysis, however, was robust in regards to nonnormal data, so that method was used.

The small sample size complicated the factor analysis. Too few observations in comparison to the number of measures analyzed would result in unstable factors, where the measures might load incorrectly. It was necessary to reduce the number of measures to a 5:1 ratio of observations to measures. Since only 124 observations were received and since some observations were missing data, the reduction process sought to limit the number of measures to 20 or less. Manual observation of correlations between measures or between a measure and its group sum reduced the number of measures to 23. Four additional measures were dropped because they related only to one measure and factors should have at least three measures. Since the measures dropped did not correlate with the other measures, the resulting input set represented the best set of measures to be used under the circumstances. Since most of the measures used in the study had not been previously developed and tested, it was not unusual that so many of the measures did not measure a common latent variable. The lack of cohesiveness among the measures within a group suggests that the survey had strong measurement error. Better pretesting of the survey could have avoided this measurement problem in the actual survey.

Principal components factor analysis was performed using varimax rotation to insure independence of the factors. At least one cohesive group of three measures was found for each of the five areas hypothesized except competition. The resulting factors were analyzed for item reliability using Cronbach's Coefficient Alpha; the reliability process resulted in eliminating four more measures so that alphas of at least 0.70 were obtained for each factor. Thus, complexity was represented by Product, Routings, and Setups, which are consistent with the search for a resource consumption pattern where consumption is diverse and uncorrelated with the base. No factor emerged for competition, so latter analysis was forced to use separate measures in an attempt to cover competition. The lack of a cohesive group raises doubts as to the validity of the underlying assumption for Hypothesis 2 that competition is a cohesive latent variable. Strategy was represented by Prod_Inn, Proc_Inn, and Differen, which all related to Hypothesis 3a; no factors emerged for hypotheses 3b and 3c. Any conclusions drawn about Hypothesis 3 relate only to Hypothesis 3a. This lack of overall cohesiveness in the group of measures also raises doubts about assuming strategy to be a cohesive latent variable. Managerial support was represented by Control, Top, and Level. Given that nearly all the measures suggested for this group had high correlations and were reduced primarily based on which correlated most strongly with the group sum, this factor could well have had more measures if they had been included in the factor analysis. The implementation obstacles group was represented by Sponsor, Quant_CB, C_Plan, C_IS_Chg, C_Train, and C_Data. The measures in this group correlated so strongly together and with the sum of the group that it was difficult to eliminate more measures.

After the item reliability analysis, the measures remaining were again processed through the factor analysis procedure to generate factor scores, which became the values representing the constructs for each observation.

In addition to the constructs, several measures were identified for use in the regression analysis. Labor was retained because it represented a different type of complexity where many labor rates (representing different labor resources) were required. The measure Labor did not correlate well with any other measures, but it correlated with OVERALL higher than did any other measure. Where the strategy group had proven mostly insignificant in hypothesis testing, two measures (Proc_Inn and Cost_Bas) were examined as substitutes for STRATEGY. Finally, three measures (Per_Comp, Lower, and Firm_HHI) were retained to represent competition, which had failed to form a cohesive group.

Regressions

Several regressions used the data to test the hypotheses in regards to parameter signs and parameter significance. The data consistently suggested Hypothesis 1 (complexity) to be valid and supported. The complexity of product and process, resulting in resource consumption patterns which were diverse and uncorrelated to the allocation base, was related to the implementation of FCA methods, with increasing complexity being associated with implementation of finer allocation methods. The data suggested that Hypothesis 2 (competition) was invalid in that competition was not a cohesive latent force. Some of the measures suggested for competition were significant, but the direction of the sign was inconsistent. No significant association was found for the two life-cycle measures for testing Hypothesis 2a; therefore, H_{2a} was not supported. Firm_HHI, an individual measure for testing Hypothesis 2b was significant, but the sign was reversed; therefore, H_{2b} was not supported. Lower and Per_Comp, two individual measures for testing Hypothesis 2c, were significantly associated with implementation of FCA methods, but the two measures took opposite signs, so H_{2c} was not supported. The data suggested that Hypothesis 3 (strategy) was not supported in the area of differentiation in product and process (Hypothesis 3a). There was an association between differentiation in product and process and the implementation of FCA methods, but the sign was opposite that expected. No constructs emerged for testing H_{3b} or H_{3c}; nor did significant associations emerge for individual measures to test those hypotheses. The data also suggested that Hypothesis 4 (managerial support) was valid; the association between managerial support and FCA method implementation was significant at a lesser confidence level and in the anticipated direction. The data strongly suggested that Hypothesis 5 (implementation obstacles) was valid; the significance and sign of the association were as expected.

