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A LONGITUDINAL STUDY OF QUALITY MANAGEMENT PRACTICES IN THE MANUFACTURING SECTOR

BY

CHARLES M. RYAN

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
Doctor of Philosophy
in the
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GEORGIA STATE UNIVERSITY
COLLEGE OF BUSINESS ADMINISTRATION
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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the College of Business Administration of Georgia State University.

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Chair

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Finally, I thank God for my wife Debbie. She is my partner and best friend, absolutely unwavering in her support of me. My success is hers, and I look forward to our next great adventure together.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES. cont.

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

A Longitudinal Study of Quality Management Practices in the Manufacturing Sector

By
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March. 1998

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Major Department: Management

The overriding purpose of this dissertation has been to investigate the relationship between change in quality management adoption patterns and performance of small- and medium-sized manufacturing firms. A sample of 425 firms representing a broad range of industry were surveyed. The instrument and experimental design of this dissertation demonstrate that longitudinal studies of quality management program transformation can be successfully undertaken.

Factor analysis, mapping of change in hierarchical quality management adoption level change, and analysis of variance were used to identify movement in quality management adoption level. Significant movement among quality management adoption levels was identified. Furthermore, patterns of quality management adoption level change were shown to be related to change in firm performance. The results of this research suggest that movement in cluster membership is more powerful in predicting performance levels than change in any single quality management factor.

This research also identified significant change in quality management intensity among firms. Factor analysis, regression, logistic analysis, and analysis of covariance were used to study

change in quality management, over time, and firm performance. Significant relationships between change in quality management intensity and operational performance of the firm were revealed. The results of this analysis suggests that clusters of change in level of quality management intensity are more powerful predictors of firm performance than change in any single quality management measure.

Chapter I
INTRODUCTION

Quality management issues became increasingly important in the United States during the late-1970's and early-1980's as global competition began in earnest. U.S. firms found themselves losing increasing segments of their markets to foreign competition whose quality management skills, and ultimately their products, were superior (Saraph, Benson, & Schroeder, 1989). This loss of market resulted in renewed practitioner focus on quality and research on issues surrounding quality. Quality management remains an important topic in the academic literature. In the past five years, more than 3,900 quality-related articles have appeared in academic publications. Leading journals such as *Management Science, Decision Sciences, Academy of Management Journal, Journal of Management, Administrative Science Quarterly, Academy of Management Review, Journal of Operations Management, Strategic Management Journal,* and *International Journal of Operations* have either recently published articles dealing with quality management or have devoted entire issues to the subject (i.e. Smith, Tranfield, Foster, & Whittle, 1994; Hackman & Wageman, 1995; Powell, 1995; Anderson, Rungsusanatham, Schroeder, & Deveraj (1995); Dean & Snell, 1996). Feigenbaum (1982) summarizes the importance of quality stating that it is the key to successfully competing in a global market. This assertion is supported by recent research reporting that U.S. executives feel that improving product and service quality is the number one issue in the marketplace (Zeithaml, Parasuraman, & Berry, 1990).

While there is a vast body of literature dealing with the subject of quality management, there is a need for analyses that document changes taking place within the organization after TQM programs are implemented. Hackman and Wageman (1995) report that less than 15% of the academic work undertaken in the area of quality management addresses the "effects of TQM

interventions and the means by which those effects are generated" (p. 318), and most of those endeavors rely on anecdotal descriptions of specific quality interventions.

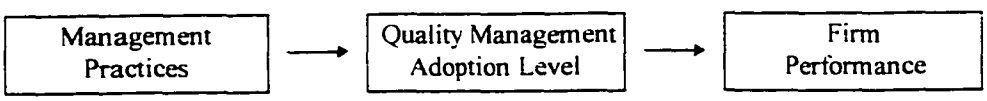
Purpose of the Research

The central issue addressed in this dissertation is the longitudinal effect of total quality management (TQM) programs on manufacturing firms. The general objectives of the research are to: 1) empirically investigate changes that occur over time in quality management programs and 2) to identify the impact of those changes on firm performance.

This research builds upon a previous dissertation by Ellington (1995). Ellington empirically confirmed varying levels of quality management adoption among a database of almost 500 small- and medium-sized manufacturers in 1994. He assessed a firm's level of quality management adoption through an analysis of a large number of management practices in areas such as training, employee authority, supervisory practices, etc. He also related quality management adoption levels to firm performance, as illustrated in Figure 1.

Figure 1

Quality Management Adoption Process



Ellington found that higher levels of quality management adoption were associated with higher firm performance.

This research examines changes in the quality management programs among the same group of manufacturers surveyed by Ellington. The research analysis will be conducted in two

distinct phases. The first phase will determine whether firms significantly alter their quality management adoption intensity over time. Quality management adoption intensity is defined as the degree of application of underlying quality management initiatives deployed by the firm. Do firms with higher degrees of quality management adoption in 1994 also tend to exhibit higher degrees of adoption in 1997? Likewise, are there firms that move from a lower degree of quality management adoption in 1994 to a higher degree of quality management adoption in 1997?

For firms that do make a transition in quality management adoption, it is of interest to determine whether "across the board" changes in quality management practices are observed. That is, is a significant increase in degree of quality management adoption typically associated with focused changes in a specific quality area such as training, role of management, etc., or are the changes of a more holistic nature.

The second phase of the research analysis will examine the relationship between migration among quality management adoption levels and firm performance. Quality management adoption level is defined as membership in a four-cluster hierarchy developed by Ellington (1995). The literature suggests that firms which have adopted TQM at any level should continuously improve. Continuous improvement should result in enhanced performance. However, the performance of firms altering their quality management adoption practices has not heretofore been studied.

TQM Defined

For the purposes of this undertaking, TQM is defined as continuous improvement through collaborative efforts across functional boundaries and between organization levels with the ultimate goal of providing customer satisfaction (Evans & Lindsay, 1993). This definition is consistent with the literature and captures the key elements of quality management such as

product/service design, conformance, training, employee relations, leadership, and performance (Crosby, 1980; Deming, 1986; Garvin, 1988; Juran, 1988; Benson, Saraph, & Schroeder, 1991).

Research Scope

This is a longitudinal study of small- to medium-sized manufacturing firms that replicates the work of Ellington (1995). Consistent with the literature, a small- or medium-size business is defined as one with less than 1,000 employees (Business Week, 1992). Ellington identified over 8,000 small- to medium-sized manufacturing firms which were located in Georgia. The State was stratified into 13 regions, and the final sample was randomly selected by region. A total of 486 usable responses were received (48.6% net response rate) in 1994, and these respondents form the target population of the current research.

Rationale for the Research

Since the late 1980's the number of both small and large firms implementing TQM has grown significantly (Durity, 1991). Businesses are pouring substantial sums of money and time into quality improvement programs (Smith, et al., 1994). Many programs have been successful: Xerox, Allen-Bradley, Motorola, Marriott, Harley-Davidson, Ford, and Hewlett-Packard are examples. This success is not limited to large firms. Three small electronics firms won Baldridge awards in 1990 (Fuchsberg, 1992). However, there have also been many disappointments. Surveys have shown failure rates as high as 67%, even for programs which have been in place two years (Smith, et al., 1994).

The primary criticism of academic research that has attempted to capture the effects of quality management on performance is that the research is primarily cross-sectional and evidence is largely anecdotal. There is a need for empirical research that investigates what occurs

subsequent to quality program implementation (Hackman & Wageman, 1995). To date, there is no research in the literature that attempts to fill this void. Thus, this exploratory study investigates the long-term effects of TQM programs, the associated underlying quality program changes within organizations, and the resulting impact of quality program changes on performance.

Organization

This dissertation is organized into six chapters. Chapter I has introduced the research and related issues of interest. Chapter II presents a review of the literature in terms of quality management implementation, organizational change, and performance. Chapter III describes a model of change which underpins the entire research project. Chapter IV discusses research issues and methodology. Chapter V summarizes results of the empirical analysis. Chapter VI contains conclusions, limitations of the study, and implications for future research.

Chapter II
LITERATURE SURVEY

This research investigates changes that take place after TQM program implementation and the effect of those changes on performance. Thus, there are three relevant subject areas within the context of total quality management that must be explored: implementation, change, and performance, respectively.

Implementation

Price & Chen (1993) conducted a case study of TQM implementation in a small, high-tech company. They believe that small firms should gradually adopt quality management, rather than implement it in one step. They suggest that a type of Pareto approach be used: the company should first identify several important projects, implement the changes, and demonstrate success before taking additional steps. The key is that the first application chosen is one that will provide "tangible" benefits for the organization (p. 109). The use of teams and their training is critical. Training should first take the form of providing education in basic TQM methods and generate enthusiasm for quality improvements. Once training in fundamental quality management techniques is accomplished, efforts should move towards educating entire teams in more sophisticated tools as skills at each level are mastered.

Kordupleski, Rust, and Zahorik (1993) offer an explanation as to why TQM programs are not always successful. They believe that some failures result from the fact that the firm becomes so involved with the tools of TQM such as improvement teams, quality circles, SPC, and continuous improvement that they actually lose sight of the customer. Everyone concentrates on improving processes, but fails to stay centered on those which customers deemed most important. The situation is analogous to an aircraft crash. Pilots become so involved with monitoring cockpit

instruments that they forget to look out the window. missing the fact that they are about to fly into a mountain.

Kordupleski. et al. (1993) advise that they key to preventing quality management program failures is to link the customer to quality efforts and measure key issues directly through customers. whose needs may be entirely different from those that management thinks are important. The authors suggest the best place for this analysis to take place is in marketing departments.

Hackman & Wageman (1995) present an outstanding critique of TQM in their review of empirical. conceptual. and practical issues. First. to achieve quality. they note that it is absolutely necessary to know what customers want and to provide products and services that meet these requirements. Second. they suggest that there are five core features of a TQM program: 1) the organization continually assesses customer requirements and measures performance against those requirements. 2) that suppliers are chosen on the basis of quality and the organization works with them to improve supplier quality. 3) members of the organization operate independently as team across functions. 4) the use of statistics and scientific reasoning is employed to formulate and test hypotheses regarding work processes and strategies for performance improvement. and 5) firm members use process-management heuristics to improve the decision-making and problem-solving capability of team members. Finally. they suggest that a full analysis of the effectiveness of any total quality program must include: 1) an empirical demonstration that a total quality management package has been implemented. 2) a determination of whether quality management has changed how people work together to meet customer requirements, and 3) a quantitative assessment of bottom-line outcomes.

Carman (1993) conducted a case study of the quality management program at Southern Pacific Railway. The firm implemented quality improvement in three phases. The first was to provide clear leadership and commitment from top management, and the hiring of a seasoned executive intimately familiar with quality management (QM). A quality department was subsequently formed and key staff positions were filled with personnel experienced in QM. Phase two was designed to build enthusiasm by selecting a pilot project, using employees in structured problem solving, and involving union leaders. Phase three centered on increasing the employee participation and improving processes. Training, QM teams, benchmarking, cross-functional planning and the use of key performance indicators were implemented. Carman proposes that one of the lessons to be learned from the experience is that not everyone needs to be trained up front or for all data to be in ideal form. Training, data collection and analysis, and team formation can take place simultaneously, as long as objectives and strategy are clearly communicated by top management.

Ellington (1995) identified 29 factors which comprise the degree of TQM adoption. These key implementation factors are shown in Appendix A. The factors identified by Ellington (1995) are measures of customer focus (4 factors), breadth of quality definition (2 factors), use of quantitative measurement systems (2 factors), process capability (1 factor), vendor conformance (2 factors), manufacturing conformance (2 factors), employee involvement in problem solving (3 factors), priority on improvement (3 factors), structures for continuous improvement (2 factors), manager's responsibility (2 factors), and quality management training (6 factors). Ellington (1995) then grouped the firms into clusters based on the 29 measures derived in the factor analysis. A four cluster solution was identified, which suggests that there are four levels of

TQM adoption: 1) strategic or holistic adopters. 2) threshold adopters who focus on quality tools training. 3) selective adopters who are unfocussed in their selection of quality management components. and 4) non-adopters who exhibit traditional manufacturing focus and supervisory roles.

Change

March and Simon (1958) believe that organizations do not consider alternatives to their current methods of doing business unless management perceives that the current course is leading to an "unsatisfactory" conclusion (p.173). They write of an inverse relationship between satisfaction and the amount of searching undertaken by a firm for a different business approach. Thus. a firm that is satisfied continues with its current program. However. the organization which is highly dissatisfied with its performance actively seeks alternative processes. procedures. or focus.

Cyert and March (1964) proposed that businesses are "adaptive institutions" (p. 100). The adaptive system consists of several properties. The first is that there are alternatives. and within these alternatives are those that are preferable. Second. there are outside influences which organizations cannot control. These "shocks" impinge on the organization (p. 99). Third. there are many internal decision variables which can be manipulated in response to these outside "shocks". Fourth. there is an interaction between the shocks and the decision variables. Different combinations of the decision variables and outside influences result in distinct organizational changes. Finally, decisions which lead to preferred states are more likely to be used in the future. Decision sets which lead to unsatisfactory conclusions are likely to be scrapped in the future.

The work of Cyert and March (1964) suggests that firms will be forced to periodically review their performance as a result of outside "shocks" to the organization. Policies and procedures which are viewed as resulting in successful performance are unlikely to be changed.

Perhaps the best known model of change within a TQM context originated with Shewhart in the 1930's and has subsequently been called the "Deming Wheel" (Deming, 1986, p. 88). Deming's model suggests a continuous cycle of planning a change, executing the plan, observing or checking the effects of the change, and either institutionalizing or abandoning the change (PDCA). The central idea is that no matter how well a firm is currently performing, it could always do an even better job. Deming's model of plan, do, check, action in the normal course of business, irrespective of performance level, represents a shift away from the March and Cyert (1964) model which suggests that firms are unlikely to change successful policies and procedures.

Ellington (1995) models change as a four step linear process of: 1) dissatisfaction; 2) unfreezing attitudes, perceptions, and actions; 3) introduction of transformation or change; and 4) refreezing with the transformation complete. That dissatisfaction is the first stage is supported by both March and Simon (1958) and Cyert and March (1964). An organization is unlikely to undergo change unless a better course is perceived. Where results are unsatisfactory, however, the organization unfreezes its policies, procedures, and processes to challenge the old way of doing business. As a preferred course of action is arrived at by building a new decision variable set, the organization implements those changes. Finally, those changes are institutionalized until the next shock results in unsatisfactory performance.

Benson, Saraph, & Schroeder (1991) used MANCOVA and canonical correlation to test an organization theory-based model for managing quality in organizations. A stratified random

sample of 22 small, medium, and large firms was taken. Each firm had from two to ten business units. A questionnaire based on Saraph, Benson, and Schroeder's 1989 scale for managers was distributed to each business unit's general manager and top quality manager. A total of 152 responses were received. The survey asked the executives' opinions on ideal and actual management and evaluations of their quality context which included managerial knowledge, corporate support for quality, marketplace environment, product/process environment, and past quality performance. The study found that management actions with regard to quality issues are triggered by stimuli in their environments and that quality management is contingent upon past experience. The authors report that, " ...corporate support and past performance turned out to be important contextual variable for...managers" (p. 1118).

Madu and Kuei (1993) propose a transformation or change model based on the notion of strategic total quality management. Their model shows quality to be driven by customer and environmental needs, and identifies 10 factors critical to firm competitiveness and survival. The strategic quality management model (STQM) appears to work in concert with the Deming's (1986, 1993) PDCA cycle. STQM suggests that the environment and customer demands cause the organization to reevaluate systems, supplier relationships, and firm culture. The outcome of the evaluation process is a new organization. The resulting new organization is subsequently appraised in light of firm performance, which provides feedback in terms of both positive and unfavorable outcomes. Outcomes are then matched with the environment and customer needs, and the process of assessment begins anew.

Performance

Schonberger (1992) offers Zytec Corp. a Baldridge Award winner. as a model for measuring performance within TQM. The process used by Zytec was to develop a five-year plan through the use of cross-functional teams which include customers and suppliers. The plans were finalized by executives who prepared generalized one-year objectives. Each Zytec department and team developed action plans. which included monthly goals. using the general one-year objectives provided by executive management. The resulting blueprints were then operationalized into financial plans.

Schonberger (1992) prefers the Zytec system as it features both operational and financial performance targets. He notes that the best companies do not frame performance goals solely in terms of financial measures. Rather. the top performers extend their performance objectives to measures of cycle time. quality. skill-upgrading. and machine up-time.

Kordupleski. Rust. and Zahorik (1993) propose that market share can increase as a result of quality. The increased market share results from two things: 1) the retention of old customers. who remain loyal to the product and 2) the acquisition of new customers who perceive that the product is of higher quality. The authors caution. however. that there might be a time lag between increased quality and improved market share owing to cyclical purchase patterns. Customers may not buy the product. even though quality is increased. since the improvement occurs before it is time for the next purchase. The authors cite mainframe computers as an example. They suggest computers are purchased on a five-year cycle. Thus. five years may pass before the customer's satisfaction with product quality is shown in the form of another purchase.

Belohav (1993) identifies several reasons why performance might not be enhanced by quality management efforts. Industries in decline, poor economic climate, and a lack of understanding of the industry on the part of the firm are possible explanations for poor performance, despite TQM deployment. Belohav (1993) notes that as forces of industry, defined by Porter (1980), change they essentially define a new industry. Unless these changes are realized and acted upon, the firm may be doomed. Therefore, we might expect industries that have undergone frame-breaking change to have higher TQM program casualty rates than those industries which are more stable.

A case study conducted by Carman (1993) showed that quality improvement was entirely responsible for Southern Pacific Railroad's return to profitability. Key to the improvement were the use of interfunctional quality improvement teams, consistent top executive leadership and support of the initiative, the use of quantifiable key performance indicators, and formal quality management training.

Cole, Bacdayan, & White (1993) also found that participation and training are related to performance. The scope of participation is broadened to include all employees and departments. Workers both individually and in teams are trained to design their own processes. Cole, et al. observe that participation alone, or outside of a quality management program, yields little improvement in performance, citing failures of quality circle programs undertaken in the United States during the 1980's.

Goshall and Bartlett (1994) note that perhaps the most fundamental method of measuring performance is the use of financial data and stock prices. They describe such assessment as being

routine in practice, observing that popular business and trade magazines routinely rate the overall performance of firms and the effectiveness of management.

Phillips, Chang & Buzzell (1983) used PIMS data and LISREL to study the effects of product quality on direct costs, ROI, and marketshare. The study was limited to manufacturing firms in six categories ranging from nondurable consumer goods to capital goods. Results showed that higher product quality results in higher ROI indirectly through improved market share. Direct ROI effects were seen in only three of the six firm categories: consumer nondurables, capital goods, and components. Another key finding is that quality is associated with lower direct costs. Finally, only in consumer durables is higher quality associated with higher marketing expenditures, and there is little evidence that achieving higher quality requires systematic trade-offs in other cost areas such as marketing. Dependent variables used in the analysis were relative direct costs, relative market position, relative prices, and ROI. Independent variables were investment intensity of business, vertical integration of business, real market growth in the product market, unionization, capacity utilization, percentage of business derived from new product introductions, sales force expenditures relative to competitors, advertising/promotion expenditures relative to competitors, and relative product quality.

Anderson, Rungsusanatham, Schroeder, and Devaraj (1995) collected data on 41 plants which were stratified into sample categories of: 1) Japanese-owned U.S. plants, 2) U.S. plants with world-class reputations, and 3) "Traditional" U.S. plants. The objective was to test their earlier theory of quality management underlying Deming's 14 point management method. The path model investigated the relationships among visionary leadership, internal and external cooperation, learning, process management, continuous improvement, employee fulfillment, and

customer satisfaction. All but two paths were found to be significant. A path between learning and process management was not significant, and the authors suggest that a multicollinearity problem is the probable reason. The other insignificant path linked continuous improvement and customer satisfaction.

Flynn, Schroeder, and Sakakibara (1995) constructed and tested a path model of quality management using Garvin's (1988) eight dimensions and Hill's (1994) concept of order-winners and qualifiers. Their study showed that quality improvement explains 33% of the variance in competitive advantage. This leaves some 67% unaccounted for, which, they believe, suggests that there are other factors contributing to competitive advantage. The unexplained variance implies that concentrating solely on quality improvement may not guarantee long-term success in the marketplace.

Powell (1995) hypothesized that TQM firms outperform those without formal quality management programs. He used subjective measures in a survey of CEOs and quality executives in the Northeastern U.S. Overall financial performance was measured subjectively, and measures addressed profits, sales growth, and overall financial performance. He found that firms practicing TQM performed better than those without a TQM program.

Dean & Snell (1996) investigated in a longitudinal study the strategic use of integrated manufacturing, a construct which integrates the use of advanced manufacturing technology, just-in-time inventory control, and total quality management. The authors employed factor analysis and hierarchical regression to conclude that TQM accounted for some 23% of the total variance in performance. Performance was represented by an eight item scale, which was based on

subjective assessments of current performance in terms of productivity, lead time, product quality, etc. relative to competitors within the same industry.

Smith, Tranfield, Foster, and Whittle (1996) note that a substantial body of literature exists that shows quality management programs often fail. The authors cite studies which report failure rates ranging from 20 percent to 67 percent, even two years after TQM was implemented. Smith, et al. indicate that quality management programs will likely fail or "run out of steam" 18-24 months after implementation (p. 75). The authors believe the problem exists largely owing to an inability of firms to break out of the existing mindset. They propose that the solution is to practice "TQM2" which consists of a sequence of deploying mindset audits, assumption surfacing, mindset expanding, and refocusing the quality management program (p. 82). TQM2 suggests that quality management program success is contingent on the situation, and that simply sticking to one approach is likely to lead to failure.

Ahire (1996) also studied the impact of TQM programs, centering on the following question: Is TQM a long campaign, one taking several years before desired results are seen? He surveyed a total of 499 U.S. and Canadian plant managers (30% response rate) and found that successful firms see measurable benefits of their quality management efforts in 2-3 years. The survey results also indicate that higher adoption levels of constructs representing top management commitment, customer focus, supplier quality management, design quality management, benchmarking, use of SPC, use of internal quality information, employee involvement, employee training, and employee "empowerment" are associated with better operational results. Ahire further posits that higher adoption levels will continue to be associated with higher performance.

Flynn, Schroeder, & Sakakibara (1994) identified seven dimensions of quality: top management support, quality information, process management, product design, work force management, supplier involvement, and customer involvement. From the seven dimensions, a set of 14 perceptual scales was developed to measure worker perceptions of quality at the plant level. The scales were pretested at 12 plants throughout the U.S. and subjected to an analysis using responses from 716 people at 42 U.S. plants which were stratified by industry. The authors note that basing measures only on the basis of responses from managers has "the potential for bias" (p. 341).

Conclusion

Total quality management continues to be an important research topic. There is a growing body of cross-sectional and anecdotal evidence that level of quality management implementation, change in quality management focus or relative intensity of quality management initiatives within the context of a quality management program, and performance are linked. However, there has been little empirical research into what happens to the relationship between change in quality management programs and performance over time. It is this apparent gap in the literature that the current study seeks to fill.

Chapter III
A LONGITUDINAL QUALITY MANAGEMENT MODEL

Introduction

The longitudinal quality management model developed in this study builds on previous work by Deming (1986); Benson, Saraph, and Schroeder (1991); Madu and Kuei (1993); and Ellington (1995). Consistent with the literature, Ellington (1995) identified three key causal components of quality management and related them to TQM adoption levels and firm performance. The three components are: 1) scope of the quality management initiative, 2) quality management training, and 3) managerial role in implementation. These three key components of TQM and firm performance are introduced in the first sections of this chapter. Potential paths of quality management adoption transformation are then discussed, followed by a discussion relating firm performance to quality management adoption change. Four important process models of quality management are presented, and the chapter concludes with the introduction of a longitudinal quality management model.

Scope of the Quality Management Initiative

Scope is a combination of customer focus, quality of design, quality of conformance, and continuous improvement. Customer focus is the starting point of any quality management program (Hackman and Wageman, 1995) and accounts for 30% of the Malcolm Baldridge National Quality Award criteria. Customers are both internal and external to the firm. Internal customers are the organizational entities (i.e. teams, departments, divisions, etc.) who receive the output of a previous group. The framing of internal entities as customers encourages increased quality of workmanship, serving to discourage poor quality work being passed to the next

department. Internal customers include traditional in-house service functions such as accounting, data processing, human resources, purchasing, and maintenance.

The philosophy of serving both internal and external customers results in an expansion of the definition of quality to include performance, reliability, attractiveness of the product, and service. These are translated into customer requirements and design specifications. These specific design quality levels must be achieved in order for internal and external customers to be satisfied.

Achieving customer-based design quality levels on a consistent basis is a theme promoted by both Deming (1986, 1993) and Juran (1988). Consistently attaining the desired degree of design quality requires a shift towards process effectiveness, supplier quality, and shifting responsibility and authority to the factory floor. The objective is to reduce variation and improve conformance quality within existing processes and purchased products/services.

Vessey (1992), Slater (1993), and Bayus (1994) speak of the increasing speed of today's marketplace. What is considered to be of good quality today may be inferior tomorrow, as firms scramble to improve existing lines and introduce newer and better products and services. Continuous improvement (CI), long a basic component of TQM, has become a necessity. The present research is interested in the level of management priority given CI, level of firm involvement in continuous improvement, and structure of the continuous improvement process.

The priority given to continuous improvement is indicated in the firm's approach. High levels of CI priority are demonstrated when the firm is proactive, embedding improvement into all processes and systems. Low levels of priority are indicated by "fire fighting", responding only when customers complain.

Continuous improvement involvement is a construct exemplifying the extent to which goals and vision of executive management permeates throughout the organization, so that each operation, or activities of each organizational entity, are aligned with those goals. The alignment of actions and goals can only be achieved with the commitment of top management (Crosby, 1979; Deming, 1986; Garvin, 1988; Juran, 1988; Carman, 1993; Flynn, Schroeder, & Sakakibara, 1994; Hackman & Wageman, 1995).

Continuous improvement structure deals with systems and processes which promote improvement efforts. These can be as informal as unscheduled exchanges with management and the use of suggestion boxes to more formalized initiatives such as planned team meetings with established procedures for implementing improvement ideas.

Overall, scope of the quality management initiative represents how a firm approaches the implementation of the quality management program. At the highest level of implementation, quality initiatives become an integral part of the firm's strategy. Thus, formal systems are implemented to solicit, analyze, and document customer requirements. These requirements drive formalized process and product specifications. Quality becomes the responsibility of everyone, and this filters to the lowest levels of the business. Cross-functional, self-directed teams are formed and given the authority to make decisions related to quality.

At intermediate levels of quality management implementation, continuous improvement is practiced; however, structural changes within the organization are not made. Quality improvement efforts are lead by management, and intervention teams are used extensively. These teams are guided by management who serve as links to executive management and who direct

what projects are selected, who is selected to serve on intervention teams, and levels and type of training.

The lowest levels of the quality management approach feature bare-bones implementation. Firm efforts are typically aimed more at cost reduction than quality improvement. The company may have documented quality procedures and processes, a formal quality council, and may even periodically use statistical techniques to analyze processes. However, the emphasis at this level is "business as usual" (Ellington, 1995, p. 40).

Quality Management Training

Training is a key component in a quality management program. Deming (1986, 1993) was a strong proponent of training both on the job and in programs of continuing education and self-improvement. Garvin (1988) notes that the Japanese were quick to grasp the long-term benefits of training and have used it to their advantage. Training is an important method of communicating changes in methods and standards of performance to employees. The variables of interest in this research are the type (or content) and levels (or amounts) of training conducted.

Ellington (1995) defines a robust training program as one that results in participant understanding of both the quality management philosophy and technical tools. The robust program explains the need for change, models of desired behavior, and tools and techniques while allowing for experimentation to facilitate learning at higher cognitive levels. Subject areas include team-based problem solving, group dynamics, data collection, statistical techniques, and methods for establishing priorities and targets.

Quantitative programs focus solely on the tools and techniques of quality management. Topics may include pareto analysis, cause and effect diagramming, and statistical process control.

The key is that emphasis is on quantitative techniques, as opposed to understanding the philosophy of quality management.

Qualitative programs concentrate on teaching the underlying philosophy of quality management. Relevant subject areas include teamwork, group dynamics, and interpersonal skills (Ellington, 1995). Often, improving relationships and interactions with customers is emphasized.

Managerial Role in Quality Management Program Implementation

The role of management transforms in TQM (Deming, 1993). The manager moves from being the sole source of influence within the department or group and serving as a primary communication link, to serving as a facilitator or coach. The manager practicing a pure facilitative role participates in the development of a planned change and champions its implementation (Benne & Birnhaum, 1969; Nadler, 1987). Furthermore, emphasis moves from supervising to process improvement. The goal is to shift daily operation decisions to line employees.

In a pure supervisory role, the manager continues to oversee day-to-day activities. The first-line manager is neither involved in the design of plans for change nor given responsibility and authority to help with implementation. The lack of authority and responsibility causes the manager to question the future as management signals the need for change (Ellington, 1995).

Firm Performance

There are two general categories of performance. The first is financial achievement, found in the operating statements of the firm (i.e. income statement and balance sheet). By definition, every transaction of the firm finds its way into either the balance sheet or income statement, and the two are ultimately linked by the accrual process and firm profits (Mosich & Larsen, 1986).

Hard financial results such as profitability and return on assets are examples of financial performance indicators.

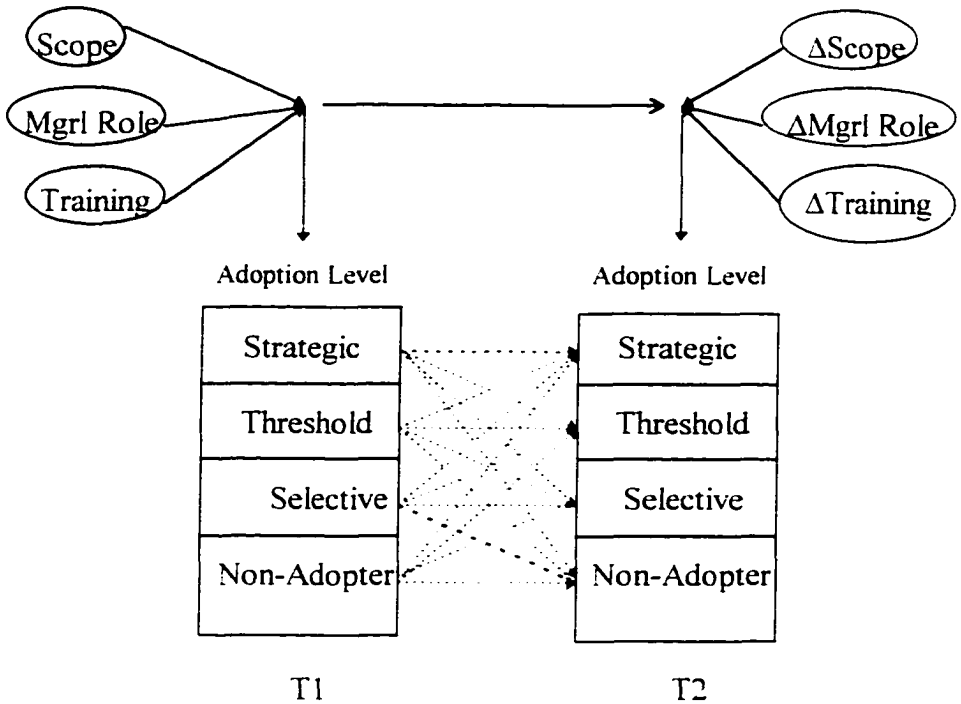
The second general category of performance consists of non-financial outcomes. These are just as important as they may be early indicators of ultimate success or failure. Examples here include market share, delivery speed, product quality, and customer service.

While the literature is filled with anecdotal evidence and the expectation that quality management programs are associated with firm performance (e.g. Deming, 1986; Crosby, 1987; Juran, 1988; Carman, 1994; Smith, Tranfield, Foster, and Whittle, 1996), there is little empirical evidence which confirms the association (Phillips, Chang, & Buzzell, 1983; Benson, Saraph, & Schroeder, 1991; Ellington, 1995). Given the apparent gap in empirical evidence, it is of interest to investigate these relationships (financial and nonfinancial) in terms of both past and current performance. As discussed earlier in this chapter, past performance is important as it is often a catalyst for change. Current performance is also key, as it allows a contrast of current levels of attainment with previous levels, facilitating the study of movements in performance.

Quality Management Adoption Change

The intensity of quality management scope, training, and managerial role deployed by the organization define the firm's level of quality management adoption. This research seeks to investigate changes in quality management adoption intensity and resulting changes in quality management adoption level among the same group of manufacturers surveyed by Ellington (1995). The literature suggests that firms may increase, decrease, or hold constant their degree of quality management adoption (Ellington, 1995; Ahire, 1996; Smith, et al., 1996). Change in quality management adoption is modeled in Figure 2.

Figure 2
Paths of Quality Management Adoption Transformation



The movement in adoption level, represented by the dotted lines, results from changes in key quality management variables underlying scope, managerial role, and training (Ellington, 1995). What is not known is whether the firms manipulate the same variables over time to produce either an upward or downward shift in adoption level, and to what extent scope, training, and managerial role change in relative importance.

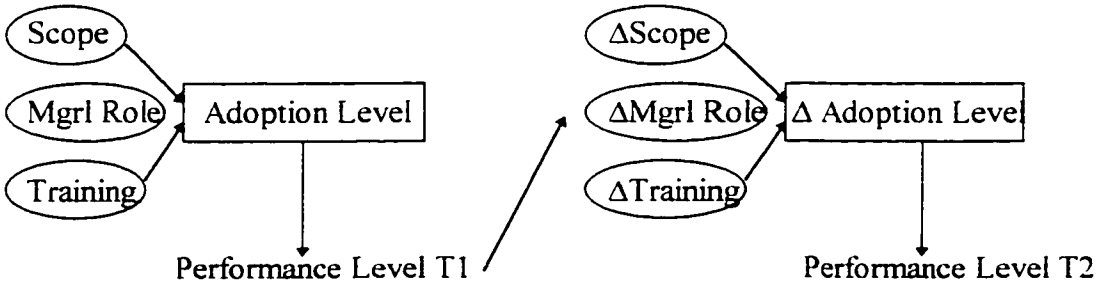
Performance Level Change

Both Ellington (1995) and Ahire (1996) demonstrate that quality management adoption change is associated with firm performance. Ellington developed a four-level hierarchy of quality management adoption: strategic or holistic adopters, threshold and selective adopters at intermediate levels, and non-adopters. His work showed that membership in higher levels of the

quality management adoption hierarchy were associated with greater performance levels. Thus, one would expect strategic adopters to outperform non-adopters.

Ahire (1996) found in a cross-sectional study that firms more experienced in TQM outperformed those less experienced. He noted that firms more experienced in TQM executed the following 10 quality management constructs "more rigorously" than less experienced firms: 1) top management commitment, 2) customer focus, 3) supplier quality management, 4) design quality management, 5) benchmarking, 6) SPC usage, 7) internal quality information usage, 8) Employee involvement, 9) employee training, and 10) employee empowerment. He therefore deduced that adoption level is related to performance. Both studies suggest that changes in underlying dimensions of scope, managerial role, and training result in differing levels of firm performance. The relationship among scope, adoption level, and performance is illustrated in Figure 3.

Figure 3
A Model of Key Variables, Adoption Level, and Performance



Scope, managerial role, and training are key variables of total quality management, the intensity of which results in a level of quality management adoption (Ellington, 1995). Adoption levels appear to be related to performance. Thus, changes in both quality management intensity and adoption levels should be related to changes in performance over time. However, the actual longitudinal

relationship among key variables, intensity, adoption level, and performance has not heretofore been tested empirically.

A Longitudinal Model of Quality Management Transformation

There are four models that are relevant to the construction of a longitudinal model of quality management adoption. The first model is that of Ellington (1995), which suggests that firm performance results from the degree of TQM adoption. Organizational change is showed as a linear process of dissatisfaction; unfreezing attitudes, perceptions, and actions; introduction of change; and refreezing with the transformation complete. Phases of the TQM change process are shown in Figure 4.

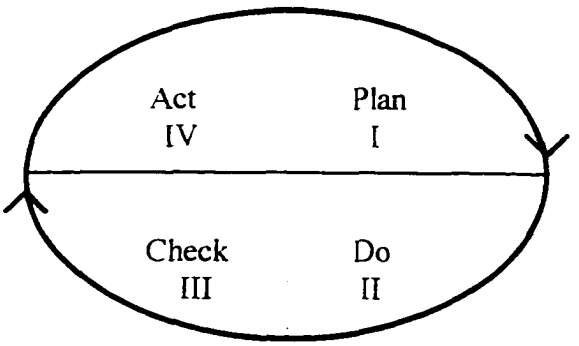
Figure 4
Phases of the TQM Change Process

Dissatisfaction ⟶ *Unfreezing* ⟶ *Change* ⟶ *Refreezing*

Dissatisfaction with profit or management style triggers a review, unfreezing, and change in quality management scope, role of management, and training interventions deployed by the firm. As the quality management initiatives are transformed, the level of quality management adoption also changes and is frozen.

The second model is based on a philosophy of continuous improvement and originates from Deming (1986, 1993), who believed that a loop exists in quality management. His cycle of plan, do, check, act (PDCA) suggests contingent action. He proposed that firm performance could be enhanced by continually using the PDCA approach. Deming's model of continuous improvement is shown in Figure 5.

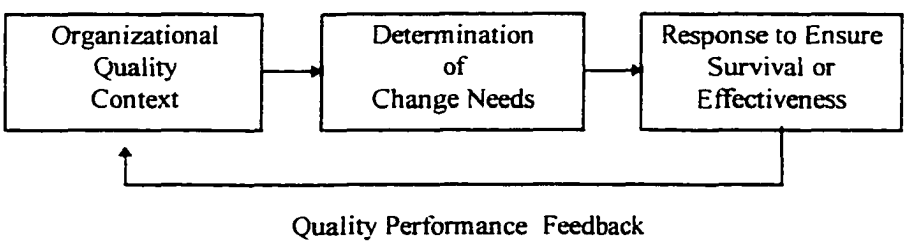
Figure 5
PDCA Model



Step one, "plan", is to identify important accomplishments that could be made or changes that might be desirable. Step two, "do", is to carry out the modifications identified in step one. The third step, "check", involves studying the effects of the change using empirical methods. The objective is to establish what was learned that could enhance "tomorrow's product" (1987, p. 88). The final step is to "act" on the change, and the entire process begins again.

Benson, Saraph, and Schroeder (1991) believe that past performance is an important variable that influences quality management (QM). They model QM as a three-stage sequence of events that are tied together with a quality performance feedback loop. The three-stage change model is illustrated in Figure 6.

Figure 6
Three-Stage Change Model

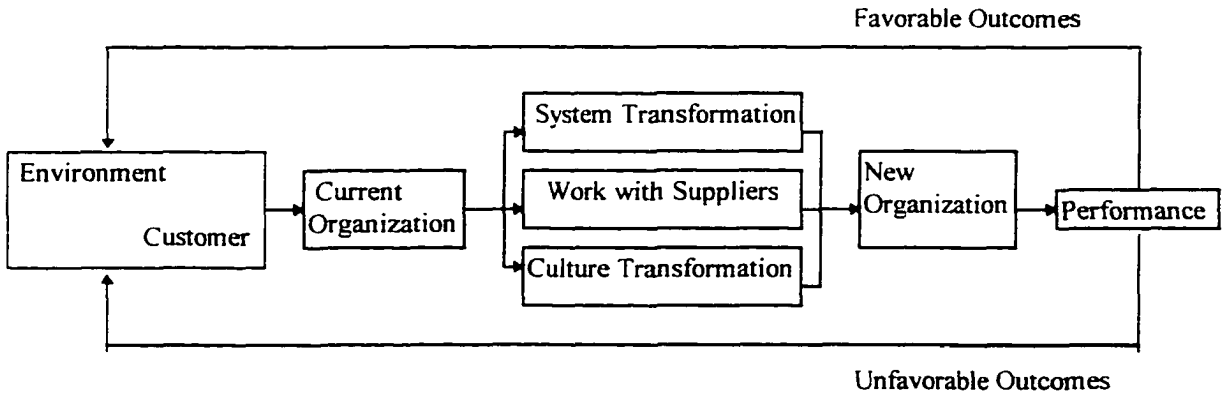


In the first stage, managers consider past performance, external quality demands, resources that might be available to improve quality, and the competitive environment. In stage two, based on

the considerations and positions identified in stage one, managers formulate the need for change. In stage three, knowing the "context and...change needs", a response is initiated to achieve the desired level of quality (Benson, et al., 1991, p. 1108).

Madu and Kuei (1993) model strategic quality management (STQM) as an iterative cycle of contingent action, where both favorable and unfavorable performance feedback serve as a catalyst for change. Their model is both customer and environmental driven, with organizational focus centered on overall quality in the short- and long-term. The overriding goal of STQM is to prevent errors in products and services and to be environmentally responsible. Strategic total quality management requires that: 1) every employee of the firm is responsible for quality, but that top management provides the quality vision and direction of the business, 2) everyone practices a never-ending philosophy of improvement, and 3) employees are given necessary tools and training to improve their problem solving abilities and performance. The Madu and Kuei (1993) model is illustrated in Figure 7.

Figure 7
STQM Process



STQM suggests that past performance (both favorable and unfavorable) spurs a review of how well the existing organization maps to customer needs and the environment in which the firm operates. The outcome of the evaluation is a new organizational framework, resulting from

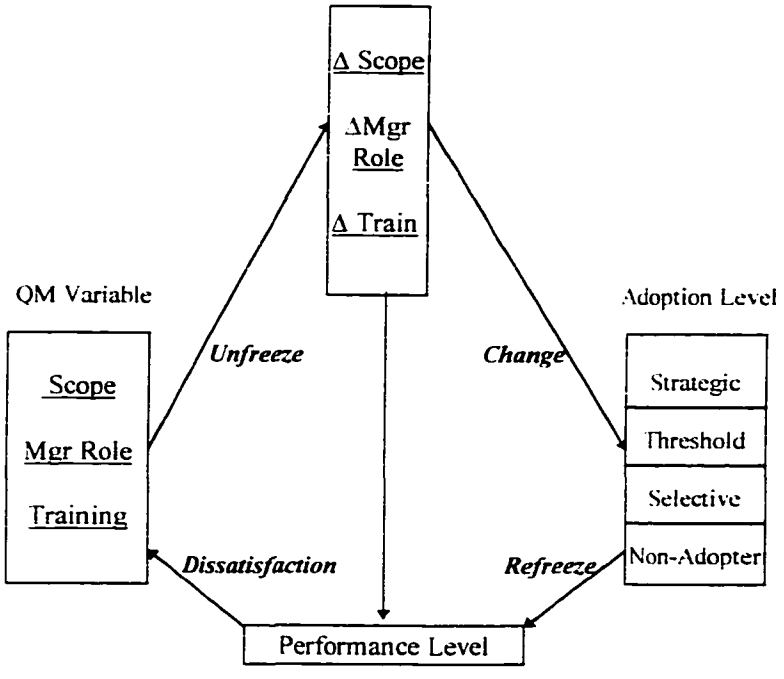
changes in one or more three key areas: 1) systems employed by the firm. 2) supplier relations. and 3) the overarching philosophy as to how business should be conducted. This new organization is subsequently evaluated in light of firm performance. outcomes are matched with environmental and customer needs. and the change process begins anew.

The models of Deming (1986). Benson. et al. (1991). and Madu and Kuei (1993) are related. First. each illustrates a contingent process. Changes in level of performance signal the potential need to review and revise the quality management program that the firm has deployed. Second. they describe an iterative process. The self-evaluation cycles which they undergo are never ending. which is consistent with a philosophy of continuous improvement. whereby the firm incessantly searches for ways to improve the quality of the product as defined by the customer. both internal and external to the firm. The philosophy of continuous improvement parallels the teachings of March and Simon (1958) who believe that the firm is unlikely to change unless the current course is perceived unsatisfactory. The difference is that a firm practicing quality management takes a proactive approach by continuously reviewing performance in light of the environment and customer requirements.