This study suffered from five problems. First, there was a large amount of measurement error, as evidenced by the large portion of measures which could be eliminated during the reduction of measures based simply on the failure to correlate with any other measure at a 0.35 level. Better pretesting and reworking of the survey instrument could have alleviated this problem.

The second problem was the small sample size. A much larger sample size would have eliminated the need to reduce the number of variables. A large sample size also increases the likelihood of measures loading correctly onto the factors.

The third and fourth problems resulted from improper research design. The third problem was that hypotheses assumed cohesive underlying forces where none existed. Hypotheses 2 and 3 each assumed a cohesive latent force; data did not support this assumption. Splitting the hypotheses into subhypotheses helped correct this deficiency. The fourth problem was that the conjectured relationships were incorrect; this problem showed itself where signs were opposite of what was expected. More thorough thinking in regards to how measures relate to the underlying variable might have prevented some incorrect specification. The fourth problem, however, is also what the study was intended to test.

In addition to the four problems discussed above, a fifth problem is that other forces which affect the FCA method implementation decision were not incorporated in the model. Literature discussing other events or courses of action taking place in manufacturing plants suggests some other paths managers are following which may affect the decision to implement FCA methods. Consider two examples. First, a plant committed to continuous improvement may choose to focus on process improvement rather than costs, assuming that costs would eventually come under control. This is the philosophy behind statistical process control. Second, a plant embarking on implementing the theory of constraints focuses simply on reducing total operating costs rather than on allocating the costs to individual products. Such a plant would not need an FCA method to find total operating costs.

Although this study has had a number of shortcomings, the study still has produced results supporting three of the five hypotheses. For the other two hypotheses, relationships between at least some measures and FCA methods implementation were established, but the hypotheses were not supported due to inconsistent signs.

CHAPTER VI

CONCLUSION

This chapter addresses the contributions of this research and discusses the limitations of the research and analysis. Finally, it discusses possible directions for further research.

CONTRIBUTIONS

The literature has suggested that finer cost allocation methods are appropriate in situations where the resource consumption patterns are diverse and uncorrelated with the allocation base (referred to in this study as complexity). Previous to this study, no study had empirically tested whether FCA method implementations actually support this suggestion. As a result of survey analysis, this study has shown a significant positive relationship between complexity and FCA method implementation. In addition, a reliable item has been developed for measuring complexity in an FCA methods implementation setting. This item considers product diversity, routings diversity, and extent of setups in assessing complexity.

The literature also suggests that project implementations are more likely to occur when managerial support is present and implementation obstacles are missing. No previous studies have related these suggestions to the implementation of FCA methods. This study has provided support for these two suggestions in regards to implementing FCA methods. As a result of survey analysis, a positive significant relationship (at the 90% confidence level) was found between managerial support and FCA methods implementation. In addition, a reliable item has been developed for measuring managerial support in an FCA methods implementation setting. This item considers support by the controller, support by other top management (excluding the CEO), and the level in the organization of the champion for FCA methods in assessing managerial support. As a result of survey analysis, a negative significant relationship was found between implementation obstacles and FCA methods implementation. In addition, a reliable item has been developed for measuring implementation obstacles in an FCA methods implementation setting. This item considers lack of a sponsor; the difficulty of assessing costs and benefits; and the costs of planning, changing the information system, training the users, and collecting and processing additional data in assessing implementation obstacles.

The results of this study, therefore, support the movement occurring in the manufacturing community toward implementing finer cost allocations in situations where products and processes become complex and differ in their consumption of resources and where managerial support is present and implementation obstacles are missing.