Finally. the firm is transformed as a result of the change process. Quality management adoption levels change as a result of revisions in the key variable mix of scope. managerial roles. and training deployed by the firm. The transformation process is consistent with Cyert and Marsh's (1964) belief that businesses are adaptive institutions that will select alternatives which are preferable and. should the decision set prove unsatisfactory. will scrap the inadequate set for one more likely to yield desired results.

The integration of the four models previously discussed in this chapter results in the longitudinal quality management process model, presented in Figure 8.

Figure 8
Longitudinal Quality Management Transformation Model



The longitudinal quality management transformation model illustrates a never ending, but contingent, quality management process. Intensity of quality management deployment and membership in a hierarchy of quality management adoption are hypothesized to be associated with performance (Ellington, 1995). Performance is reviewed in light of the environment and customer requirements, and where current scope, managerial role, and training are inconsistent with the desired level of quality performance, the firm will undergo change to address the deficiencies (March & Simon, 1958; Cyert & March, 1964; Benson, Saraph, and Schroeder, 1991; Madu & Kuei, 1993). The transformation takes the form of changes in the deployment level of scope, managerial role, and/or training interventions which the firm previously deployed. These changes

in quality management *intensity* have a direct influence on performance. In addition, alterations in scope, managerial role, and training result in position change within the hierarchy of quality management *adoption*. Ultimately, the new position within the hierarchy of QM adoption is associated with firm performance and the cycle continues.

Hypotheses

Ellington (1995) found that firm performance and membership in a four-cluster hierarchy of quality management adoption level were related. Firms that were positioned in higher levels of quality management hierarchy were also those with higher levels of performance. This present study extends that work, focusing on change in quality management program intensity and movement within the four-cluster hierarchy of quality management adoption, over time. For the purposes of this research, quality management intensity is defined as the degree of application that dimensions underlying key quality management elements of scope, role of the first-line supervisor, and training are deployed by the firm. Quality management adoption level is defined as position within the four-level quality management adoption hierarchy developed by Ellington (1995). From the two central research questions and related issues the following hypotheses were proposed.

Change in Quality Management Intensity

Hypotheses one through three address the relationship between change in quality management program intensity and performance. The literature suggests that firm performance and the deployment intensity of quality management adoption are related (Ahire, 1996) and that training is a critical element of quality management programs (Deming, 1986; 1993). Thus, as the deployment intensity of dimensions underlying quality management increases, one would expect to see an increase in firm performance.

H1: Changes in firm performance levels are associated with changes in the deployment intensity of factors underlying quality management adoption. Ahire (1996) found in a cross-sectional study that higher concentrations of quality management deployment intensity were associated with better firm performance. Thus, one would expect to see firm performance significantly related to the change in quality management deployment intensity, over time.

H2: Firms identified as low performers in the first wave of data collection are more likely to make significant positive changes in quality management initiatives than firm identified as high performers in the first wave of data collection.

Consistent with the literature, the longitudinal quality management model suggests that past firm performance is a catalyst for transforming quality management initiatives. Thus, it was expected that firms with lower levels of performance in 1993 would be more likely to make significant changes in their quality management programs than firms with higher levels of 1993 performance.

H3: Changes in quality training intensity are associated with firm performance. Training has been specifically and consistently identified as an important element of quality management programs in both the practitioner and academic literature. This hypothesis sought to quantify the longitudinal relationship between change in quality management training initiatives and performance.

Movement in Quality Adoption Group

Hypotheses four through six address movement patterns within the hierarchy of quality management adoption hierarchy identified by Ellington. The literature supports the notion that movement in adoption level group can be discerned, and that the change in group will be associated with firm performance.

H4: Significant migration over time within the quality management adoption hierarchy is observable among firms.

The longitudinal quality management transformation model suggests that firm performance signals the need for change in the manufacturers quality management program. As firms transform their quality management initiatives, adoption levels also change. The practitioner literature implies that using a strategy of continuous improvement will lead to higher levels of adoption. However, some studies show that quality management programs are not always successful and that the initiative may "grind to a halt" (Smith, et al., 1996, p. 75). Thus, one should expect both upward and downward movement patterns within the quality management adoption hierarchy.

H5: Changes in quality management hierarchy position are associated with different patterns of change in the underlying factors of quality management adoption.

The longitudinal model of quality management is based upon a contingent process. Each firm has a different set of "distinctive competencies" or strategic strengths relative to the competition (Markland, Vickery, & Davis,

1995, p. 75). Likewise, the customer base of each firm is different. Given distinctive firm strengths and customer differences, it is expected that change patterns in the underlying factors or dimensions of quality management programs will vary by adoption group.

H6: Present firm performance is associated with quality management position change.

The literature suggests two quality management implementation approaches. The first is wholesale or holistic adoption from the outset. The second is adoption in a series of steps, based on implementing those initiatives which are expected to have the largest impact on performance. It was of interest to examine whether movements over time in levels of adoption are associated with present firm performance. Firms practicing continuous improvement should improve their quality management programs over time, and one would expect performance to increase in concert with the changes in adoption level.

Pattern of TQM Implementation and Firm Performance

The aim of Hypothesis seven was to verify the stability of Ellington's work (1995) and test the relationship between quality management adoption group membership and performance.

H7: Firm performance in 1997 is associated with the quality management adoption level found during the second wave of data collection.

Summary

This chapter has presented a longitudinal model of quality management transformation and resulting hypotheses. The model proposes that scope, training, managerial role, and performance are key focus areas in a continuous process of quality management intensity and adoption level

change, both of which are related to firm performance. Chapter 4 presents specific measures underlying these quality management focus areas, the research design, and proposed measurement techniques.

Chapter IV
METHODOLOGY

Nature of the Research

This is an exploratory study into the longitudinal effects of quality management programs. It is exploratory in that a migration model is offered showing how small- and medium-sized manufacturing firms might change quality management adoption intensity and move to different levels within a hierarchy of quality management adoption. Also a longitudinal model is offered describing the change process that occurs within a quality management program over time. Changes in key quality management variables and influence on firm performance are tested.

Research questions

This study centers on two major research questions. The first is whether firms change the degree of TQM adoption over time. It is also of interest to determine whether the mix of quality management factors is different for firms that increase their intensity of quality management adoption versus those who decrease their intensity of quality management adoption. The second question is whether firms migrate within a hierarchy of quality management adoption. Related issues include the identification of underlying quality management factors driving the migration. For both questions it is of interest to determine changes in quality management practices, over time, are related to firm performance.

Sample Selection

There are two waves of data used in this longitudinal study. The first was collected in 1993 by Ellington (as reported in 1995). The 1993 sample was taken from 8,000 manufacturing companies featured in the Georgia Manufacturing Directory. Two criteria were set for selection in 1993: 1) the firm conducted manufacturing operations within the State of Georgia and 2) more

than 50 and less than 1,000 people were employed on site. A total of 1,000 businesses meeting the above criteria were selected in a stratified random sample. The final 1993 sample included 50 randomly selected companies in each of 12 regions throughout Georgia, and 400 located in the Atlanta Metroplex. Surveys were mailed to senior executives and quality managers at each location. A total of 553 usable survey questionnaires were returned from respondents representing 494 firms, and these are used as the first wave of data.

Each of the 494 businesses that responded in 1993 were targeted for the 1997 wave of data collection. All of the firms were contacted by telephone to verify that manufacturing was conducted on site and to obtain current mailing addresses and senior management names. During the verification process 68 firms were dropped from the study owing to the fact that: 1) primary operations focus had changed and the firm was no longer manufacturing in Georgia, 2) the firm refused to participate in the study, 3) operations had relocated out of the State since 1995, or 4) the firm had gone out of business. Thus, the second wave mailing list consisted of 426 firms.

Data Collection

Technique

Personal interviews with each firm were considered, but the target population of nearly 500 firms made the idea impractical owing to logistical, financial, and time constraints. As most of the firms are private, secondary data could not be utilized. Therefore, both waves of data were collected by mail survey using the Total Design Method (Dillman, 1978).

Questionnaire

The survey instrument used to gather 1997 data is based on the questionnaire used by Ellington in 1993 (as reported in 1995). While the second data wave questionnaire was rearranged

to facilitate flow and clarity, the questions relevant to the present study are exactly the same as used in 1993.

The questionnaire was designed after an extensive review of the quality management literature to ensure that all key elements were captured. Several questionnaires dealing with quality assurance, productivity, and organizational behavior were considered. The validity of the questionnaire was examined using an expert panel and a pilot test (Saraph, Benson, & Schroeder, 1989). The initial draft of the instrument was reviewed by quality management practitioners and experts in survey methods and instrument development. In addition, the questionnaire was evaluated by the Productivity and Quality Center at the Georgia Institute of Technology for format and style. Finally, the instrument was pilot-tested by 12 senior managers from small- and medium-size Georgia manufacturing companies. First wave responses by multiple raters of the same firm were evaluated by Ellington (1995) and found to be highly consistent.

In order to facilitate response, the 1997 survey was printed in booklet form on high quality, off-white, 60-lb. paper. The cover was designed to be attractive and to center the respondent on the scope of the study. Confidentiality was ensured by numbering the surveys, precluding any need for respondents to identify themselves by name. A single question was placed within the survey asking only that the person completing the survey identify their position within the firm.

Survey Administration

All correspondence was written on university letterhead and addressed to the senior manager on site (Appendix B). The mailings were sent First Class. An initial contact letter detailing study objectives, confidentiality, and seeking firm participation was sent to the senior

manager approximately one week before surveys were mailed. The envelope in which the letter was mailed featured a custom-designed, two-color return address. The surveys were accompanied by a letter emphasizing that all responses would be treated in the strictest of confidence and that each respondent would receive a summary of study results. Envelopes for the return of completed surveys were provided and postage was prepaid

Approximately one week after the surveys were mailed, a postcard was sent to each senior manager. The card emphasized the importance of the study, thanked those who had already responded, and reminded those who had not completed the survey to do so as soon as possible. A second survey, with a transmittal letter included, was mailed some three weeks later to firms who had not yet responded. Finally, approximately six weeks subsequent to the second survey mailing, 90 randomly selected senior managers representing firms who had not returned completed surveys were contacted by telephone, and participation was again solicited.

A total of 221 responses were received, for a 51.8% gross response rate. Of these responses, three stated that they would be unable to participate in the study owing to fundamental restructuring of the firm. Of the remaining responses, 210 were usable; a net response rate of 49.3 percent. No questionnaires were returned by the post office as "undeliverable", which can be attributed to the fact that every firm was contacted before the first mailing.

The relatively high gross response rate was facilitated by the fact that the target population had previously shown a willingness to participate in survey research, that two major State universities were jointly involved in the data gathering process, and that the topic remains both important and interesting to senior executives.

Data Entry

A data entry template was developed in Microsoft Access to enhance reliability and validity (Microsoft Corporation, 1995). The template was designed so that only valid entries could be placed in the database. For example, if a question employed a seven-point response scale, data entry of the value "8" was prevented. The template was pilot-tested before data entry began.

All data were entered twice, each time by a separate operator. The two databases were then compared item by item, and any differences were reconciled by consulting the source document. The final database was imported into SAS/STAT (SAS Institute, 1995) for analysis.

Sample Demographics

The goal of the research is to extend the findings across the entire population of small- and medium-sized manufacturing firms. Thus, a heterogeneous sample is desired. This section provides initial sample detail on industry, firm size, and years in business.

Table 1 presents a summary of industries represented by those responding to the 1997 survey and is presented below:

Table 1
Distribution of 1997 Survey Respondent by Industry

Industry Classification	Frequency	Percent	1993%
Textile Mill Products	34	16.1%	14.3
Paper and Allied Products	28	13.3	12.0
Fabricated Metal Products	23	11.0	9.4
Food Products	19	9.2	10.3
Machinery	19	9.2	9.4
Apparel and Finished Products	18	8.7	8.3
Lumber and Wood Products	15	7.3	6.5
Rubber and Plastic Products	13	6.4	6.3
Chemical and Allied Products	9	4.1	2.5
Clay, Concrete, Glass, and Stone	6	2.8	3.1
Primary Metals	2	.9	.7
Miscellaneous Manufacturing	24	11.0	17.2
Totals	210	100%	-

The 1997 respondent percentages by industry are similar to those found in the first wave of data collection, and feature a broad cross-section of manufacturing industries. That the 1997 respondent results are consistent with that found in 1993 augurs well for the comparative methodology that will be employed in the study. In addition, the broad mix of firms enhances generalizability.

Firm size and number of years in business were also categorized for 1997 data. Detail is found in Tables 2 and 3, respectively. Table 2 is shown below:

Table 2
1997 Distribution of Firm Size
(Number of Employees on Georgia Site)

No. of Employees	Frequency	Percent	Cumulative Percent
Less than 51	4	1.8%	1.8%
51-100	20	9.2	11.0
101-150	32	15.6	26.6
151-250	19	23.4	50.0
250-500	54	25.7	75.7
501+	51	24.3	100%
Total	210	100%	-

Table 2 shows that the majority of firms responding to the 1997 survey had 500 or less employees at their respective Georgia manufacturing sites. It is interesting to note that four firms showed that employment slipped to 50 or less, and would not have met the 1993 study criteria (Ellington, 1995).

Table 3 details the length of time the firm has conducted manufacturing in Georgia. Results are shown below:

Table 3

Distribution of Years in Business

Age	Frequency	Percent
< 10 years	31	15.1
10-19	33	16.1
20-29	33	16.1
30-39	29	14.2
50-59	25	11.5
60-69	16	7.3
70-79	9	4.1
80-89	11	5.0
90-99	4	1.8
≥ 100 years	16	7.3
Total	207	98.6

Table 3 shows a wide range of business age. Note that three respondents neglected to complete this survey question. Thus, the total number of firms in the distribution is 207.

The initial demographic analysis shows both a broad and diverse pool of respondents, and consistency between the two waves of data collection in terms of industry representation.

Measurement of Independent and Dependent Variable Change

This research uses difference scores to capture the change in each variable that has occurred between waves of data collection (1994-1997). Difference scores are used to capture individual or organizational outcomes (Keppel & Zedec, 1989; Bedeian & Day, 1994). There is an ongoing debate in the literature as to the appropriateness of using difference scores to measure change. The discussion centers on the use of scores between "distinct but conceptually linked constructs", problems of a change in scale, and correlation's between the difference score and

pre- and post measures from which the difference score is obtained (Goldstein, 1979; Keppel & Zedec, 1989; Tisak & Smith, 1994, p. 675). The first two issues can be immediately dismissed as the variables used and scales employed in this study are exactly the same in both 1993 and 1997. The remaining issue is a problem when two groups (control and treatment) are being compared over time. A solution to the potential problem of correlated scores is to employ a hierarchical technique (such as ANCOVA) which assumes that "the initial differences between two groups are only chance differences" (Keppler & Zedeck, 1989).

The present research however, tests only the change in responses of a single group of firms. In addition, the initial differences in the first measurement of independent variables among members is systematic (i.e scope, role of managers, and training), not random. Indeed, since the present research seeks to establish what happens after implementation, it is of specific interest to capture the simple change in measures of independent variables between the two waves of data collection. Therefore, measures of independent variables were constructed using simple difference scores.

Measurement of Change in Firm Performance

The current level of performance of any given firm is likely related to the level of prior performance (Dean & Snell, 1996). Therefore, hierarchical regression was employed to measure changes in the dependent variable, performance (Dean & Snell, 1996). Performance in 1993 was treated as an independent variable, and loaded into the regression equation first. In so doing, any effects of initial differences in performance across firms are eliminated (Dean & Snell, 1996). In effect, each firm was put on equal footing with respect to 1993 performance. If a simple difference was used as a dependent variable, it would not be possible to know whether the

independent variables of interest were influencing performance, or if performance changes were simply a continuation of previously existing performance differences. The strength of the design was that "ruled out all rival hypotheses" as to the association of the change in the level of independent variables and performance (Snell & Dean, 1996, p. 467).

Measurement of Independent and Dependent Variables

Scope of the quality management initiative

Ellington defined scope of the quality management initiative as: 1) customer focus, 2) quality of design, 3) quality of conformance - purchasing, 4) quality of conformance - manufacturing, 5) continuous improvement - involvement, 6) continuous improvement - level of priority, and 7) continuous improvement - structure (1995, pp. 44-50). Such a definition allows a firm's quality management practices to be captured on the basis of realized actions, rather than planned intentions. That the present research is based on past actions is important as Golden (1992) reports that retrospective executive accounts of past behaviors and facts are more likely to be correctly reported than either intentions or beliefs.

Scope of the firm's quality management initiatives is assessed by measuring the firms actions and practices. Ellington (1995) found that high level adopters embrace the quality management process throughout the organization and in all levels of decision making. Partial adopters limit their adoption to problem-solving activities in selected functional areas. Non-adopters wish external customers to think that they are disciples of quality management, when in fact they have not adopted any part of the quality management process. A brief discussion as to how each area of quality management initiative scope was measured follows next.

Customer focus

Customer focus centers on the interaction process with the customer. A total of 15 questions pertaining to customer focus activities were used. These questions measured customer involvement by category of employee, customer feedback mechanisms, and systems for ensuring that customer requirements were being met.

Quality of design

Quality of design is concerned with performance characteristics of the product or service. There were 18 measures of design quality. These measures emphasized traditional definitions of quality such as product reliability and technical support, delivery speed and dependability, where within the firm were quantitative measurement systems deployed, and the emphasis given to linking customer requirements to process capability.

Quality of Conformance - supplier relationships

Vendor relationships are an integral part of TQM (Hackman & Wageman, 1995). Nine measures of supplier relationships were used in the study. These measures focused on the emphasis that the firm gave to total quality practices of vendors and past vendor performance in the purchasing decision.

Quality of conformance - manufacturing

Conformance is found throughout the literature as a major component of the quality management movement (i.e. Juran, 1988). That conformance is important in today's market is exemplified by the relatively quick and successful move by Japanese automotive manufacturers into the luxury sedan market (Hayes, Pisano, & Upton, 1996). Manufacturing conformance

consisted of eight questions which measured the use of process control tools and traditional practices such as acceptance sampling and inspection procedures.

Continuous improvement - involvement & priority

Continuous improvement is a basic feature of quality management (Deming, 1986; Saraph, et al., 1989). Consistent with Ellington (1995), continuous improvement was separated into two components: 1) involvement in problem-solving and 2) priority on improvement. A total of 10 questions were used to capture problem-solving. The questions measured the level of involvement by production, support function, and supplier personnel.

Sixteen questions related to priority on improvement. These measured the linkage of between compensation and quality improvement, measuring performance against internal requirements, and evaluating quality on the basis of external measures such as the Baldrige Award.

Role of the first line manager

Measures for the role of the first line manager are: 1) participation in facilitating the quality initiative, 2) degree of emphasis on traditional supervisory responsibilities, and 3) clarity of the first line manager's role and responsibilities (Ellington, 1995). In sum, the manager's role is either facilitative, characterized by active participation in the planning and implementation of the quality management program, or supervisory, neither taking an active role in planning nor implementation. In the supervisory role the manager is concerned only with day-to-day operations.

Training

There are two focal areas of training in the literature. Qualitative training deals with philosophies of quality and interpersonal or group skills. Quantitative training centers on problem identification and rectification. The following measures have been selected from the literature to represent the firm's training approach: 1) content of training, 2) to whom is training provided (i.e. levels within the organization), and 3) the amount of training provided.

Performance

Subjective measures of performance were used in this research. Many of the firms within the study are privately owned, which precludes the use of secondary data. In addition, Ellington (1995) reports that small firms are often reluctant to provide hard data. Subjective data has been used in quality management research conducted by Benson, Saraph, and Schroeder (1991); Ahire and Golhar (1996); and Dean and Snell (1996). Dess and Robinson (1984) and Golden (1992) conclude that it is appropriate to use subjective measures where objective data are unavailable and where members of the senior management team are providing responses. The following measures will be used to capture firm performance: 1) return on sales, 2) return on assets, 3) return on investment, 4) overall profit, 5) delivery dependability, 6) delivery speed, 7) customer service, 8) customer service, 9) product quality, 10) technical support, 11) market share, and 12) pricing.

Summary

This chapter has presented the methods of data collection and development of independent and dependent variables for testing the longitudinal quality management quality management model. The data collection process was stringently controlled so that only responses from appropriate members of the firm's senior management team were utilized in the study. While 218

questionnaires were completed and returned, a total of eight respondents failed to meet the criteria of being members of a senior management team, and were subsequently deleted from the study. The remaining 210 completed questionnaires results in a net response rate of 49.3 percent.

Respondent firms represent a broad mix of industries, firm sizes, and time in business. The mix of industries included in the study very closely matches that found in Ellington (1995). The industry consistency between the two waves of data collection and the heterogeneous sample helps support the external validity of research findings.

Chapter V
Findings

The focal point of this dissertation is quality management program change. Quality management program change was measured in two ways. The first centered on change in quality management program *intensity*, which can be defined as the degree of program scope, role of the first level supervisor, and training application or deployment. The second area of interest, closely tied to the first, was movement within a *hierarchy* of quality management adoption. For both types of change, it was of interest to determine the effect of quality management program transformation on firm performance and to identify what specific measures were driving the changes.

The first sections of this chapter present a study of change in quality management program intensity. These are followed by analyses of how firms move within the hierarchy of quality management adoption, and the relationship between 1997 performance and 1997 quality management adoption level cluster membership, respectively. The chapter concludes with a summary of hypotheses and findings.

Change in Quality Management Program Scope

Scope of the quality management initiative represents the breadth of the quality management program. It includes customer focus, design quality, conformance quality, and continuous improvement. In order to identify key dimensions of change in program scope, difference scores were calculated. These scores were subsequently factor analyzed using principle components analysis. Results are shown in Table 4.

Table 4
Focus Area Change Dimensions

Area	Factor Name	Description
•Customer Focus	NONTRAD	Non-traditional customer interaction.
	CUSTFEED	Customer feedback practices.
	CUSTREQ	Emphasis on meeting customer requirements.
•Breadth of Quality Definition	AFTRSALE	After sale service emphasis.
	DELVPERF	Delivery performance emphasis.
•Measurement	QUANTSUP	Use of quantitative measurement in support areas.
	QUANTPRD	Use of quantitative measurement in in production areas.
•Capability	CUSTLINK	Customer requirement-production process linkage.
•Vendor Conformance	VENDQUAL	Vendor emphasis on quality.
	VENDSERV	Vendor emphasis on service.
•Manufacturing Conformance	PROSTOOL	Use of process tools.
	PREVTOOL	Use of prevention tools.
•Problem-solving Involvement	SUPTPROB	Support department involvement.
	PRODPROB	Production team involvement.
	SUPLPROB	Supplier team involvement.
•Improvement Priorities	COMPQUAL	Link between compensation and quality.
	XTRFOCUS	Externally-focused performance measurement
	NTRFOCUS	Internally-focused performance measurement.
•Continuous Improvement Structure	INDIVSUG	Individual suggestion approach.
	TEAMAPCH	Team approach.

Customer Focus

The factor analysis of the 15 questions pertaining to customer focus (Ellington, 1995) identified three underlying dimensions accounting for 47.8% of the total variance. A summary of results is presented in Table 5. The three customer focus factors are:

- NONTRAD - a measure describing the customer interaction emphasis a company places on not only top management but also production supervisors, hourly employees, quality department staff, and engineers.
- CUSTFEED - a measure describing methods by which the firm solicits customer

feedback. The methods include focus groups, customer surveys, hotlines, and the use of customer service representatives.

- CUSTREQ - a measure describing the emphasis the company places on ensuring that customer specifications and delivery requirements are met.

Table 5
Factor Analysis Summary - Customer Focus Loadings

Item	NONTRAD	CUSTFEED	CUSTREQ
First line supervisors	83*	-4	16
Hourly employees	75*	-4	2
Engineering staff	69*	19	8
Quality department	59*	27	10
Top management	42*	12	22
Customer focus groups	35	68*	-6
Customer surveys	18	68*	11
Customer service reps	-2	59*	11
Complaint review	15	53*	29
Phone hotlines	-2	52*	9
Can meet specifications	9	9	83*
Can meet delivery	17	-2	82*
Complaint evaluation	30	27	55*
Sales force reports	-3	38	51*
Customers in review team	27	33	35

Breadth of Quality Definition

The factor analysis of the seven breadth of quality definition focus questions (Ellington, 1995) identified two underlying dimensions accounting for 52.96% of the total variance. A summary of results is presented in Table 6. The two factors are:

- SERVICE - A measure of firm service emphasis as demonstrated by level of technical support, after sales support, product reliability, and customer service.
- DELVPERF - A measure of the emphasis the company places on delivery speed and dependability.

Table 6
Factor Analysis Summary - Breadth of Quality Definition

Item	SERVICE	DELVPERF
Technical support level	84*	9
After sales support level	82*	13
Customer service	68*	32
Product Reliability	57*	30
Conform. to customer spec.	48	34
Delivery dependability	26	84*
Delivery speed	16	84*

Measurement

The factor analysis of the 10 quality management measurement questions (Ellington, 1995) identified two underlying dimensions accounting for 52.96% of the total variance. A summary of results is presented in Table 7. The two quality measurement factors are:

- QUANTSUP- a measure describing the emphasis of using quantitative quality management techniques in support functions such as marketing, sales, purchasing, accounting, customer service, shipping, and scheduling departments.
- QUANTPRD - a measure describing the emphasis on using quantitative quality management techniques in engineering, production, and quality departments.

Table 7
Factor Analysis Summary - Quality Management Measurement Loadings

Item	QUANTSUP	QUANTPRD
Technique use-Marketing	81*	1
Technique use-Sales	80*	3
Technique use-Purchasing	74*	19
Technique use-Account.	72*	11
Technique use-Cust. Svc.	68*	26
Technique use-Shipping	52*	34
Technique use-Scheduling	52*	28
Technique use-Quality	6	79*
Technique use-Production	4	70*
Technique use-Engineering	33	64*

Process Capability

The factor analysis of the three process capability questions (Ellington, 1995) identified a single underlying dimension accounting for 53.66% of the total variance. A summary of results is presented in Table 8. The factor is:

- CUSTLINK - describes a measure of firm's emphasis on linking customer requirements with the capability of the production process.

Table 8
Factor Analysis Summary - Process Capability

Item	CUSTLINK
Process capability studies	86*
Quality function deployment	82*
Documented shop specs.	45

Vendor Conformance

The factor analysis of the 9 vendor conformance questions identified two underlying dimensions accounting for 56.11% of the total variance. A summary of results is presented in Table 9. The two quality measurement factors are:

- VENDQUAL- a measure describing the emphasis the firm places on entering partnerships with suppliers that have adopted quality management practices.
- VENDSERV - a measure describing the emphasis the firm places on vendor service.

Table 9
Factor Analysis Summary - Vendor Conformance

Item	VENDQUAL	VENDSERV
Vendor TQM program	83*	21
Vendor certification	83*	6
Vendor SPC initiative	81*	24
Vendor compliance certificate	78*	1
Documented purchasing specs.	53*	-14
Strategic impl.-product quality	31	18
Vendor delivery	17	89*
Vendor price	-18	67*
Vendor service	34	67*

Manufacturing Conformance

The factor analysis of the 9 manufacturing conformance questions (Ellington, 1995) identified two underlying dimensions accounting for 49.78% of the total variance. A summary of results is presented in Table 10. The two quality measurement factors are:

- PROSTOOL - a measure describing the use of process control tools such as control charts, control variables, and internal quality systems audits. partnerships with suppliers that have adopted quality management practices.
- PREVTOOL - a measure describing the use of prevention tools such as first piece and final inspection, preventive maintenance, and documented operating procedures on the production floor.

Table 10
Factor Analysis Summary - Manufacturing Conformance

Item	VENDQUAL	VENDSERV
SPC chart use	90*	9
SPC process variables	87*	15
IQS audit	55*	38
Automatic inspection equipment	49	11
Final inspection	-10	71*
First piece inspection	27	63*
Documented operating procedures	33	62*
Preventive maintenance	11	61*
Acceptance sampling	23	49

Problem-Solving Involvement

The factor analysis of the 10 problem-solving involvement questions identified three underlying dimensions accounting for 72.26% of the total variance. A summary of results is presented in Table 11. The three quality measurement factors are:

- SUPTPROB- a measure describing support department involvement in quality related problem-solving. customer service, shipping, and scheduling departments.
- PRODPROB - a measure describing production team involvement in quality related problem-solving.
- SUPLPROB - a measure describing supplier team involvement in quality related problem solving.

Table 11
Factor Analysis Summary - Problem-Solving Involvement

Item	SUPTPROB	PRODPROB	SUPLPROB
Sales department involvement	83*	19	13
Top management involvement	83*	30	8
Purchasing involvement	78*	20	31
Planning staff involvement	63*	36	17
Engineering involvement	35	76*	19
Quality department involvement	30	76*	10
Hourly employee involvement	8	73*	10
Prod. supervisor involvement	42	72*	10
Equipment vendor involvement	20	13	90*
Raw mtl. vendor involvement	18	21	87*

Problem-Solving Priorities

The factor analysis of the 15 questions related to the priority given to continuous improvement (Ellington, 1995) identified three underlying dimensions accounting for 55.46% of the total variance. A summary of results is presented in Table 12. The problem-solving priority factors are:

- COMPQUAL - a measure describing the linkage between compensation and quality improvement.
- XTRFOCUS - a measure describing how the firm evaluates its quality improvement performance against industry or quality award models.
- NTRFOCUS - a measure describing how the firm evaluates its quality improvement performance using customer requirements and company standards.

Table 12
Factor Analysis Summary - Problem-Solving Priorities

Item	COMPQUAL	XTRFOCUS	NTRFOCUS
Link-engrg/tech staff	88*	10	6
Link-prod. supervisors	87*	11	23
Link-support staff	82*	18	0
Link-senior management	79*	15	26
Link-hourly employees	77*	1	18
Link-sales	75*	18	10
Benchmark competitors	18	72*	20
Benchmark noncompetitors	25	69*	8
Industry-specific standards	-1	65*	13
Baldridge criteria	12	60*	5
Internal customer philosophy	20	-15	72*
Internal quality audit	7	36	63*
Customer quality audit	-8	35	62*
Sr. mgt. commitment	19	2	55*
ISO 9000 standards	10	16	32

Continuous Improvement Structure

The factor analysis of the six continuous improvement structure questions (Ellington. 1995) identified two underlying dimensions accounting for 63.13% of the total variance. A summary of results is presented in Table 13. The two factors are:

- INDIVSUG - Use of formal suggestion and feedback programs.
- TEAMAPCH - Use of formal employee and management problem-solving teams.

Table 13
Factor Analysis Summary - Continuous Improvement Structure

Item	INDIVSUG	TEAMAPCH
Formal suggestion program	81*	36
Formal suggestion feedback	81*	28
Suggestion-monetary reward	79*	-2
Employee teams	9	78*
Quality steering committee	18	75*
Mgt. led teams	17	63*

Change in First Line Manager Role

Role of the first line production manager/supervisor is a key component of Total Quality Management. The quality management literature suggests that once a program is put in place, the role of the first line manager transitions from detailed control of daily production activities to that of being a facilitator and coach. It is of interest to identify how these responsibilities change over time. Thus, the focus of the first line supervisor is a key element in longitudinal quality management model. Principal components analysis was conducted on the seven questions dealing with change in supervisor's role (Ellington, 1995) to identify underlying constructs. The factor analysis identified two dimensions accounting for 74.42% of the total variance. A summary of results is presented in Table 14. The two first line supervisor role factors are:

- FACLTATE- a measure describing the emphasis the firm places using their supervisors as facilitators in activities such as problem-solving, coordinating interdepartmental interaction, and making process improvements.
- TRDITION - a measure describing the emphasis the firm places using their supervisors in traditional roles of achieving production schedules, assigning tasks to workers, and maintaining product quality.

Table 14
Factor Analysis Summary - First Line Manager Role

Item	FACLTATE	TRDITION
Product quality improvement	88*	22
Mfg. process improvement	87*	20
Problem-solving	74*	42
Coordinate dept. interaction	66*	28
Employee job assignments	15	91*
Achieve production schedule	36	82*
Maintain product quality	55	64*

Change in Quality Management Training

Training has been identified is a key element of total quality management (Saraph, Benson, & Schroeder, 1989). The question that the current research seeks to address is what changes are made over time in quality management training initiatives. In this study, responses to 27 questions (Ellington, 1995) dealing with change in quality management training initiatives were combined to form three summed scales (Hair, et al., 1995). These scales represent the number of training hours in technical quality management tools, leadership, facilitation, and team building that 1) employees, 2) supervisors, and 3) managers were provided. The scales were factor-analyzed using principal components analysis. The factor analysis identified a single underlying dimension accounting for 78.96 of the total variance: Table 15 presents a summary of the results:

- TRAINING - describes a measure of the firm's emphasis given to training in quantitative and qualitative quality management subject areas.

Table 15
Factor Analysis Summary - Quality Management Training

Item	TRAINING
Supervisor training	93*
Management training	89*
Employee training.	45

Firm Performance

Most of the literature investigating the relationship between quality management and performance is cross-sectional (e.g. Benson et al., 1991, Ellington, 1995). The present research seeks to fill this apparent gap by analyzing longitudinal effects of quality management programs on performance. Of specific interest is the impact of change in intensity of the underlying factors of total quality management and firm performance. Principal components analysis was conducted

on the two sets of 11 questions (Ellington. 1995) dealing with 1993 and 1997 firm performance. respectively. In each case the factor analysis identified two performance dimensions. For 1993. these two dimensions account for 66.91% of the total variance. For 1997. the two dimensions account for 69.18% of the total variance. A summary of results is presented in Tables 16 and 17. The two factors are:

- FINPERF- a measure describing the financial performance of the firm consisting of items such as return on sales. return on assets. and overall profitability.
- OPSPERF - a measure describing nonfinancial. or operational performance of the firm consisting of items such as delivery speed. product quality. customer service. and marketshare.

Table 16
Factor Analysis Summary - Firm Performance 1993

Item	FINPERF	OPSPERF
Return on sales	92*	2
Return on assets	92*	26
Return on investment	90*	29
Overall profit	88*	28
Delivery dependability	24	84*
Delivery speed	26	81*
Customer service	14	76*
Product quality	19	69*
Technical support	24	63*
Market share	44	56
Pricing	33	34

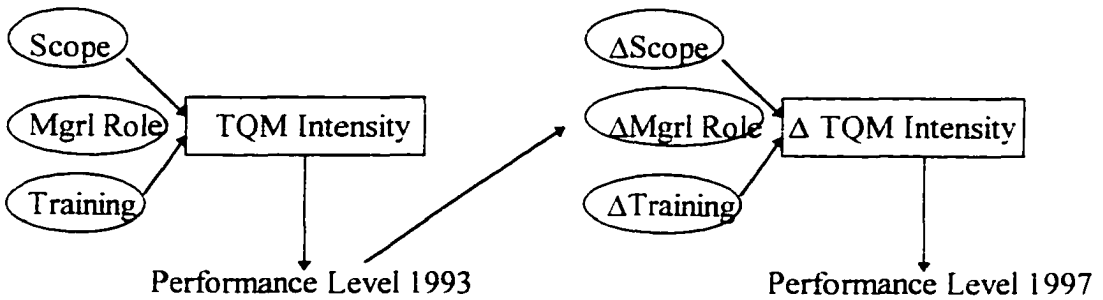
Table 17
Factor Analysis Summary - Firm Performance 1997

Item	FINPERF	OPSPERF
Return on investment	94*	18
Return on sales	94*	16
Return on assets	93*	19
Overall profit	87*	26
Pricing	54	39
Marketshare	52	39
Dependability of delivery	14	87*
Delivery speed	12	82*
Customer service	20	80*
Product quality	31	67*
Technical support	31	64*

Change in Intensity of Quality Management Focus Dimensions and Firm Performance

The quality management literature is filled with anecdotal evidence outlining the expectation that quality management programs are related to firm performance (e.g. Deming, 1986; Crosby, 1987; Carman, 1994; Smith, et. al., 1996). There is also a growing body of empirical evidence that performance and quality management are related (Phillips, et. al., 1983; Benson, et. al.; 1991; Ellington, 1995). However, the influence of quality management intensity change on firm performance has not been investigated, heretofore. Thus, it is of interest to study how the 23 quality management change dimensions, as outlined in the previous sections of this chapter, are related to performance. The model of relationships that were tested is shown in Figure 9.

Figure 9
A Model of Change in Quality Management Intensity and Performance



The experimental design used was two-step hierarchical regression (Dean & Snell, 1996). Hierarchical regression assigns the order of entry of variables according to theoretical considerations (Tabachnick & Fidell, 1989). The effects of prior performance were removed before testing the relationship between quality management program change and 1997 performance. The strength of the design is that all rival hypotheses regarding pre-existing performance levels are ruled out (Dean & Snell, 1996). Dependent variables were 1997 financial and operations performance dimensions. Independent variables were dimensions representing 1994 performance and the 23 quality management change factors. A total of two full model analyses were conducted; one testing financial performance and the other testing operational performance. In addition, two step-wise regressions were run testing financial and operational performance.

The procedures used for both the full model and stepwise regressions were the same. In the first run, 1994 performance was entered and found to be significant, as expected. In the second run, the 23 factors representing quality management change were entered simultaneously and tested against the residual variance from step one. This use of separate runs is suggested by

Tabachnick and Fiddell (1989, p. 144). The null hypothesis was no relationship between the 23 quality management change factors and 1997 performance. Results are shown in Tables 18 and 19.

Table 18
Quality Management Intensity Change and Firm Performance: Full Model

Analysis	Total DF	F Value	Prob>F	R-square
Financial Perf	63	.861	.6420	-
Operational Perf	64	2.123	.0174	.5436

Table 18 shows that change in quality management intensity does not appear to be significantly related to financial performance. However, operational performance and change in the degree of quality management application by the firm are significantly related, partially supporting hypothesis 1. Tests for assumptions underlying the appropriate use of regression were completed (e.g. normality, homoscedasticity, independence of error terms, influential observations, and multicollinearity) and no significant departures were found.

Table 19
Quality Management Program Change and Operational Performance: Stepwise

Parameter	Estimate	Std. Error	F Value	Prob>F	R-Square
Overall	-	-	9.94	.0001	.3984
Intercept	-.4461	.1309	11.62	.0012	-
NONTRAD	.1466	.0763	3.70	.0593	.2157
CUSTFEED	.2360	.0695	11.53	.0012	.1009
QUANTPRD	.6173	.1798	11.79	.0011	.0448
PRODPROB	-.1311	.0579	5.13	.0271	.0371

Table 19 shows a summary of the operational performance stepwise analysis. As found in the full model analysis, Stepwise on the relationship between financial performance and the 23 change factors was not significant. The significant result for operational performance provides partial support for hypothesis 1.

Stepwise regression is useful in exploratory research for model-building purposes (Tabachnick & Fidell, 1989, p. 150). Forward stepwise regression analysis was conducted to find those variables that had the most significant impact on 1997 operational performance once the effect of 1994 operational performance was removed. The results suggest that higher intensity of customer focus (NONTRAD and CUSTFEED) and increased intensity of quantitative quality management techniques are related to higher levels of firm performance. This is consistent with classic total quality management theory (e.g. Deming, 1986; 1993). The stepwise analysis also shows that ever increasing involvement in continuous improvement by production team members can be damaging to performance. This negative relationship might be explained by expectancy theory. Expectancy is a belief in the likelihood that a particular level of effort will be followed by a corresponding performance level (Szilagy & Wallace, 1990). When there is not enough time or resources available to perform at a high level (a condition of low expectancy), the result is low instrumentality and low motivation (p. 124). Simply put, involvement in continuous improvement, over time, may exhibit diminishing returns. These diminishing returns are consistent with the traditional model of quality management, which suggests that there is an optimum point past which costs of further initiatives exceed any attendant benefit (Evans & Lindsay, 1993, p. 46). An alternative to expectancy theory is that the production team members "internalize" continuous improvement over time, and conduct it without conscious thought.

Hierarchical Change in Quality Management Intensity

Research by Ellington in 1995 showed that performance increased as firms moved up a hierarchy of quality management adoption. Firms that adopted and practiced more of the concepts and techniques of quality management had higher levels of performance than those firms who

either ignored quality management or selectively adopted concepts and techniques, which suggests that performance is associated with increased quality management program intensity. Ellington (1995) found that quality adoption cluster membership was the single most powerful predictor of firm performance. Thus, it is of interest in the present research to test whether position within a hierarchy of quality management *intensity* change is related to performance.

To investigate the relationship between position in a hierarchy of quality management intensity change and performance, cluster analysis was performed. Firms were grouped into clusters based on the 23, standardized, quality management change measures. A four-cluster solution was found. Standardized scores of the quality management intensity change measures by cluster are presented in Table 20. Graphical presentation of the quality management intensity change clusters is shown in Figure 10.

Table 20
Standardized Total Quality Intensity Change Scores

Measure	Cluster 1	Cluster 2	Cluster 3	Cluster 4
NONTRAD	-1.03924	-.22231	.07948	1.60457
CUSTFEED	-.1.05218	-.43905	.22429	1.20109
CUSTREQ	-1.21791	-.19962	.12415	1.34952
AFTRSALE	-1.43193	-.05869	.15696	.84540
DELVPERF	-.73753	.05918	-.01943	1.00181
QUANTSUP	-.92530	-.29095	.16809	1.12270
QUANTPRD	-.80963	-.23640	.08921	1.08259
CUSTLINK	-.91919	-.59612	.25583	1.22857
VENDQUAL	-1.15430	-.39466	.25041	1.06757
VENDSERV	-.41712	-.12853	.01734	.93504
PROSTOOL	-.99203	-.50224	.22582	1.30393
PREVTOOL	-1.05577	-.45991	.26767	1.02021
SUPTPROB	-1.14064	-.18897	.13433	1.01105
PRODPROB	-1.18606	-.11883	.06700	1.30323
SUPLPROB	-.1.12139	-.49519	.28100	.79397
COMPQUAL	-1.41180	-.26799	.23434	.94297
XTRFOCUS	-.96958	-.51636	.31254	.83095
NTRFOCUS	-.94973	-.66385	.29492	1.60123
INDIVSUG	-1.13346	-.05105	.05901	1.24682
TEAMAPCH	-1.16184	-.02331	.00602	1.42845
FACILTATE	-.22394	-.59747	.23139	.37608
TRDITION	-.16642	-.67083	.26811	.50792
TRAINING	-.65834	-.44466	.16856	1.16860
Firms/Cluster	14	113	20	48

Figure 10

Change in Quality Management Intensity Clusters (Standardized Data)

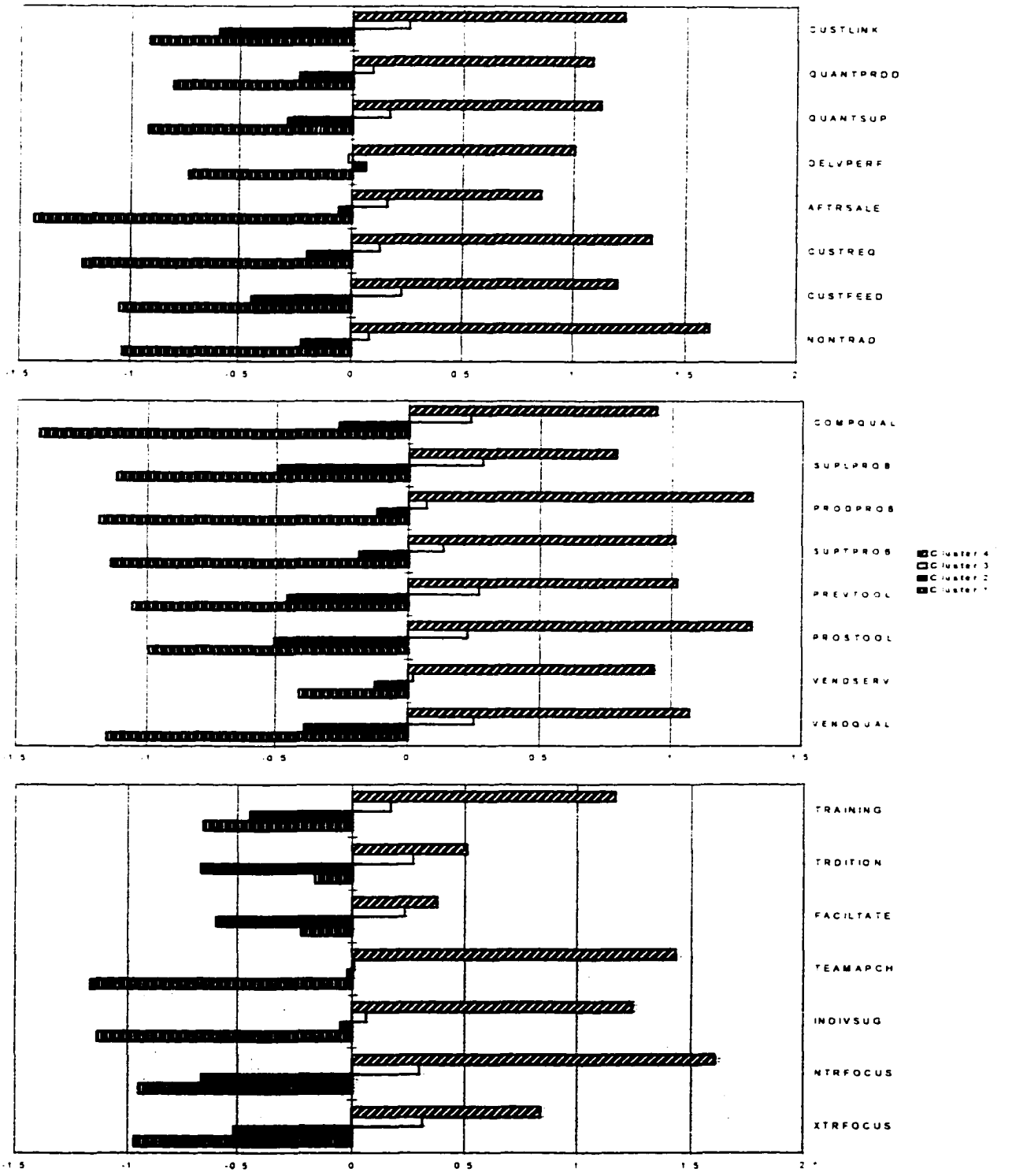


Figure 10 shows that cluster four scores very high on all quality management intensity change measures. Cluster three scores somewhat lower on all quality management intensity change measures than cluster four, but higher than cluster three. Finally, cluster one scores very low on all quality management intensity change measures.