LIMITATIONS

The results of this study are useful as an informative study but have two limitations. First, when considering only the constructs developed in the study, only 6% of the variation is explained. By considering additional measures, however, 27% of the variation is explained. The low explanatory power exhibited indicates that other factors not included in this study exert great influence in affecting which FCA methods are implemented. Thus, the significant relationships found in this study relate to only a portion of the decision-making influences. Second, the small sample size raises the question of whether the results are specific to the sample or are generalizable to the main population. Even if the results are limited to the sample, the results may be of interest to managers deciding whether or not to implement FCA methods.

DIRECTIONS FOR FUTURE RESEARCH

This study has limited explanatory power. Two other influences (focusing on process rather than cost and tracking only total operating costs instead of refining product cost allocations) were suggested during the interpretation of results. Future research could address these two influences and incorporate the appropriate measures into a common model.

In the survey, data were obtained which assessed the plants' performance relative to that of their competitors. The relationship of performance to FCA method implemented could be examined. Similarly, data were obtained about the importance of cost allocations in making various decisions. The relationship of cost usage to FCA methods implementation could also be examined.

In this study, some measures did not show a significant relationship to FCA methods implementation using regression analysis but some relationship may exist. To explore this possibility, LOGIT techniques could be used to group responses by characteristics, then to find whether the distinction helps improve the ability to predict implementation of FCA methods. For example, each observation could be classed as a high or low FCA methods implementor; then the characterization could be tested.

In conclusion, future research could focus on methods to add missing influences or to filter out the noise which presently obscures the relationship between specified plant/firm characteristics and the use of FCA methods.

APPENDIX

SURVEY INSTRUMENT

Michigan State University
Firm Characteristics and Allocation Practices Study

Basic Instructions

1. Thank you for participating in this project. The researchers are examining whether certain firm characterisitcs are associated with the firm's choice of overhead allocation methods. You indicate your voluntary agreement to participate by completing and returning this questionnaire.

2. Your participation is important to the success of this study. To show our appreciation, two respondents' names will be drawn at random to receive a $75 cashiers check which may be used as desired, such as to take some staff members to lunch. Pleas include your name on the survey in case you are drawn. Your name will not be released to other plants or firms.

3. Please fill out your *entire* questionnaire to the best of your ability.

4. Strict confidentiality will be maintained throughout the project. Only aggregate data will be released to the public. Plant data from one firm will NOT be made available to another firm. If requested, firms returning information from multiple plants will be provided a summary by plant for their own firms; such a summary will include data from all the firm's responding plants unless a plant indicates it does not want to be included.

5. Please return the completed questionnaire in the self-addressed postage-paid envelope within one week after receiving it.

   (This survey is being mailed on ____________________.)

6. If you would like a copy of the firm and/or aggregate results, please indicate on your business card which results you desire, then attach the card to the front of the survey.

7. The inserted page of definitions is for your use in completing the survey; it need not be returned.

If you have any questions concerning this project, please contact:

Mr. Win G. Jordan at (517) 353-8642

If Mr. Jordan is unavailable, then contact any of the following at (517) 355-7486:

Dr. Susan F. Haka
Dr. Ronald Marshall
Dr. Fredric H. Jacobs

Please return the completed questionnaire to :

Win G. Jordan
Department of Accounting
Eli Broad Graduate School of Management
Michigan State University
N270 North Business Complex
East Lansing, Michigan 48824-1121

Michigan State University
Firm Characteristics and Allocation Practices Study

1. **Tell us about yourself. (Your name, title, and telephone number will be kept confidential, even within your firm.) The optional telephone number is requested in case the combination of characteristics and practices in your plant raises additional questions that could be answered in a brief conversation.**

Your name: ______________________ **Your title:** ______________________

Your plant: ______________________ **Your telephone number:** ______________________

Main product lines made at your plant: ______________________

Years with this company: __________ **Years in this industry:** __________

Your primary background or area of expertise:

- ☐ **Accounting**
- ☐ **Business Administration**
- ☐ **Engineering**
- ☐ **Other, please specify** ______________________
- ☐ **Finance**
- ☐ **Manufacturing**
- ☐ **Sales/Marketing**