Change in Quality Management Intensity and 1993 Performance

Consistent with the literature, the longitudinal quality management model suggests that firm performance is a catalyst for transforming quality management initiatives (Ellington, 1995; Ahire, 1996). Thus, one would expect a that firms with low performance in 1993 would have higher probabilities of making significant changes in their quality management programs, thereby falling into quality management *intensity* change cluster 4, where overall scores are high on each quality management change measure.

The experimental design used to test this expectation was logistic regression. Logistic regression is an appropriate technique when the dependent variable is nonmetric and the independent variable is metric. Discriminant analysis can also be used with a nonmetric dependent variable and metric independent variables. However, logit analysis is often preferred to discriminant analysis (Hair, et al., 1993). Perhaps the most important reason is that underlying assumptions of multivariate normality and equal variance-covariance matrices must be strictly met when using discriminant analysis. Logit analysis does not require such strict assumptions (p. 60) and is an effective tool when the dependent variable membership splits are not evenly distributed (Tabachnick & Fiddell, 1989, p. 270).

The overall measure of goodness of fit in logistic regression is given by the likelihood value (p. 61). This is similar to R^2 in multiple regression. However, instead of minimizing squared

deviations. logit analysis maximizes the "likelihood" that an event will occur (p. 61). Logit analysis also tests the hypothesis that a coefficient is different from zero. The Wald statistic provides the statistical significance for each estimated coefficient, thus allowing logit to be used in hypothesis testing.

The dependent variable in the logistic regression was quality management intensity change cluster membership. The independent variable was 1993 performance. A total of two analyses were conducted: one using the dimension representing financial performance, the other using operations performance as the predictor variable. The data were standardized before conducting the regression. Results of the analyses are shown in Table 21.

Table 21
Intensity Change Cluster Membership and Performance

Performance Measure	χ^2 Prop Odds p Value	-2 log χ^2	-2 log p value	Wald χ^2	Wald Pr>χ^2	Parameter Estimate
Financial	.4083	6.642	.0100	6.0210	.0141	-.3560
Operational	.0758	13.333	.0003	12.8921	.0003	-.5306

Table 21 shows that quality management intensity change cluster membership and 1993 performance, both financial and operational, are significantly related at the .05 level. Parameter estimates of both analyses are negative, with respect to clusters 4, 3, and 1, respectively. Therefore, with each increment in 1993 financial performance, the odds of the firm being in the fourth cluster; or the fourth and third clusters; or the fourth, third, and first clusters (respectively) decreases by 35.6%. That is to say as 1993 performance increases, the probability of being in a positive quality management intensity change cluster decreases. The same logic follows for operational performance. As 1993 operational performance increases by one unit, the log odds of

being a member in the fourth cluster; the fourth and third clusters; or the fourth, third, and first clusters (respectively) decreases by 53.06%. Thus, as operational performance decreases, the probability of making negative changes in quality management adoption level increases.

The above results are consistent with hypothesis 2, firms with lower 1993 performance are more likely to make positive changes in quality management intensity than higher performing firms.

The logistic analysis helps clarify the results of the quality management intensity cluster analysis and subsequent profiling. Those firms with relatively high performance in 1993 have tended to decrease their overall quality management intensity, and have emphasized quality management training, or service and delivery. Firms whose performance in 1993 was relatively low have increased the intensity of their quality management programs and concentrated on quantitative quality management techniques or customer focus systems. The next section explores the relationship in level of quality management program change and 1997 performance.

Position in Quality Management Intensity Change Hierarchy and Firm Performance

Ellington (1995) found in a cross-sectional study that position within a four-cluster quality adoption hierarchy was the most powerful predictor of firm performance. Thus, it is of interest to determine if position within a hierarchy of quality management intensity change is associated with performance. The experimental design employed to test the relationship between membership in a hierarchy of quality management intensity change and performance was analysis of covariance (ANCOVA), conducted on standardized data. Quality management intensity change cluster position was selected as the independent variable. The dependent variables were the two factors representing 1997 financial and operational performance. The covariate was 1993 performance.

represented by financial and operational performance factors. The inclusion of the 1993 covariate centers the firms with respect to the beginning level of performance, removing relationships that are simply a continuation of pre-existing differences in performance. This centering of performance is similar to the regression methodology employed by Dean & Snell (1996). Removing previous performance differences rules out all other such rival hypotheses (p. 467). The methodology allows the researcher to detect those performance impacts attributable to change in quality management adoption intensity over the four-year period of interest. Results are presented in Table 22.

Table 22

ANCOVA Significance Test - Performance and Intensity Change Cluster Membership.

Performance Test	Overall Model F Value	Overall Model Pr>F	Covariate F Value	Covariate Pr>F	Cluster F Value	Cluster Pr>F
Financial	3.55	.0082	11.6	.0008	.86	.4619
Operational	10.42	.0001	26.53	.0001	5.05	.0022

Table 22 shows partial support for hypothesis 1. Change in quality management intensity is associated with operational performance. However, no statistically significant relationship between cluster membership and financial performance was found. These results are consistent with the previously discussed regression analysis conducted on the change in underlying quality management dimensions.

A Scheffe's test for differences in means was conducted for operational performance. The findings are presented in Table 23.

Table 23

Operational Performance and Intensity Change Cluster Membership-Standardized Data

Cluster -Degree of Change	Mean	Grouping
Negative Change	-.0924	A
Intermediate Negative	-.0599	A
Intermediate Positive	.0079	A
Positive	.1600	A

While the Scheffe test was unable to detect significant differences among the four clusters, note that the means follow degree of change. That is, a high degree of positive change is associated with the highest mean score, intermediate degrees of positive change are associated with the next highest score, and so on. The lowest mean score is associated with high degrees of negative change in quality management intensity.

Quality Management Training Intensity Change and Firm Performance

Training has been identified as an important element of quality management programs (Crosby, 1980; Garvin, 1983; Deming, 1986; Saraph, et al., 1989). Therefore, it is of interest to quantify the contribution of change in quality management training intensity, in and of itself, to improved performance. The experimental design selected for this analysis was hierarchical regression, requiring two runs (Tabachnik & Fidell, 1989). In the first run, 1993 performance was used as the independent variable. This approach is consistent with Dean & Snell (1996). In the second, the independent variable was a factor representing change in quality management training intensity (from the hierarchical change in quality management intensity factor analysis). The dependent variables were factors representing 1997 operational and financial performance, as previously discussed. Two separate regressions were performed. Results are found in Table 24.

Table 24
Change in Quality Management Training and Performance

Analysis	Total DF	F Value	Prob>F	R-square
Financial	153	1.777	.1845	.0116
Operational	155	2.620	.1076	.0167

Table 24 shows that neither financial nor operational performance are statistically related to change in the degree of quality management training at the .05 level. However, operational training borderlines on being significant at the .10 level. These results fail to support hypothesis 3.

Position Change in Quality Management Adoption Hierarchy

The second key research question of this study is whether movement within a hierarchy of quality management adoption can be observed over time. The analysis proceeded in four steps. First, a cluster analysis was conducted on 1997 data using exactly the same procedures as Ellington in 1993 (as reported in 1995). 1997 factor structure was forced by using Ellington's summed-scale of factor scores. Firms were then grouped into four clusters, representing the same levels of adoption found by Ellington (1995). Second, movement of firms among quality management adoption levels was identified by mapping changes in cluster membership from 1993 to 1997 on a firm by firm basis. Third, upward and downward movement of firms within the hierarchy was profiled in an effort to identify which specific quality management measures were acting as drivers of the change in adoption level cluster membership. Finally, the relationship between a firm's change in quality management adoption level and firm performance was then tested.

The results of 1997 cluster analysis are shown in Table 25.

Table 25

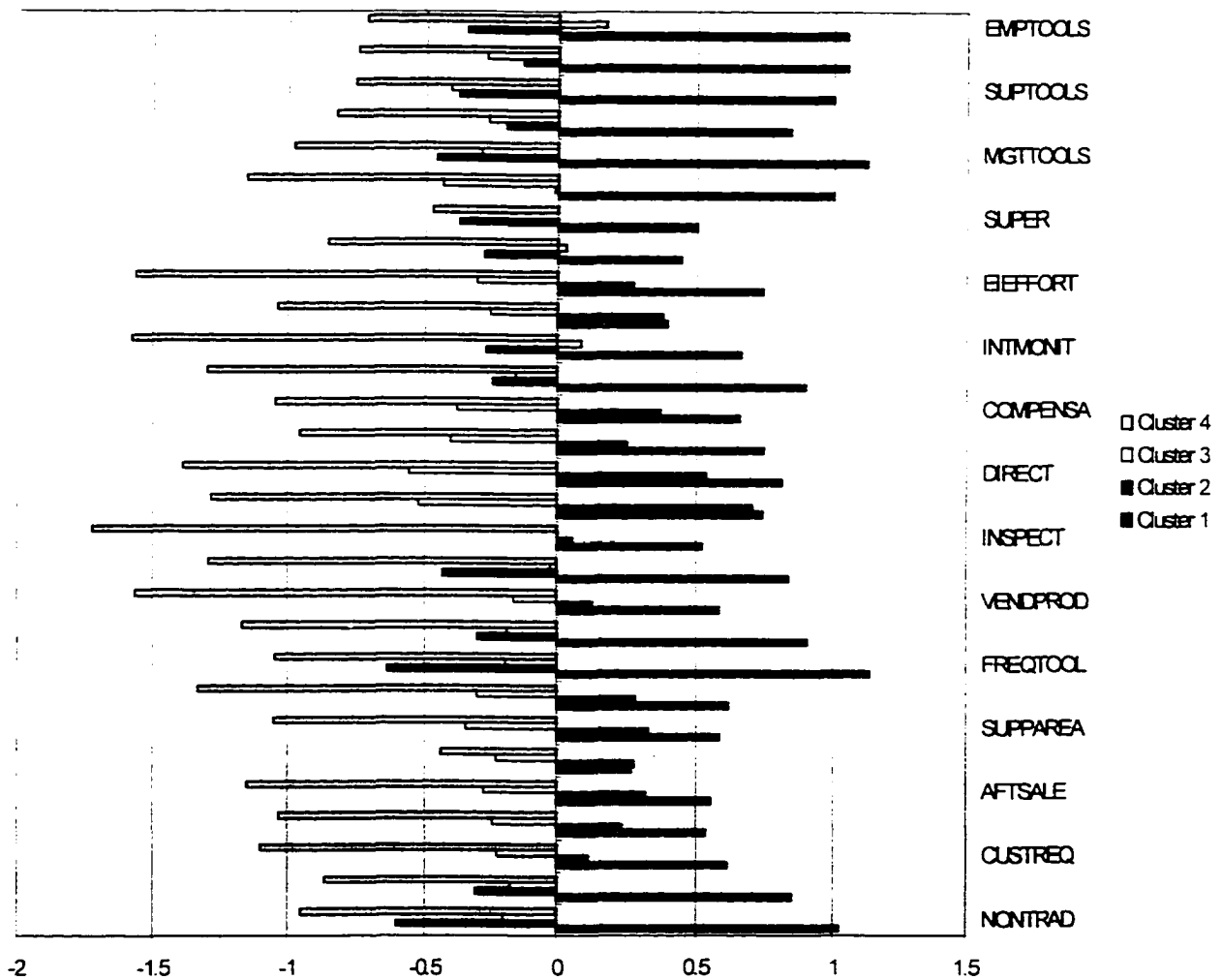
1997 Quality Management Adoption Level Groups (Standardized Scores)

Measure	Cluster 4	Cluster 3	Cluster 2	Cluster 1
NONTRAD	1.02163	-.60488	-.20256	-.95254
PROACT	.84539	-.31014	-.17412	-.86871
CUSTREQ	.60939	.11089	-.22886	-1.09815
TRADIT	.53009	.22587	-.24470	-1.02994
AFTSALE	.55119	.31203	-.27627	-1.14836
DELPERF	.26168	.27206	-.22980	-.43994
SUPPAREA	.58239	.32379	-.34438	-1.04777
PRODAREA	.61345	.27432	-.30287	-1.33261
FREQTOOL	1.1400	-.63982	-.19284	-1.04303
VENDINIT	.90278	-.30295	-.18804	-1.16513
VENDPROD	.57869	.12770	-.15826	-1.56511
PROCNTL	.83493	-.43250	-.02315	-1.29020
INSPECT	.51842	.05682	.00432	-1.72013
SUPPFUNC	.73994	.70149	-.52252	-1.28296
DIRECT	.81040	.53272	-.55811	-1.38881
OUTPART	.74132	.24473	-.40452	-.95521
COMPENSA	.65424	.36558	-38104	-1.04406
XQUALSYS	.89496	-.24401	-.15147	-1.29563
INTMONIT	.66170	-.26975	.08485	-1.57672
SUGGEST	.39125	.37528	-.25352	-1.03578
EIEFFORT	.73656	.26662	-.30496	-1.56458
FACIL	.44164	-.27825	.03039	-.85880
SUPER	.49761	-.37319	.-.04286	-.47360
MGTQM	.99191	-.01381	-.43787	-1.15241
MGTTOOLS	1.12613	-.45938	-.28833	-.97861
SUPQM	.83919	-.19500	-.26197	-.82802
SUPTOOLS	.99356	-.37545	-.40653	-.75957
EMPQM	1.04929	-.13006	-.26980	-.75162
EMPTOOLS	1.04529	-.34718	.16856	-.71989
Firms/Cluster	58	48	87	17

The structure of the clusters in Table 25 are the same as those found in 1993 by Ellington (as reported in 1995). The first cluster shows high scores on all quality management program

measures. the second relatively high scores on most measures. the third a mix of high and low scores. and the last level shows low scores on all quality adoption measures. Consistent with the study done by Ellington (1995). these levels were named Strategic. Threshold. Selective. and Non-adopters. respectively. A graphical presentation of clusters is shown in Figure 11.

Figure 11
1997 Adoption Level Means



From Figure 11. the Strategic adopters feature holistic quality management implementation. Threshold level firms also show a high level of quality management implementation. albeit at a somewhat lower level that members in Cluster 1. Selective level firms are somewhat unfocused.

seeming to pick and choose the elements of their quality management implementation. Nonadopter level firms show low scores on all quality adoption measures.

It is of interest to determine whether movement in group membership took place from 1993 to 1997. For example, did firms move from strategic level adopters to the selective level grouping? Can movement in the opposite direction be detected? Relative movement among the four hierarchical quality management adoption clusters was identified by mapping each firm's position within the four-cluster 1993 group to the four-cluster 1997 group. This mapping is presented in Table 26.

Table 26

Relative Movement in Quality Management Adoption Level

1994 Level \ 1997 Level	Non-Adopter	Selective	Threshold	Strategic	1994 Total
NonAdopter	*8*	13	4	2	27
Selective	5	*24*	9	12	50
Threshold	1	31	*13*	13	58
Strategic	4	18	22	*31*	75
1997 Total	18	86	48	58	210

Table 26 shows that 36.2% of the subject firms stayed at the same relative level of quality management adoption. 25.2% moved to a higher level, and 38.6% moved to a lower level. A Chi-Square analysis (Emory, 1980) showed these results to be highly significant (3 d.f., $P < .001$), supporting the hypothesis that firms move up and down a quality management adoption level hierarchy over time.

The literature suggests that quality management implementation enhances firm performance (Phillips, et al., 1983; Deming, 1986; Ahire, 1996). Indeed, Ellington (1995) found that adoption hierarchy levels and firm performance were positively related. The higher the level within the quality management adoption hierarchy, the greater the financial and operational

performance of the firm. If 1997 cluster membership is also significantly related to performance level, then any movement within the hierarchy from 1993 to 1997 should be associated with change in relative performance. Thus, movement to a lower level in the quality management adoption hierarchy should be associated with a deterioration in firm performance. Accordingly, the opposite should also be true, a move to a higher-level group from 1993 to 1997 should indicate that, on average, relative performance increased.

The relationship between 1997 quality adoption cluster and 1997 firm performance was tested by using two one-way ANOVAs. The independent variable was 1997 quality adoption cluster membership and the dependent variables were factors representing 1997 financial and operational performance of the firm. Test results are shown in Table 27.

Table 27
ANOVA Significance Test - 1997 Firm Performance and 1997 Cluster Membership
Forced Factor Structure

Performance	F Value	Pr > F
Financial	1.82	.1455
Operational	10.44	.0001

Results of the ANOVAs show that operational performance and cluster membership are significantly related. There is a significant difference between at least two of the clusters. Scheffe minimum difference tests were conducted on operational performance to identify how the clusters differ. The results of the minimum difference tests are shown in Table 28.

Table 28
Scheffe's Minimum Difference Test
Firm Performance and Cluster Membership

Grouping		Mean	N	Cluster
	A	.4682	58	Strategic
B	A	.2196	48	Threshold
B	C	-.2363	87	Selective
	C	-.6998	17	NonAdopter

Strategic Adopters were consistently in the highest operational performance group, followed by Threshold, Selective, and NonAdopters. Since firm position within the quality management adoption hierarchy in both 1993 and 1997 are significantly related to operational performance, it seems likely that any upward or downward change by firms in quality adoption hierarchy membership from 1993 to 1997 is associated with a change in firm performance.

The relationship between upward and downward change in the quality adoption level and firm performance change was tested using ANOVA. The results are shown in Table 29.

Table 29
ANOVA Significance Test - Upward/Downward Quality Adoption Hierarchy Migration and Change in Firm Performance

Performance Change Measure	F Value	Pr > F
Financial	1.82	.4410
Operational	116.343	.0001

As expected, upward and downward movement within the quality adoption hierarchy is significantly related to change in operational performance. Scheffe minimum difference tests were conducted on operational performance to identify how the upward and downward adoption level movements differ. The results of the minimum difference tests are shown in Table 30.

Table 30
Scheffe's Minimum Difference Test
Operational Performance Change and Hierarchical Movement

Grouping	Mean Performance Change	N	Hierarchical Movement
A	.3900	42	Upward
B	-.3500	72	Downward

Table 30 shows that firms moving to higher levels in the quality adoption hierarchy experienced significant improvement in operational performance, while operational performance decreased for those moving to lower levels. These results support hypothesis 6.

In addition to identifying the relationship between relative performance and movement in quality management adoption levels over time, it was of interest to determine which quality management measures drove the migration among adoption levels. The analysis was conducted by taking differences in quality management measure scores, by group, from 1993 to 1997. These were then profiled for intra-cluster emphasis by calculating the deviation of each quality management change measure from the overall change cluster mean. Tables 29-31 present standardized difference scores for each quality management measure given no overall change in group membership, upward movement in group membership, and downward movement in group membership. Figures 12-16 detail profiling results.

Table 31
Standardized Difference Scores - Total Quality Adoption Measures
No Movement in Adoption Level

	Strategic	Threshold	Selective	Nonadopt
NONTRAD	0.27105	-0.88607	0.26491	0.11655
PROACT	0.32967	-0.52247	0.15012	-0.17168
CUSTREQ	-0.05938	0.32622	-0.24570	-0.15692
TRADIT	-0.12403	0.32519	-0.17547	-0.11226
AFTSALE	-0.05459	0.58707	-0.20452	-0.52636
DELPERF	-0.28991	0.55475	-0.06871	-0.05936
SUPPAREA	0.17913	0.05710	-0.10940	-0.32613
PRODAREAD	0.24616	-0.03431	-0.20493	-0.40815
FREQTOOL	0.42606	-1.00522	0.32760	-0.07299
VENDINIT	0.23053	-0.50239	0.08494	-0.12595
VENDPROD	-0.08717	0.34898	-0.23220	-0.57060
PROCNTL	0.27497	-0.93343	0.45059	-0.31106
INSPECT	-0.04790	0.28319	-0.09404	-0.90035
SUPPFUNC	0.00398	0.75990	-0.37243	-0.22296
DIRECT	0.21905	0.20393	-0.44055	-0.17782
OUTPART	0.07038	0.22198	-0.09369	-0.13185
COMPENSA	-0.03750	0.51145	-0.17413	-0.23254
XQUALSYS	0.55743	-0.77910	0.23295	-0.52442
INTMONIT	0.12172	-0.58678	0.29908	-0.51138
SUGGEST	0.00147	0.11810	-0.10567	-0.20060
EIEFFORT	0.28279	-0.14857	-0.18189	-0.40335
FACIL	0.19824	-0.69678	0.51507	-0.52536
SUPER	0.26651	-0.63260	0.35161	-0.24014
MGTQM	0.37427	-0.49394	0.19028	-0.25264
MGTTOOLS	0.59992	-1.14426	0.47631	-0.21030
SUPQM	0.27919	-0.65151	0.30303	0.03266
SUPTOOLS	0.54960	-1.03700	-0.34068	0.01395
EMPQM	0.59517	-0.59579	0.18179	0.02840
EMPTOOLS	0.74460	-1.03642	0.70094	-0.01610

Table 31 shows that even those firms that kept the same cluster membership from 1993-1997 made changes in their quality management programs. That there are changes in quality management measures is not surprising. Most of the changes in quality adoption measures are

generally small and in keeping with the continuous improvement philosophy found in the quality management literature (i.e. Deming, 1986; 1993).

Table 32
Standardized Difference Scores - Total Quality Adoption Measures
Firms with Upward Movement in Adoption Level

	Threshold - Strategic	Selective - Strategic	Selective - Threshold	NonAdopt - Strategic	NonAdopt- Threshold	NonAdopt - Selective
NONTRAD	0.74044	1.48910	-0.13741	2.09072	0.46421	0.86653
PROACT	0.63306	1.16963	0.01410	1.54242	0.38689	0.52291
CUSTREQ	0.82472	0.59255	0.09405	1.55062	1.05212	0.71237
TRADIT	0.62941	0.59932	0.29510	1.44777	1.14355	0.67298
AFTSALE	0.82623	0.62294	0.38378	1.17319	0.93403	0.34573
DELPERF	0.54437	0.42277	0.43315	0.64226	0.65264	0.15078
SUPPAREA	0.31570	0.81737	0.55877	1.30403	1.04543	0.37726
PRODAREAD	0.30482	0.71139	0.37226	1.53791	1.19878	0.62159
FREQTOOL	0.77460	1.66044	-0.11938	2.11004	0.33022	0.77720
VENDINIT	0.70334	1.17576	-0.02997	1.94196	0.73623	0.85114
VENDPROD	0.79997	0.50475	0.05376	1.57320	1.12221	0.83625
PROCNTL	0.33400	1.30867	0.04124	1.81407	0.54664	0.95599
INSPECT	0.74479	0.42006	-0.04154	1.33820	0.87660	0.82410
SUPPFUNC	0.79835	0.89003	0.85158	1.79994	1.76149	0.53748
DIRECT	0.48161	0.92796	0.65028	2.02139	1.74371	0.65288
OUTPART	0.71857	1.05215	0.55556	1.56468	1.06809	0.41884
COMPENSA	0.80011	0.86115	0.57249	1.46576	1.17710	0.43048
XQUALSYS	0.35987	1.27938	0.14041	1.66617	0.52720	0.61974
INTMONIT	0.34467	0.87593	-0.05552	1.72704	0.79559	1.15019
SUGGEST	0.13407	0.53910	0.52313	1.22643	1.21046	0.58166
EIEFFORT	0.32137	0.85963	0.38969	1.89779	1.42785	0.85627
FACIL	0.02311	0.92632	0.20643	0.77508	0.05519	0.36383
SUPER	0.23820	0.89208	0.02128	0.73107	-0.13973	0.19060
MGTQM	0.51178	1.62006	0.61434	1.89168	0.88596	0.46190
MGTTOOLS	0.44125	1.89077	0.30526	1.89444	0.30893	0.47998
SUPQM	0.38268	1.40419	0.37000	1.69987	0.66568	0.59871
SUPTOOLS	0.33201	1.05941	-0.30960	1.76708	0.39807	0.36699
EMPQM	0.58356	1.50088	0.32153	1.82931	0.64996	0.51022
EMPTOOLS	0.35605	1.57767	0.18520	1.74908	0.35661	0.87235

Table 32 results are as expected. Difference scores are generally positive, and the greater the jump in cluster membership, the higher the change in quality management measure score.

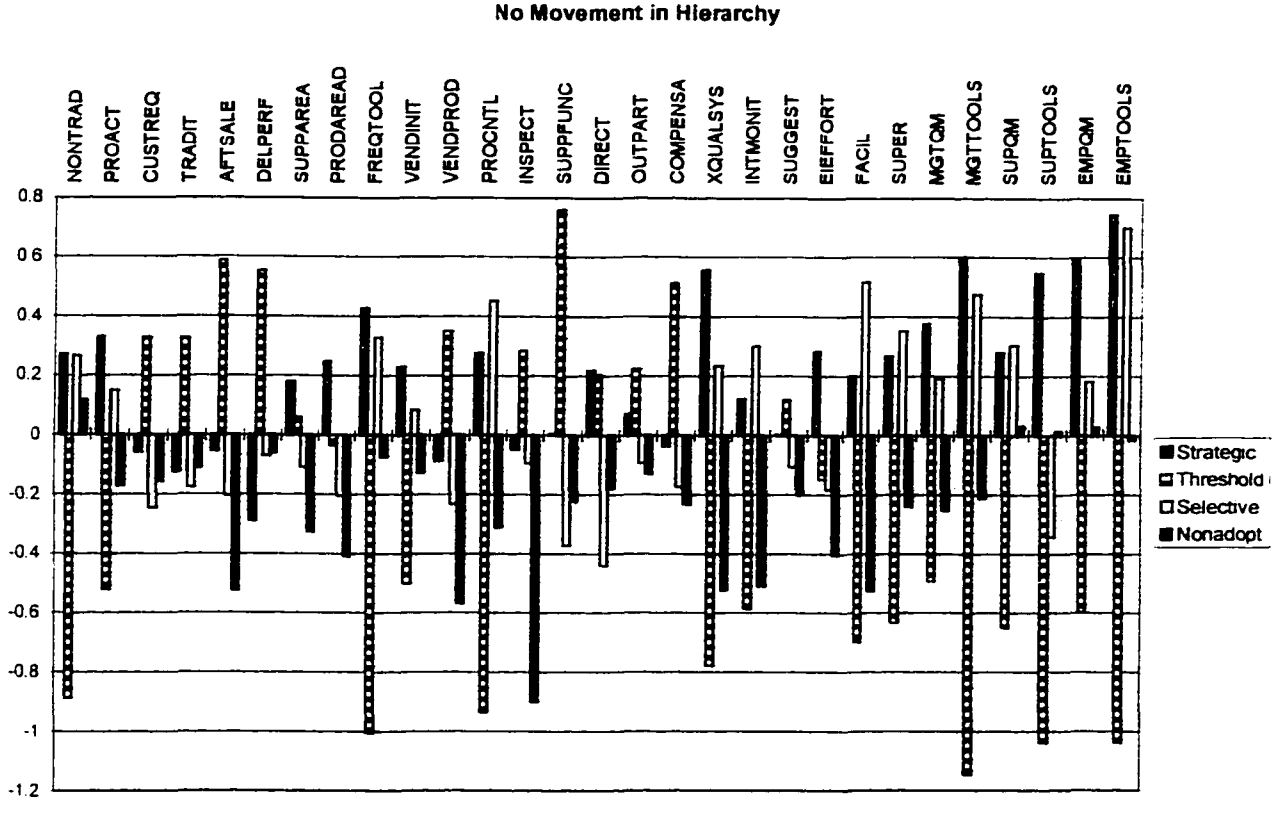
Table 33
Standardized Difference Scores - Total Quality Adoption Measures
Firms with Downward Movement in Adoption Level

	Strategic - Threshold	Strategic - Selective	Strategic - NonAdopt	Threshold - Selective	Threshold - NonAdopt	Selective - NonAdopt
NONTRAD	-1.35546	-0.95314	-1.70312	-0.48375	-1.23373	-0.48507
PROACT	-0.82586	-0.68984	-1.38443	-0.38645	-1.08104	-0.54447
CUSTREQ	-0.55788	-0.89763	-1.76692	-0.01353	-0.88282	-1.11499
TRADIT	-0.42825	-0.89882	-1.68406	-0.14538	-0.93062	-0.96071
AFTSALE	-0.29375	-0.88205	-1.75414	-0.00123	-0.87332	-1.07661
DELPERF	-0.27953	-0.78139	-0.99153	0.05289	-0.15725	-0.27885
SUPPAREA	-0.07947	-0.74764	-1.45103	-0.61107	-1.31446	-0.81279
PRODAREAD	-0.09297	-0.67016	-1.69990	-0.61150	-1.64124	-1.23467
FREQTOOL	-1.35376	-0.90678	-1.75697	-0.55824	-1.40843	-0.52259
VENDINIT	-0.97520	-0.86029	-1.83738	-0.38748	-1.36457	-0.89215
VENDPROD	-0.53816	-0.82412	-2.23097	0.06302	-1.34383	-1.63905
PROCNTL	-0.99246	-0.58311	-1.85016	-0.52408	-1.79113	-0.81646
INSPECT	-0.50950	-0.56200	-2.28645	0.23069	-1.49376	-1.81849
SUPPFUNC	-0.03447	-1.25848	-2.01892	-0.46411	-1.22455	-1.13287
DIRECT	-0.05863	-1.14946	-1.98016	-0.88690	-1.71760	-1.27125
OUTPART	-0.42621	-1.07546	-1.62615	-0.42727	-0.97796	-0.64438
COMPENSA	-0.32616	-1.07278	-1.73580	-0.23517	-0.89819	-0.83715
XQUALSYS	-0.58154	-0.48900	-1.63316	-0.68656	-1.83072	-0.91121
INTMONIT	-0.80973	-0.45513	-2.11670	-0.23218	-1.89375	-1.36249
SUGGEST	-0.01450	-0.64330	-1.42556	-0.51070	-1.29296	-0.88793
EIEFFORT	-0.18715	-0.75873	-2.01835	-0.72015	-1.97977	-1.44151
FACIL	-0.52165	-0.21301	-1.10220	-0.38814	-1.27733	-0.37412
SUPER	-0.60429	-0.27396	-0.70470	-0.30227	-0.73301	-0.07913
MGTQM	-0.63145	-1.05551	-1.77005	-0.91800	-1.63254	-0.52426
MGTTOOLS	-0.98559	-0.81454	-1.50482	-0.97321	-1.66349	-0.21397
SUPQM	-0.75500	-0.82197	-1.38802	-0.71848	-1.28453	-0.26302
SUPTOOLS	-0.81941	-0.85049	-1.20353	-1.06808	-1.42112	-0.69372
EMPQM	-0.58418	-0.72392	-1.20574	-0.73553	-1.21735	-0.30003
EMPTOOLS	-0.64787	-0.13213	-1.02058	-0.52068	-1.40913	-0.18751

Again the results are not surprising; change scores are generally negative and the greater the change in group membership, the higher difference score.

In order to better identify change cluster emphasis, profiling was conducted by calculating the deviation of each quality management adoption change measure from the overall mean of the change cluster. This analysis is presented in Figures 12-16.

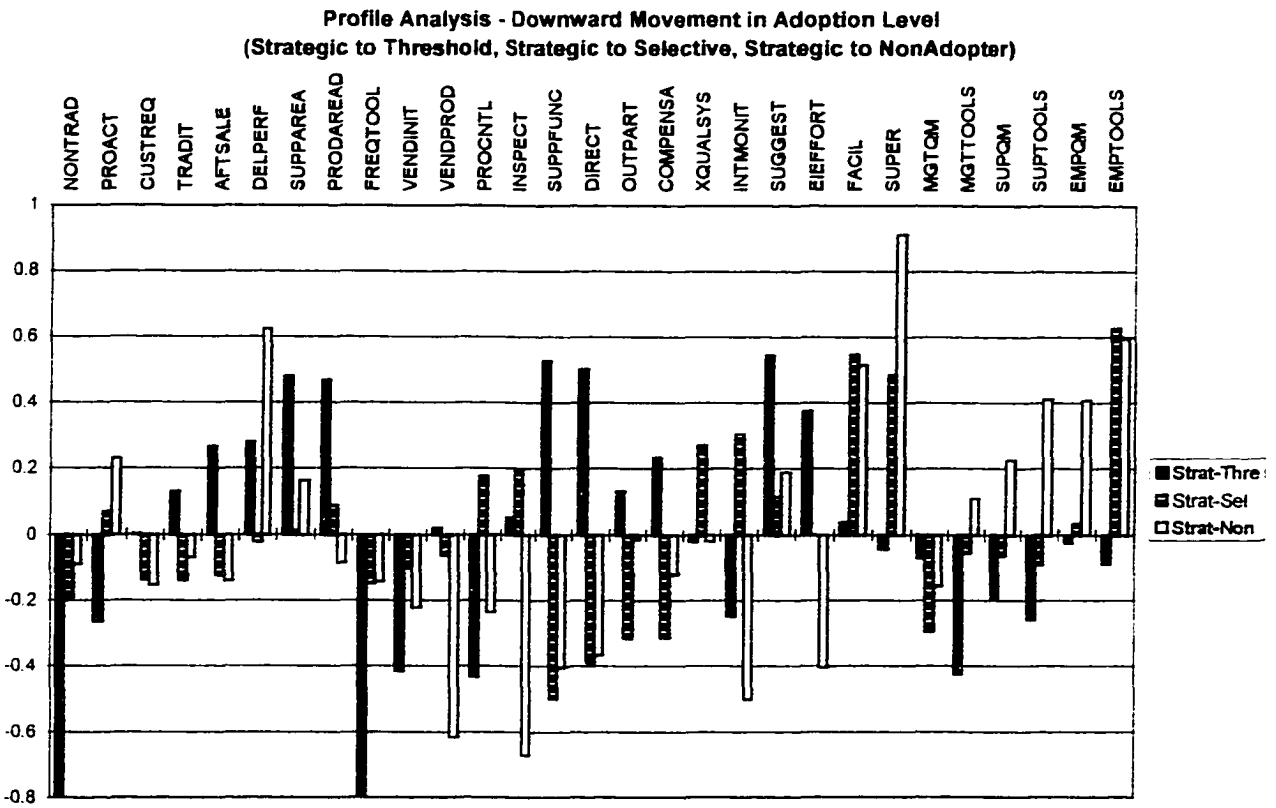
Figure 12



It is interesting to note that while these firms kept the same cluster membership, changes consistent with incremental improvement were made at the strategic, threshold, and selective levels. Strategic adopters increased emphasis on quality management tools training, measures that they gave relatively little emphasis to in 1994. Threshold adopters significantly decreased emphasis on quality management tools training, measures that they gave very high levels of emphasis in 1994. These movements suggest a pattern of training, gestation, and retraining. The

gestation period allows time for firm personnel to internalize and implement the tools learned in the workplace, followed by periodic training to "keep them current."

Figure 13



The selective to strategic level firms show the highest degree of change in emphasis. This result is consistent with the fact that they are "jumping" two levels, while the other firms only move one level. Note that the selective to strategic level firms have significantly increased quality management tools training and facilitation, leadership, and team-building skills training. In concert with these changes are an increased emphasis in the use of advanced process design techniques. All of the above measures were given very low emphasis in 1994. These increases are consistent with a shift in philosophy from what Deming has identified as traditional approaches to

management to the "New" philosophy of coaching and guiding workers (Deming, 1993, pp. 116-120).

Figure 14

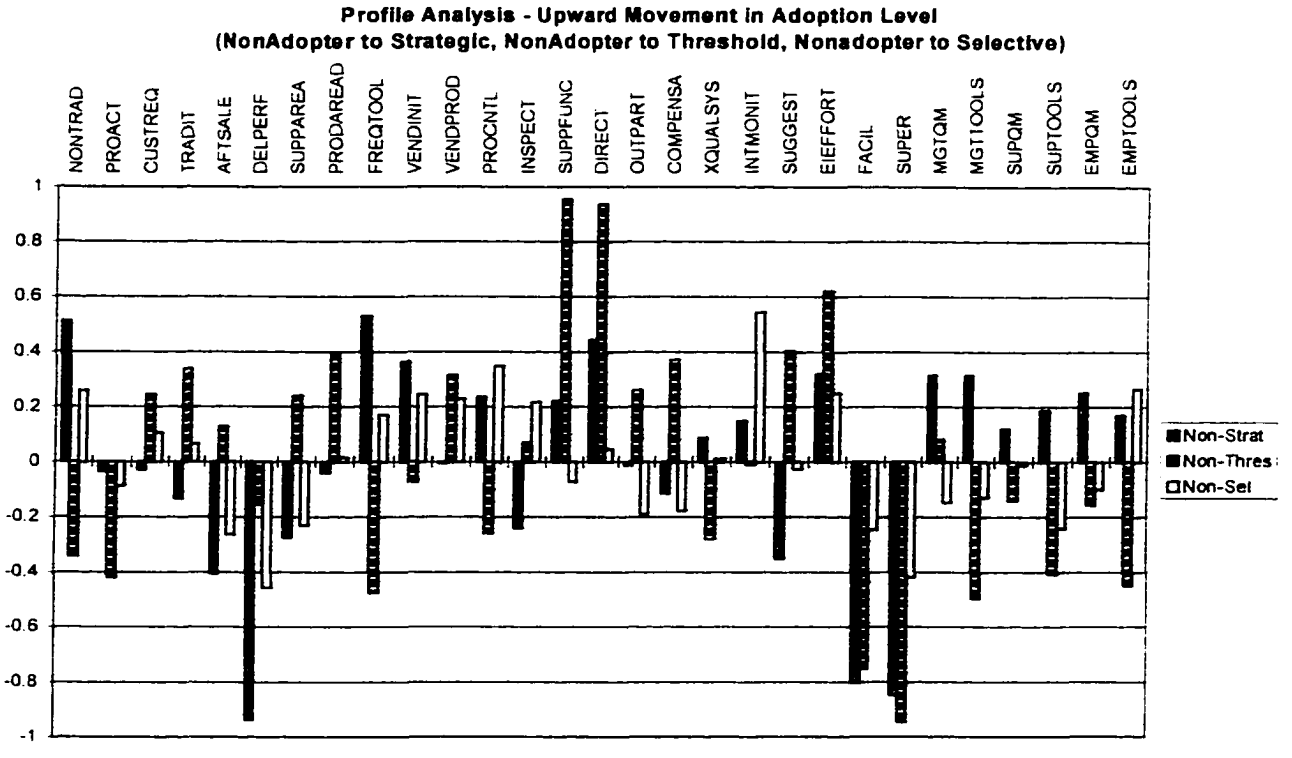
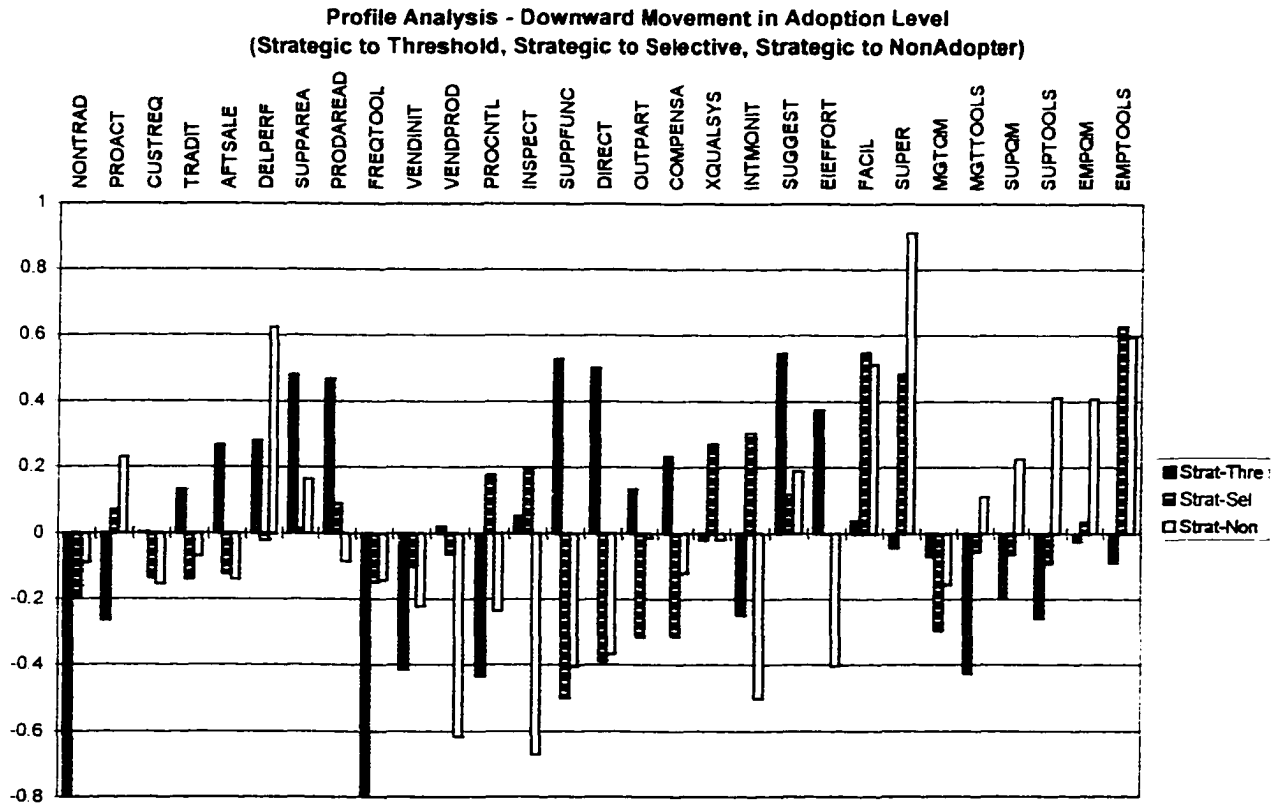