2. **Indicate the degree to which you agree with the following statements regarding your firm's competitive environment for the *industry in which your plant's products compete*. A plant is one or more buildings at a site which jointly produce one or more product lines. Circle the correct response.**

	Strongly Agree			***Neutral***			***Strongly Disagree***
The industry is only marginally competitive	1	2	3	4	5	6	7
Our major competitors are not particularly aggressive	1	2	3	4	5	6	7
Competition is forcing my firm to severely reduce prices and/or profit margins on its products	1	2	3	4	5	6	7
My firm is often challenged in the marketplace by foreign competitors with a differential advantage based on quality, flexibility, technological advantage, or price	1	2	3	4	5	6	7
My firm is often challenged in the marketplace by domestic competitors with a differential advantage based on quality, flexibility, technological advantage, or price	1	2	3	4	5	6	7

3. **Considering the total manufacturing cost of your plant, indicate the percentage of that cost associated with products in each product life-cycle stage. (See definition sheet for definitions of the various stages.)**

Introductory Stage: __________ **%** **Maturity Stage:** __________ **%**

Growth Stage: __________ **%** **Decline Stage:** __________ **%**

4. Indicate the degree to which you agree with the following statements regarding your firm's strategies as they pertain to your plant. Circle the correct response.

	Strongly Agree			*Neutral*			*Strongly Disagree*
My firm excels at new product innovation	1	2	3	4	5	6	7
My firm excels at new process innovation	1	2	3	4	5	6	7
My firm produces highly differentiated products	1	2	3	4	5	6	7
My firm sells primarily high-profit-margin products	1	2	3	4	5	6	7
My firm produces undifferentiated (commodity) products	1	2	3	4	5	6	7
My firm is an industry low-cost leader	1	2	3	4	5	6	7
My firm bases prices primarily on costs	1	2	3	4	5	6	7
My firm uses target pricing and costs to insure profitability	1	2	3	4	5	6	7
My firm is heavily involved in cost reduction efforts	1	2	3	4	5	6	7
My firm focuses strongly on customer service	1	2	3	4	5	6	7
My firm allows the plant to select its own allocation methods	1	2	3	4	5	6	7

5. Indicate the degree to which you agree with the following statements regarding the complexity of manufacturing and costing your firm's products within your plant. Circle the correct response.

Within Your Plant:	*Strongly Agree*			*Neutral*			*Strongly Disagree*
Product lines are NOT very diverse	1	2	3	4	5	6	7
Product lines are built to essentially the same routing	1	2	3	4	5	6	7
Equipment is dedicated to a single product line	1	2	3	4	5	6	7
All direct labor is costed at the same standard rate	1	2	3	4	5	6	7
Setups to change between products use only minimal time	1	2	3	4	5	6	7
The plant is a job shop	1	2	3	4	5	6	7
The rate of new product innovation is very slow	1	2	3	4	5	6	7
The length of the product life cycle has rapidly compressed	1	2	3	4	5	6	7
Production technologies change quite frequently	1	2	3	4	5	6	7

6. Enter the percentages or numbers for your plant in the following areas:

The total manufacturing costs (direct and indirect) in dollars for your plant .... $________________

The total manufacturing OVERHEAD costs in dollars for your plant .... ________________

The number of product lines .... ______________

The number of routings used .... ______________

The number of engineering change orders per year .... ______________

The number of direct labor rates (not counting new/apprentice rates) used in your plant ______________

For your typical product, what domestic market share do you think your firm holds? .... ____________%

What do you think is the largest domestic market share held by your firm for a product manufactured in your plant? .... ____________%

7. **Indicate your firm's performance relative to your competitors** for the products made in your plant along the following dimensions. Circle the appropriate response.

	Relative to Industry Competitors Much Greater			About the Same			Much Less
Overall product quality	1	2	3	4	5	6	7
Above-average cost reductions over the last three years	1	2	3	4	5	6	7
Sales growth in the last three years	1	2	3	4	5	6	7
Market share growth in the last three years	1	2	3	4	5	6	7
Growth in Return on Assets (ROA) in the last three years	1	2	3	4	5	6	7
Overall competitive position today	1	2	3	4	5	6	7
Overall customer service	1	2	3	4	5	6	7

8. Indicate the **level of support** for the implementation of more detailed cost allocation techniques (such as departmental allocations or activity-based costing) in your firm. Circle the appropriate response.

	Don't Know	*Strong Resistance*			*Indifferent*		*Strong Support*	
CEO support	0	1	2	3	4	5	6	7
Controller support	0	1	2	3	4	5	6	7
Other top management support	0	1	2	3	4	5	6	7
Middle management support	0	1	2	3	4	5	6	7
Accounting support	0	1	2	3	4	5	6	7
Marketing support	0	1	2	3	4	5	6	7

9. Indicate the **organizational level of the champion (not the funding sponsor)** for more detailed cost allocation techniques in your firm. Check the appropriate response.

- ❑ CEO
- ❑ Controller or other top management
- ❑ Middle management
- ❑ Accounting or marketing
- ❑ Other
- ❑ No champion exists
- ❑ Don't know who champion is

10. Indicate the level of **effectiveness of the champion** in persuading both top management and users to support implementation of more detailed cost allocation techniques. Circle the appropriate response.

	Don't Know	*Very Effective*			*Indifferent*		*Very Ineffective*	
Champion's effectiveness	0	7	6	5	4	3	2	1

11. Indicate below the importance of the role cost allocations play in the specified areas. Circle the appropriate response.

	Little Importance			*Moderate Importance*		*Extreme Importance*	
Financial reporting	1	2	3	4	5	6	7
Cost reduction decisions	1	2	3	4	5	6	7
Continuous improvement	1	2	3	4	5	6	7
Product mix decisions	1	2	3	4	5	6	7
Budgeting	1	2	3	4	5	6	7
Resource allocation decisions	1	2	3	4	5	6	7

12. **As your firm has discussed the possibility of implementing more detailed allocation methods, how strong an obstacle to implementation has each of the following considerations been? Please circle the appropriate response.**

	No Obstacle			*Moderate Obstacle*			*Strong Obstacle*
Managerial resistance to making the change	1	2	3	4	5	6	7
Lack of a high-level sponsor	1	2	3	4	5	6	7
Focus on short-term financial measures	1	2	3	4	5	6	7
Quantifying costs and benefits of the change	1	2	3	4	5	6	7
Communicating results of planning throughout the organization	1	2	3	4	5	6	7
Cost of adequate planning	1	2	3	4	5	6	7
Cost of bringing in consultants	1	2	3	4	5	6	7
Cost of changing the information system	1	2	3	4	5	6	7
Cost of training	1	2	3	4	5	6	7
Cost of running a dual cost system for some period of time	1	2	3	4	5	6	7
Cost of gathering and processing more detailed data	1	2	3	4	5	6	7

The rest of the survey looks at cost allocation techniques which may have been implemented in part or all of your firm, as well as the process by which they were implemented. These questions are independent of the previous questions. Three increasingly detailed techniques are considered; each is described below:

Single Plantwide Allocation Method	Allocates *all* indirect plant manufacturing costs via a single cost driver. LEAST DETAILED method.
Departmental or Multiple Plantwide Allocation Methods	Allocates all plant manufacturing costs by using either a single rate per department or multiple plantwide rates. MODERATELY DETAILED method.
Activity- or Process-Based Allocation Method	Assigns costs to individual activities or processes (rather than departments), then traces costs to users of the activities. MOST DETAILED method.

13. For each of the three types of allocation techniques, indicate 1) whether or not your plant has implemented it, 2) the year in which it was implemented, and 3) the percentage of your plant's manufacturing costs associated with the areas in which it is implemented. *(A given area of the plant may use more than one technique, so percentages do not have to equal 100%.)*

	Implemented?		*If Implemented:*	
	Yes	*No*	*Year*	*% of Mfg Costs*
Single Plantwide Allocation Method	❑	❑	____	________%
Departmental or Multiple Plantwide Allocation Methods	❑	❑	____	________%
Activity- or Process-Based Allocation Method	❑	❑	____	________%

14. Indicate the number of indirect cost pools used in your plant under the various allocation methods. (Skip the method if it is not implemented; circle "7" if 7 or more pools are used.)