Figure 14 shows that firms moving two or more levels (nonadopter to strategic and nonadopter to threshold) make more changes in quality adoption measure emphasis than firms only moving one level. Nonadopters that moved to the highest level in the quality management adoption hierarchy significantly increased training, production team involvement in problem-solving, and customer interaction with non-traditional groups (i.e. line workers). This is again consistent with a shift towards giving lower-level workers more authority to make changes in firm systems and processes. Nonadopters to threshold members continue to relatively ignore training, but involve workers in direct problem-solving, the use of formal suggestion and feedback programs and formal continuous improvement activities. Nonadopters to threshold firms also involve support

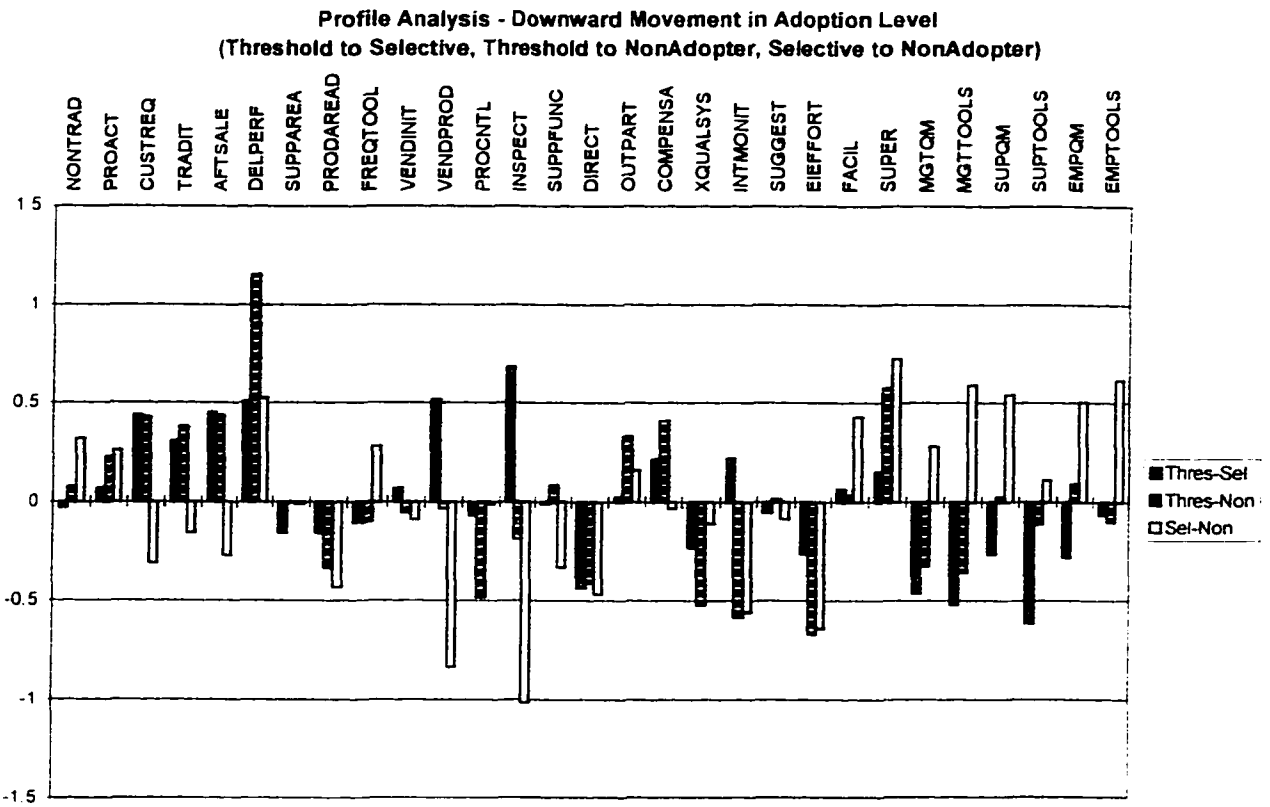
functions in problem-solving efforts, consistent with the use of a cross-functional approach as suggested by Hackman and Wageman (1995).

Figure 15



Strategic to nonadopters move from scoring high on all 29 quality management adoption measures in 1994, to scoring low on all 29 quality management adoption level measures in 1997. These firms have decreased emphasis in customer focus, process capabilities, vendor involvement, and the use of cross-functional teams. These areas form the very core of TQM (Hackman & Wageman, 1995). It is interesting to note that the continued emphasis of training in the absence of the four core TQM areas has not prevented these firms from sliding into the lowest performing quality management cluster.

Figure 16



With the exception of selective to nonadopter movement, the firms represented in Figure 14 have maintained customer focus emphasis and delivery performance. Threshold to selective adopters have decreased their emphasis on training and cross-functional problem-solving, holding the remaining quality management adoption emphasis relatively constant. Threshold to nonadopters, while scoring low on all 29 quality management measures in 1997, have also decreased the emphasis on training.

The profiling analysis suggests that the drivers of quality management change and cluster membership generally revolve around the core practices of TQM as suggested by Hackman and Wageman in 1995, and Deming's philosophy of enlightened management (Deming, 1986; 1993).

The deployment of cross functional teams, use of statistics and heuristics, vendor relations, and focusing on the customer appear to be important determinants of cluster membership.

This section dealt with change in quality management adoption group membership. The final section presents the results of a group membership analysis conducted only on 1997 data.

1997 Level of Adoption and 1997 Performance

The final item of interest was if firms could be grouped into a hierarchy of quality management adoption based on 1997 survey results, and whether the resulting cluster membership and 1997 performance were related. [Note: This analysis is different than that conducted for hypothesis 3, factor structure here is not forced to match that of 1993]. The experimental design chosen to conduct this test was cluster analysis, followed by ANOVA on standardized data. The analysis yielded four clusters: 1) all highly positive scores, 2) an intermediate cluster where most scores were positive, 3) an intermediate cluster where most scores were negative, and 4) all highly negative scores. These results are consistent with Ellington (1995). The ANOVA summary is shown in Table 32.

Table 34

ANOVA Summary - 1997 Level of Adoption Cluster Membership and Firm Performance

Test	DF	F Value	Prob>F
Financial Perf.	205	3.11	.02076
Operational Perf.	205	8.43	.0001

Table 34 shows that cluster membership and both measures of firm performance are related for data collected in 1997. These results support Hypothesis 7.

Summary of Research Hypotheses

A summary of the findings related to each specific research hypothesis is offered below:

H1: Changes in firm performance levels are associated with changes in the intensity of factors underlying quality management adoption.

Tables 18, 19, 21, and 22 show significant results for operational performance and for quality management areas of customer focus, quantitative problem-solving measures, and production team involvement in continuous improvement.

H2: Firms identified as low performers in the first wave of data collection are more likely to make significant positive changes in quality management initiatives than firm identified as high performers in the first wave of data collection.

Results contained in Table 20 contain strong support for this hypothesis. Firms with higher levels of performance in 1993 are more likely to be in lower quality management change clusters, which suggests that low 1993 performers are more likely to be in higher quality management intensity change clusters.

H3: Changes in levels of quality training intensity are associated with firm performance.

The analysis contained in Table 23 does not support this hypothesis at the .05 level. Results are marginal at the .10 level.

H4: Significant migration over time in level of quality management adoption is observable among firms.

Based on the analysis of Table 26, hypothesis 4 is strongly supported. Significant upward and downward migration was found.

H5: Changes in quality management adoption levels are associated with different patterns of change in the underlying factors of quality management adoption.

Tables 31-33 and Figures 12-16 show different patterns of change in underlying factors. Thus, hypothesis 5 is strongly supported.

H6: Performance is associated with changes in level of quality management adoption.

Tables 29 and 30 show significant results for operational performance, partially supporting hypothesis 6.

H7: Performance is associated with the quality management adoption level found during the second wave of data collection.

Table 34 contains an analysis which supports a significant relationship between both financial and operational performance and quality adoption level.

Chapter VI
Conclusions

The overriding purpose of this dissertation has been to investigate the relationship between change in quality management programs and performance of small- and medium-sized manufacturing firms. This research was able to discern significant change in quality management intensity and differences in quality management adoption patterns among firms. The research demonstrates that change in quality management intensity is related to performance. The study also was able to identify significant upward and downward movement in quality management adoption levels.

Quality Management Adoption Patterns

This study is the first undertaking to identify movement in quality management adoption patterns and to measure the effect of such movement on firm performance. Results point to the fact that changes in a hierarchy of quality management adoption can be measured. The levels of quality management adoption found by Ellington (1995) appear to remain consistent over time. This finding of a stable quality management hierarchy is significant in that it allows changes in level of quality management adoption to be tracked over time. The gap in the quality management literature is that the overwhelming majority of studies in the field are cross-sectional. Thus, the first contribution that the present study makes to the body of knowledge is that quality management practices can, in fact, be studied over time.

The second important contribution that the present study makes is that it is the first to identify the fact that not all firms deploy quality management at the same adoption level over time. Firms continually move up and down a hierarchy of quality management adoption level.

Finally, this is the first study to show that changes in quality management adoption levels over time are related to firm performance. Moving toward higher levels of quality adoption yields higher performance levels. Thus, quality management program initiatives have long-term positive effects on firm performance. Decreasing quality management emphasis is likely to negatively impact the operational performance of the firm.

Quality Management Intensity

Changes in quality management practice intensity over time and the effect of these changes have not been studied, heretofore. The results of the analyses contained within this dissertation show that longitudinal studies of transformation in quality management programs can, in fact, be successfully undertaken. This is a significant contribution to the body of literature as the overwhelming majority of previous work dealing with quality management program intensity takes a cross-sectional approach.

The second significant contribution of this research is that it is the first to show that firm performance is an important catalyst for positive quality management intensity change. Firms with lower levels of prior performance are more likely to increase the intensity of quality management programs. Those with higher levels of performance are more likely to remain at current intensity levels or to decrease the intensity of their programs.

Third, changes in quality management intensity have significant bearing on the operational performance of the firm. Increasing the intensity of quality management is associated with higher firm performance. In addition, quality management areas of customer focus and the deployment of quantitative problem-solving measures have a significant positive relationship with firm

performance. Interestingly, continual emphasis on continuous improvement is negatively associated with performance.

Finally, while level of quality management training has been identified to be significantly and positively related to firm performance in cross-sectional studies, no supporting evidence was found to suggest that changes in level of quality management training over time are directly related to performance.

Summary

Total Quality Management continues to be a significant research topic. That the response rate to the survey exceeded 50% is a strong indication that TQM and quality management issues remain important to today's senior executives. Responses came from high level officers representing a broad array of industries, adding the external value of the results. The instrument and experimental designs used in this research project showed that change in quality management adoption practices can be captured and analyzed. Furthermore, patterns of quality management adoption change were shown to be related to change in performance. The research also shows that cluster membership, which reflects overall quality management practices, is more powerful in predicting performance levels than any single quality management factor.

Limitations of the Research

There are several important limitations to the research. First, the data are self-reported, and therefore suffer the standard limitations of such information gathering methods. Second, likert-scaled questions were used in the research. While key terms were well-defined, individual bias is a reality. Third, while the data reflect responses from senior executives throughout a broad array of industries, only Georgia manufacturing firms were surveyed. The results may not be applicable to

firms in other parts of the United States or overseas. Fourth, the target population of this project was small- and medium-sized manufacturers. It is unclear how the results of the project might transfer to large manufacturing firms, or those whose primary business is not manufacturing. Fifth, some 33% of the firms within this study have reported that they are family-owned businesses, a group generally known for underreporting financial data. As such, financial results are probably not the best measure of performance for this group of firms. Sixth, it is not clear whether four years is a long enough time window for financial performance change to become evident. Finally, there is not enough information about selected industries within this study. In some industries quality management may simply be an order-qualifier, while in others quality management may be an order-winner. This lack of industry information could be a confounding factor in the research.

Suggestions for Future Research

While the results of this research have added significantly to the body of quality management knowledge, it would be of interest investigate:

1) change in quality management practices within single industries. It is reasonable to expect that customers in different industries have different expectations of the firms with which they do business. These expectations may be associated with different areas of quality management focus between/among industries.

2) the relationship of performance and components of TQM as defined by Hackman and Wageman (1995). Hackman and Wageman (1995) frame TQM in terms of customer focus, the use of statistics, use of heuristics, supplier relations, and cross functional teams. Empirical results that either support or that tend to refute their thesis would be beneficial to both academicians and practitioners.

3) extending this research to the service industry. Do the relationships found by this project and that in Ellington's 1995 work similar in the service industry. We are told that service is different. The question is whether or not quality management is different, as well.

4) the application of Hackman and Wageman's TQM definition in service.

5) an examination of the interrelationships among operations strategy, industry, quality management practices, and performance.

6) a third wave of data aimed at the firms who responded to this research, allowing for a more extensive and complete research effort.

Appendix A

Schedule of Total Quality Adoption Factors Used in Hierarchical Analysis

	Factor Structure							
	---- 1993 ----				----1997 ----			
Focus Area/Question	F1	F2	F3	F4	F1	F2	F3	F4
Customer Focus								
Customer involvement by hourly employees.	*				*			
Customer involvement by supervisors.	*				*			
Customer involvement by engineering.	*				*			
Customer involvement by quality dept.	*				*			
Solicit customer feedback via focus groups.		*					*	
Solicit customer feedback via surveys.		*					*	
Solicit customer feedback via hotlines.		*					*	
Solicit customer feedback via review teams.		*					*	
Systematically ensure spec's can be met.			*			*		
Systematically ensure delivery can be met.			*			*		
Systematically evaluate complaints.			*			*		
Customer involvement by cust. service staff.				*				*
Customer involvement by sales force.				*		*	*	
Solicit feedback via customer complaints.				*		*		
Customer involvement by top management.				*	*			*
Breadth of Quality Definition								
Importance of technical support.	*				*			
Importance of after-sales support.	*				*			
Importance of product reliability.	*				*			
Importance of conformance to cust. specs.								
Importance of delivery dependability.		*				*		
Importance of delivery speed.		*				*		
Importance of customer service.					*			
Measurement								
Performance measurement in sales.	*				*			
Performance measurement in marketing.	*				*			
Performance measurement in accounting.	*				*			
Performance measurement in purchasing.	*				*			
Performance measurement in planning.	*				*			
Performance measurement in quality dept.		*			*			
Performance measurement in production.		*			*			
Performance measurement in engineering.		*						
Performance measurement in packaging.		*			*			

	Factor Structure							
	---- 1993 ----				----1997 ----			
Focus Area/Question	F1	F2	F3	F4	F1	F2	F3	F4
Capability								
Use of process capability studies.	*				*			
Use of quality function deployment.	*				*			
Documented specification on shop floor								
Vendor Conformance								
Has SPC initiative.	*				*			
Has TQM initiative.	*				*			
Supplies certificate of compliance.	*				*			
Passed certification process.	*				*			
Past delivery performance.		*				*		
Past price.		*				*		
Past service performance.		*				*		
Manufacturing Compliance								
SPC on process variables.	*				*			
SPC on product characteristics.	*				*			
Internal quality systems audit.	*				*			
Automated inspection equipment.	*				*			
Preventive maintenance on equipment.								
First piece quality inspection.		*				*		
Final quality inspection.		*				*		
Acceptance sampling.		*				*		
Documented procedures on shop floor.								
Involvement in Problem Solving								
Participation level by top management.	*				*			
Participation level by sales.	*				*			
Participation level by purchasing.	*				*			
Participation level by planning.	*				*			
Participation level by quality department.		*				*		
Participation level by hourly employees.		*				*		
Participation level by engineering.		*				*		
Participation level by supervisors.	*	*			*	*		
Participation level by equipment vendors.			*				*	
Participation level by materials suppliers.			*				*	

	Factor Structure							
	---- 1993 ----				----1997 ----			
Focus Area/Question	F1	F2	F3	F4	F1	F2	F3	F4
Priority on Improvement								
Compensation-quality link for supervisors	*				*			
Compensation-quality link for engineering.	*				*			
Compensation-quality link for support staff.	*				*			
Compensation-quality link for senior mgt.	*				*			
Compensation-quality link for sales.	*				*			
Compensation-quality link for hourly empl.	*				*			
Firm evaluates efforts vs. best in class.		*				*		
Firm evaluates efforts vs. Baldrige award.		*				*		
Firm evaluates efforts vs. key competitors.		*				*		
Firm adopted internal customer philosophy.		*					*	
Firm evaluates efforts vs. ISO 9000.		*					*	
Firm evaluates efforts vs. company audit.			*				*	
Firm evaluates effort vs. customer audit.			*				*	
Firm evaluates efforts vs. industry quality.			*			*		
Continuous Improvement Structure								
Use of formal suggestion system.	*				*			
Use of formal feedback to suggestions.	*				*			
Use of monetary rewards for suggestions.	*				*			
Use of quality steering committee.		*				*		
Use of employee-lead prob. solving teams.		*				*		
Use of mgt.-lead prob.solving teams.		*				*		
First-Line Manager Role								
Manufacturing process improvement.	*				*			
Product quality improvement.	*				*			
Problem solving.	*				*			
Coordinating department interaction.	*				*			
Assigning employee tasks.		*				*		
Achieving production schedules.		*				*		
Maintaining product quality.		*						
Training								
Mgt training hours - leadership, facilitation.	*				*			
Mgt. training hours - technical tools.		*				*		
Supervisor training hours - leadership, etc.	*				*			
Supervisor training hours - technical tools.		*				*		
Employee training hours - leadership, etc.	*				*			
Employee training hours - technical tools.		*				*		

Appendix B
Initial Contact Letter (Tech Letterhead)

December xx, 1996

Name
Address

Dear Addressee:

Three years ago your firm responded to our quality management implementation questionnaire. Small- to medium-size firms manufacturers continue to fuel economic growth, and quality management remains an extremely important issue. Recent surveys have shown that executives feel that improving quality is the number one issue in the marketplace. Yet, there is much to be learned about the effects of quality management approaches over time.

A follow-up study is being conducted by the Management Department of Georgia State University, and the Georgia Productivity and Quality Center at Georgia Tech. The objective of the survey is to study how quality management approaches adapt in response to changing environments and needs.

The study includes 500 small- and medium-size manufacturers within the State of Georgia who responded to our 1993 questionnaire. In approximately one week, you will receive a short questionnaire from Georgia State University. The questionnaire is designed to confidentially collect data provided by senior executives on the quality management change process within their firms. Your assistance is critical, and is absolutely the key to the success of this important project. We hope that you will help us in this significant work.

All information which you provide via the questionnaire will be held in the strictest of confidence. Survey results will be published in aggregate form only: no specific firms will be identified.

All who complete a questionnaire will be provided a summary of results. In addition, more detailed results dealing with your specific firm will be available upon your request. We hope that you will find both reports useful.

If you should have any questions regarding the questionnaire or the confidentiality of results, please contact Chuck Ryan, Project Manager, at either 404-651-3185 or email: chuckr@gsu.edu. Thank you again for your help with this important project.

Sincerely yours,

Dr. Ned P. Ellington, Director
Georgia Productivity and Quality Center

Appendix B

Questionnaire Cover Letter (Georgia State University letterhead)

December 30, 1996

Senior Executive
Address

Dear (Senior executive addressee):

One week ago, Dr. Ned Ellington of the Georgia Productivity and Quality Center at Georgia Tech wrote to you about our study of the quality management transformation process. The results will help managers better understand how firms change approaches to quality management in response to environmental demands and needs, and will hopefully increase the overall performance of your respective company.

Your firm is one of a small group within Georgia selected for this study. In order for the project to accurately represent typical small- and medium-sized manufacturers, it is important that each questionnaire be completed by a senior executive and returned to us.

Your responses will be held in the strictest of confidence. The enclosed questionnaire has an identification number solely for the purposes of tracking who has responded. Neither your name, nor your firm's name, will be placed on the questionnaire and survey results will be published in aggregate form only.

All who respond to the questionnaire will receive a summary of the results. In addition, upon your request, we will be delighted to send a detailed report of your firm. You may receive the report by simply checking the box "Special report requested" on the back of the ***reply envelope***, and printing your name and address below it. We hope that you and your firm will find both the summary and special report useful.

If you should have any questions regarding the questionnaire or the confidentiality of the results, please contact me at either (404) 651-3185 or email: chuckr@gsu.edu. Thank you for your help with this important work.

Sincerely,

Charles M. Ryan, Project Manager
Quality Management Transformation Study
Georgia State University

(encl.)

Appendix B
Reminder Card

Jan 31. 1997

Last week we mailed to you a questionnaire regarding the quality management transformation process in manufacturing. If you have already completed and returned the survey, please accept our most heartfelt thanks.

If not, please complete and return it today. The survey has been sent to only a small representative sample of Georgia manufacturing firms, so it is extremely important that your firm be included in this very significant study.

If you did not receive the questionnaire, or if it was misplaced, please contact me now at (404)651-3185 or email: chuckr@gsu.edu, and I will immediately dispatch another survey to you. Thank you again for your help in this important work.

Sincerely,

Chuck Ryan, Project Manager
1997 Quality Management Transformation Study
Georgia State University

Appendix B
Second Follow-up: Letter

January 27, 1997

Address

Dear (Senior Executive) addressee:

Approximately three weeks ago, we wrote to you about our study of the quality management transformation process in manufacturing. As of today, we have not yet received your completed questionnaire.

We are writing to you again owing to the significance that every response has on the usefulness of the study. Questionnaires have been sent only to a small and select group of manufacturing firms. Thus, the success of this study hinges on receiving your response.

We have undertaken this survey because we believe that a better understanding as of how approaches to quality management change can help firms better compete in today's dynamic global marketplace. We believe that the results will be beneficial to both the State and to your firm. As a survey participant, you will be the first to receive a summary of the findings. In addition, if you will write your name and address on the back of the reply envelope, we will be delighted to furnish a detailed report tailored for your firm.