	Only Two Cost Pools					*Seven or More Cost Pools*
Departmental or Multiple Plantwide	2	3	4	5	6	7
Activity- or Process-Based	2	3	4	5	6	7

15. Considering your entire plant's existing cost allocation methods, rank the plant's level of implementation of more detailed cost allocation methods along the continuum below. Circle the appropriate response.

	Only Single Plantwide Allocation Methods Implemented	*Mixtures of Different Allocation Methods Implemented*	*Only Very Detailed Methods (i.e., ABC) Implemented*
Overall level of implementation	1 2 3	4 5 6 7 8	9 10 11

16. Do your operations personnel keep an allocation system that is separate from your financial one?

❑ Yes ❑ No

17. Indicate below whether your firm has abandoned a previously implemented allocation method or still uses it. Please provide the appropriate responses. (Skip the method if it was never implemented.)

	If Abandoned: Year Implemented	*If Abandoned:* Year Abandoned	*If Still in Use: Are You Satisfied?* Yes	*If Still in Use: Are You Satisfied?* No
Single Plantwide Allocation Method	________	________	❑	❑
Departmental or Multiple Plantwide Allocation Method	________	________	❑	❑
Activity- or Process-Based Allocation Method	________	________	❑	❑

18. Indicate any changes in allocation methods that your plant is planning to make within the next year. Please check the appropriate response.

	Drop	*No Change*	*Implement*	*Expand Use*
Single Plantwide Allocation Method	❑	❑	❑	❑
Departmental or Multiple Plantwide Allocation Method	❑	❑	❑	❑
Activity- or Process-Based Allocation Method	❑	❑	❑	❑

19. If multiple plants from your firm respond, would you mind if your input is shared with them? (Again, your input will NOT be released to other firms.)

❑ Yes. Other plants in my firm may receive my input

❑ No. Do not share my input with any other plants or firms.

Thank you for your time, energy, and thoughtfulness. Your assistance is greatly appreciated. Confidentiality of your responses will be protected.

Description of Terms

General

Cost-Reduction Effort — Structured effort designed to identify and reduce sources of excessive costs.

Cost Center — An organizational unit or product for which costs are collected.

Cost Pool — A pool of money (especially indirect costs) formed from costs which are viewed as sharing a common cost driver. The money in a cost pool will be spread over other cost objects (organizations or products) by the degree to which they consume the cost driver.

Champion — A person who advocates a certain change within the organization and attempts to see it implemented. The person may not have the authority or funding to actually sponsor the change, but the person would attempt to influence such a sponsor, as well as generating support among other members of the organization.

Essentially the Same Routing — Condition where most products flow through the same sequence of operations.

Firm — The overall parent company of the plant if a single industry is involved; otherwise, the segment of the company responsible for the plant's industry.

Product Life Cycle Stages

Introduction Stage — Commences with the full-scale marketing of the product in its intended market or in a large region. This stage is also characterized by low unit sales; losses or low profits; product vulnerable to attack from competing items; relatively few distrbutors; inexperienced personnel; product is often manufactured in pilot plants; product debugging; and initial promotions.

Growth Stage —Begins when unit sales start increasing at a growth rate of more than one percent monthly. This phase is also epitomized by: substantial profits; existence of many distributors; less product vulnerability; use or development of full-scale production lines; heavy amount of manufacturing overtime; and adding new models to the product line.

Maturity Stage — Occurs when sales volume continues to increase, but at a decreasing rate and, eventually, levels off or declines slightly. Unit sales may fluctuate within the range of plus or minus one percent monthly. This stage is also represented by: profits reaching a plateau and declining; existence of many aggressive competitors; declining prices; production facilities or processes in need of heavy repair; cost-price squeeze; development of new markets or new product models and sizes; and special sales inducements or concessionsto customers.

Decline Stage — Occurs when unit sales decline at an increasing rate or at more than one percent monthly. Other attributes of this stage are declining profits; product substitution by distributors; sales and profit decline cannot be curtailed except in the very short run; promotional support is withdrawn; R&D budget is cancelled; and manufacturing equipment is sold.

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