We have enclosed another copy of the questionnaire and a reply envelope for your convenience. Please have a senior executive complete it today: your response is very important.

If you have any questions about the survey or the confidentiality of the results, please contact me at (404)651-3185 or email: chuckr@gsu.edu. Thank you for your help with this significant work.

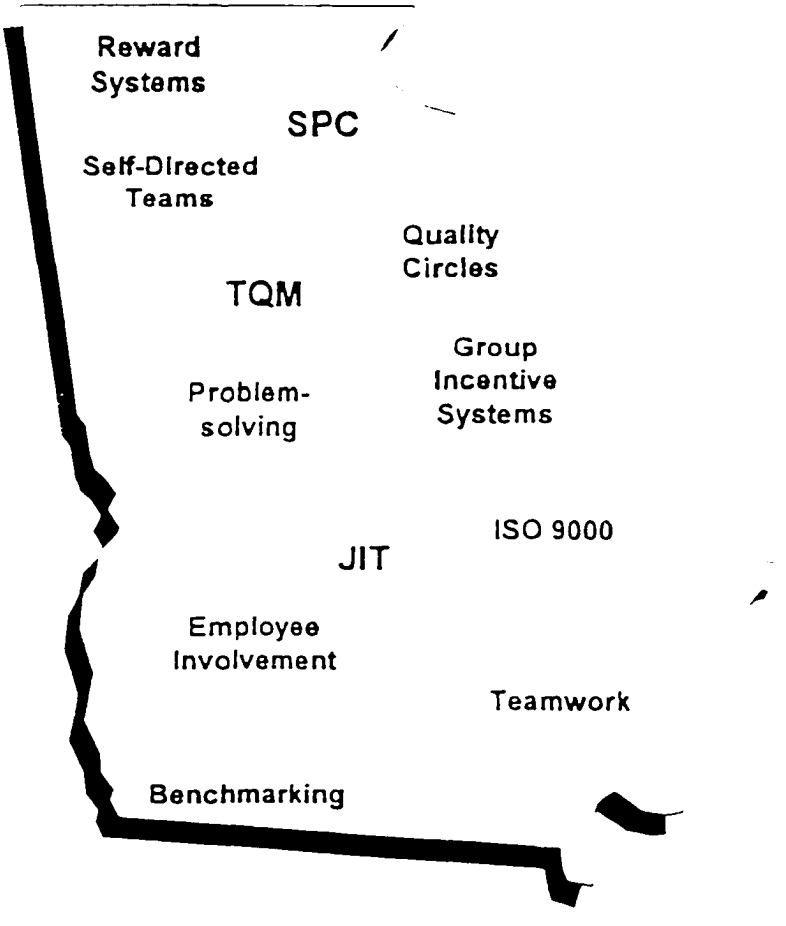
Sincerely,

Charles M. Ryan, Project Manager
Quality Management Transformation Study
Georgia State University

P.S. A number of people have written to ask when results will be available. We hope to have them out by early summer.

(encl.)

QUALITY MANAGEMENT IN GEORGIA MANUFACTURING 1997



Georgia State University
Department of Management

Georgia Tech
Economic Development Institute

Please answer the following questions relating to your organization's strategy, quality management practices, competitive environment, performance, and demographic characteristics by circling the appropriate number on the scale, checking the box beside the most descriptive statement, filling in the blank or otherwise indicating the best answer to describe your organization.

I. Strategy and strategy development

1. Please circle the position on the scale that best reflects the importance of the following in your business strategy:

	Of Minor Importance			Somewhat Important			Very Important
High performance products	1	2	3	4	5	6	7
Product quality	1	2	3	4	5	6	7
Consistency of product quality	1	2	3	4	5	6	7
Low cost production	1	2	3	4	5	6	7
Competitive pricing	1	2	3	4	5	6	7
Products that demand premium prices	1	2	3	4	5	6	7
Customer service	1	2	3	4	5	6	7
Product features	1	2	3	4	5	6	7
Product innovation	1	2	3	4	5	6	7
Manufacturing process innovation	1	2	3	4	5	6	7
Time-to-market for new products	1	2	3	4	5	6	7
Fast deliveries	1	2	3	4	5	6	7
Dependability of delivery	1	2	3	4	5	6	7
Flexibility in production	1	2	3	4	5	6	7
Just in Time (JIT)	1	2	3	4	5	6	7
New manufacturing technology	1	2	3	4	5	6	7
Diversified products/markets	1	2	3	4	5	6	7
Focusing on a market niche	1	2	3	4	5	6	7

2. Please indicate if your firm has the following documented and your estimation of the percentage of the employees in your organization who understand each component:

	Does Firm Have?			Employees With Understanding Of			
	Yes	Partial	No	All	Most	Some	Few
Written Strategic Plan	❑	❑	❑	❑	❑	❑	❑
Written Mission Statement	❑	❑	❑	❑	❑	❑	❑
Written Quality Policy	❑	❑	❑	❑	❑	❑	❑
Written Vision Statement	❑	❑	❑	❑	❑	❑	❑
Written Goals and Objectives	❑	❑	❑	❑	❑	❑	❑

3. Please circle the position on the scale that best reflects the involvement of the following individuals in developing your company's business strategy:

	Not Involved			Somewhat Involved			Very Involved
CEO	1	2	3	4	5	6	7
Top Management	1	2	3	4	5	6	7
Middle Management	1	2	3	4	5	6	7
Supervisors	1	2	3	4	5	6	7
Sales/Marketing Personnel	1	2	3	4	5	6	7
Human Resource Management	1	2	3	4	5	6	7
Engineering Staff	1	2	3	4	5	6	7
Quality Department	1	2	3	4	5	6	7
"Hourly" Production Employees	1	2	3	4	5	6	7
Support Staff	1	2	3	4	5	6	7
Outside Consultants	1	2	3	4	5	6	7

II. Quality Initiatives

4. Please choose one of the following statements which best describes your customers' current quality related demands:

- ❑ None of our customers have asked about our overall total quality improvement process.
- ❑ Some of our customers have asked about our activities to improve and control quality but they have not asked us to provide a detailed description of our overall quality improvement process.
- ❑ Some of our customers have stated it is their intention to do business with suppliers who have an ongoing quality improvement process and these customers have asked for a detailed description of our activities.
- ❑ Some of our customers have stated it is their intention to do business with suppliers who have an ongoing quality improvement process and these customers have or plan to audit our plant to learn more about our overall quality improvement process.

5. Has your company adopted a formal overall total quality improvement process?

No ❑ Planning to ❑ Yes ❑

If "yes", how long has the overall quality improvement process been in place?

❑ less than 1 year
❑ between 1 and 3 years
❑ between 3 and 5 years
❑ longer than 5 years

If you answered "Planning to" or "yes", please circle the position on the scale that best reflects the importance of the following reasons for starting your total quality improvement process.

	Not very Important			Average Importance			Very Important	Not Relevant
Customers asked for it	1	2	3	4	5	6	7	8
Local management driven	1	2	3	4	5	6	7	8
Corporate Management driven	1	2	3	4	5	6	7	8
Employee suggested or initiated	1	2	3	4	5	6	7	8
Union suggested or initiated	1	2	3	4	5	6	7	8
Reaction to implementation of quality improvement programs by competitors	1	2	3	4	5	6	7	8

6. The word "quality" has many interpretations. If you were defining your company's view of quality to a potential customer, how much importance would you place on each of the following characteristics?

	Not very Important			Average Importance			Very Important
Number of product features	1	2	3	4	5	6	7
Performance of products	1	2	3	4	5	6	7
Product durability	1	2	3	4	5	6	7
Product reliability	1	2	3	4	5	6	7
Consistency from item to item	1	2	3	4	5	6	7
Conformance to Customer Specifications	1	2	3	4	5	6	7
Aesthetics/appearance	1	2	3	4	5	6	7
Delivery Speed	1	2	3	4	5	6	7
Dependability of Delivery	1	2	3	4	5	6	7
Level of Technical Support	1	2	3	4	5	6	7
Level of After Sales Support	1	2	3	4	5	6	7
Customer Service	1	2	3	4	5	6	7
Image/Reputation	1	2	3	4	5	6	7
Other: _____	1	2	3	4	5	6	7

7. Some firms have adopted a management philosophy where the department that receives the goods or service of another department is considered to be the "internal customer" of the producing department.

	Not Adopted			Partially Adopted			Strongly Adopted
Has your organization adopted an "internal customer" philosophy	1	2	3	4	5	6	7

8. We would like to know your company's approach to increasing customer service. Which of the following activities does your company use to increase customer satisfaction? Please circle the position on the scale that best reflects how often each of the following techniques are used:

	Never			Sometimes			Always
We systematically determine if we can meet customers' product specifications before we accept an order.	1	2	3	4	5	6	7
We systematically ensure we can meet our promised delivery before we accept an order.	1	2	3	4	5	6	7
Top management systematically evaluates customer complaints.	1	2	3	4	5	6	7
Routine interactions with customers by:							
Top management	1	2	3	4	5	6	7
Customer service reps	1	2	3	4	5	6	7
1st line production manager	1	2	3	4	5	6	7
Hourly production employees	1	2	3	4	5	6	7
Engineering Staff	1	2	3	4	5	6	7
Quality department	1	2	3	4	5	6	7
We solicit customer feedback via:							
Review of customer complaints	1	2	3	4	5	6	7
Telephone "hotline"	1	2	3	4	5	6	7
Customer surveys	1	2	3	4	5	6	7
Customer focus groups	1	2	3	4	5	6	7
Sales force reports	1	2	3	4	5	6	7
Including customers in our product review teams	1	2	3	4	5	6	7

9. Over the past few years several quality models and standards have been developed to help guide total quality implementation efforts. Does your firm measure itself using the following:

	No			In some areas of the business			In all areas of the business
Malcolm Baldrige National Quality Award Criteria	1	2	3	4	5	6	7
Benchmarking against the industry of key competitors	1	2	3	4	5	6	7
Benchmarking against non-competitors (Best in class)	1	2	3	4	5	6	7
International quality standards such as ISO 9000	1	2	3	4	5	6	7
Industry specific quality standards	1	2	3	4	5	6	7
Company quality audit program	1	2	3	4	5	6	7
Customer audit program	1	2	3	4	5	6	7

III. Quality Program Impacts

10. Please rate the impact the overall total quality improvement process has had on the following areas:

	Very Negative Impact			No Impact			Extremely Positive Impact
Consistent product quality	1	2	3	4	5	6	7
Superior product quality	1	2	3	4	5	6	7
Low cost	1	2	3	4	5	6	7
Customer service	1	2	3	4	5	6	7
Product innovation	1	2	3	4	5	6	7
Process innovation	1	2	3	4	5	6	7
Time-to-market for new products	1	2	3	4	5	6	7
Fast deliveries	1	2	3	4	5	6	7
Production cycle time	1	2	3	4	5	6	7
Inventory levels	1	2	3	4	5	6	7
Employee morale	1	2	3	4	5	6	7
Vendor relations	1	2	3	4	5	6	7
Customer satisfaction	1	2	3	4	5	6	7
Company image/reputation	1	2	3	4	5	6	7
Production flexibility/response	1	2	3	4	5	6	7

IV. Quality Improvement and Problem Solving Tools

11. Please indicate how frequently the following quality assurance tools are used in your company by circling the appropriate position on the scale:

	Never use			Sometimes use			Always Use
Documented product specifications on the shop floor	1	2	3	4	5	6	7
Documented standard operating procedures on the shop floor	1	2	3	4	5	6	7
Documented purchasing specifications	1	2	3	4	5	6	7
Acceptance Sampling	1	2	3	4	5	6	7
First Piece Inspection	1	2	3	4	5	6	7
Final Inspection	1	2	3	4	5	6	7
Statistical Process Control on product characteristic	1	2	3	4	5	6	7
Statistical Process Control on process variables	1	2	3	4	5	6	7
Automated Inspection Equipment	1	2	3	4	5	6	7
Process Capability Studies	1	2	3	4	5	6	7
Internal Quality Systems Audits	1	2	3	4	5	6	7
Preventive maintenance on equipment	1	2	3	4	5	6	7
Quality Function Deployment (QFD)	1	2	3	4	5	6	7

12. Please indicate how frequently the following problem solving processes and tools are used in your company:

	Never use			Sometimes use			Always Use
Quality "steering" committee	1	2	3	4	5	6	7
Management-led problem-solving teams	1	2	3	4	5	6	7
Employees-led problem-solving teams	1	2	3	4	5	6	7
Formal suggestion system	1	2	3	4	5	6	7
Formal feedback to employees who make suggestions	1	2	3	4	5	6	7
Monetary rewards to employees for suggestions	1	2	3	4	5	6	7
Cost of Quality Analysis	1	2	3	4	5	6	7
Pareto Analysis	1	2	3	4	5	6	7
Brain Storming Sessions	1	2	3	4	5	6	7
Cause and Effect Analysis (Fishbone charts)	1	2	3	4	5	6	7
Process Flow Charting	1	2	3	4	5	6	7
Histograms	1	2	3	4	5	6	7
Scatter Diagrams	1	2	3	4	5	6	7
Other _____	1	2	3	4	5	6	7

V. Involvement and Participation in Quality Management

13. What percentage of the workforce participates in the following?

	None	Less than 25%	26% to 50%	51% to 75%	More than 75%
Routine use of statistical tools	1	2	3	4	5
Formal suggestions system	1	2	3	4	5
Management-led problem-solving teams	1	2	3	4	5
Employee-led problem-solving teams	1	2	3	4	5
Self-Directed Work Teams	1	2	3	4	5
Establishing goals relating to quality	1	2	3	4	5
Determining quality performance criteria for their jobs	1	2	3	4	5
Peer evaluation of quality performance	1	2	3	4	5
Cross-training for multiple jobs within the plant	1	2	3	4	5

14. On average, how much time do each of the following individuals or groups spend in formal problem-solving sessions involving a continuous improvement process?

	Little if any Participation					Participates on daily or weekly basis	
Hourly Production Employees	1	2	3	4	5	6	7
Quality Department	1	2	3	4	5	6	7
Engineering/Technical Staff	1	2	3	4	5	6	7
Supervisors	1	2	3	4	5	6	7
Sales	1	2	3	4	5	6	7
Top Management	1	2	3	4	5	6	7
Purchasing	1	2	3	4	5	6	7
Planning Staff	1	2	3	4	5	6	7
Equipment Vendors	1	2	3	4	5	6	7
Raw Material Suppliers	1	2	3	4	5	6	7

VI. Compensation

15. Employee compensation is influenced by many factors such as job responsibility, productivity, years of service, etc. We are interested in the link between individual compensation and the quality of the products and/or services provided. Please circle the position on the scale that best reflects the impact that quality has on compensation for:

	No Linkage			Some Impacts			Large Impact
Senior management	1	2	3	4	5	6	7
Supervisor	1	2	3	4	5	6	7
Hourly production	1	2	3	4	5	6	7
Sales	1	2	3	4	5	6	7
Engineering/technical staff	1	2	3	4	5	6	7
Support Staff	1	2	3	4	5	6	7

16. Please indicate for each of the following the percentage of employees that are covered by, or eligible for, each of the following types of compensation:

	None		Some		Most		All
Individual incentive	1	2	3	4	5	6	7
Merit pay	1	2	3	4	5	6	7
Profit sharing	1	2	3	4	5	6	7
Gain sharing	1	2	3	4	5	6	7
Stock ownership	1	2	3	4	5	6	7
All salary workforce	1	2	3	4	5	6	7
Knowledge/skill based pay	1	2	3	4	5	6	7

VII. Purchasing

17. We would now like to ask you about how your company approaches the purchase of raw materials and supplies. Please circle the position on the scale that best reflects the influence the following factors have on purchasing decisions.

	Not Important			Average Importance			Very Important
Price	1	2	3	4	5	6	7
Deliver consideration	1	2	3	4	5	6	7
Vendor Service	1	2	3	4	5	6	7
Product Quality	1	2	3	4	5	6	7
Vendor has SPC Initiative	1	2	3	4	5	6	7
Vendor has TQM Initiative	1	2	3	4	5	6	7
Vendor provides certificate of compliance or analysis with each shipment	1	2	3	4	5	6	7
Vendor has passed our certification process	1	2	3	4	5	6	7
Vendor has entered into a sole provider status	1	2	3	4	5	6	7

VII. Supervisor's role in quality management

18. Please choose one of the following statements which best describes your supervisors' role in the overall total quality improvement process:

- ❑ Our supervisors have very limited involvement in our overall quality improvement process.
- ❑ Our supervisors actively participate in the implementation of total quality improvement programs.
- ❑ Our supervisors lead in the implementation of quality improvement programs and provide much of the training to hourly employees.
- ❑ Our supervisors are involved in planning and design of the total quality programs. They also lead the implementation effort in their departments.

19 Please indicate the supervisor's responsibility in each of the following areas:

	Direct and Control						Coach and Advise
Making employee job assignments	1	2	3	4	5	6	7
Achieving production schedules	1	2	3	4	5	6	7
Maintaining product quality	1	2	3	4	5	6	7
Controlling and expediting material	1	2	3	4	5	6	7
Problem-solving	1	2	3	4	5	6	7
Manufacturing process improvement	1	2	3	4	5	6	7
Product quality improvement	1	2	3	4	5	6	7
Coordinating interaction between departments (boundary management)	1	2	3	4	5	6	7

IX. Production workers' role in quality management

20. Please circle the number on the scale that best reflects hourly production workers' responsibilities for:

	Not Responsible For			Some Responsibility For			Full Responsibility For
Monitoring product quality	1	2	3	4	5	6	7
Reporting poor quality	1	2	3	4	5	6	7
Stopping a machine that is producing poor quality	1	2	3	4	5	6	7
Adjusting a machine that is producing poor quality	1	2	3	4	5	6	7
Trouble shooting	1	2	3	4	5	6	7
Preventive maintenance	1	2	3	4	5	6	7
Product and process design	1	2	3	4	5	6	7

X. Performance Measurement

21 Now we would like to ask you how your company reports and records performance at the departmental level. Example performance measures may include:

- the percentage of invoices correctly processed the first time,
- the percentage of orders shipped on time,
- the number of defects per day.

Please indicate the category that best describes your current performance measurement practices of each of the following departments.

	Not applicable	Don't have measures	Limited measures mainly productivity	Multiple measures used to guide problem solving
Production Departments	❑	❑	❑	❑
Quality Department	❑	❑	❑	❑
Engineering/Technical	❑	❑	❑	❑
Sales	❑	❑	❑	❑
Marketing	❑	❑	❑	❑
Purchasing	❑	❑	❑	❑
Planning/Scheduling	❑	❑	❑	❑
Accounting	❑	❑	❑	❑
Customer Service	❑	❑	❑	❑
Packaging/Shipping	❑	❑	❑	❑

XI. Training

22. Now we would like to ask you some questions about the training activities in your company Please indicate the average annual amount of training provided to members of top management for each of the following specific areas and the impact of the training.

	Average Annual Amount					Impact		
Area	none	up to 8 Hours	9-24 Hours	25-40 Hours	40+ Hours	Positive Impact	No Impact	Negative Impact
Leadership	❑	❑	❑	❑	❑	❑	❑	❑
Communications	❑	❑	❑	❑	❑	❑	❑	❑
Customer Service	❑	❑	❑	❑	❑	❑	❑	❑
Total Quality Management	❑	❑	❑	❑	❑	❑	❑	❑
Date Collection & Analysis	❑	❑	❑	❑	❑	❑	❑	❑
Problem Solving	❑	❑	❑	❑	❑	❑	❑	❑
Statistical Process Control	❑	❑	❑	❑	❑	❑	❑	❑
Facilitation	❑	❑	❑	❑	❑	❑	❑	❑
Team Building	❑	❑	❑	❑	❑	❑	❑	❑

23. Please indicate the average annual amount of training provided to each supervisor for each of the following specific areas and the impact of the training.

	Average Annual Amount					Impact		
Area	none	up to 8 Hours	9-24 Hours	25-40 Hours	40+ Hours	Positive Impact	No Impact	Negative Impact
Leadership	❑	❑	❑	❑	❑	❑	❑	❑
Communications	❑	❑	❑	❑	❑	❑	❑	❑
Customer Service	❑	❑	❑	❑	❑	❑	❑	❑
Total Quality Management	❑	❑	❑	❑	❑	❑	❑	❑
Date Collection & Analysis	❑	❑	❑	❑	❑	❑	❑	❑
Problem Solving	❑	❑	❑	❑	❑	❑	❑	❑
Statistical Process Control	❑	❑	❑	❑	❑	❑	❑	❑
Facilitation	❑	❑	❑	❑	❑	❑	❑	❑
Team Building	❑	❑	❑	❑	❑	❑	❑	❑

24. Please indicate the average annual amount of training provided to each hourly employee for each of the following specific areas and the impact of the training.

	Average Annual Amount					Impact		
Area	none	up to 8 Hours	9-24 Hours	25-40 Hours	40+ Hours	Positive Impact	No Impact	Negative Impact
Leadership	❑	❑	❑	❑	❑	❑	❑	❑
Communications	❑	❑	❑	❑	❑	❑	❑	❑
Customer Service	❑	❑	❑	❑	❑	❑	❑	❑
Total Quality Management	❑	❑	❑	❑	❑	❑	❑	❑
Date collection and analysis	❑	❑	❑	❑	❑	❑	❑	❑
Problem Solving	❑	❑	❑	❑	❑	❑	❑	❑
Statistical Process Control	❑	❑	❑	❑	❑	❑	❑	❑
Facilitation	❑	❑	❑	❑	❑	❑	❑	❑
Team Building	❑	❑	❑	❑	❑	❑	❑	❑

XII. Quality Commitment

25. Please circle the position on the scale that best reflects the level of commitment to overall total quality improvement by each of the following:

	None committed			About half committed			All are committed
Senior management	1	2	3	4	5	6	7
Supervisors	1	2	3	4	5	6	7
Hourly production workers	1	2	3	4	5	6	7
Sales staff	1	2	3	4	5	6	7
Engineering/technical staff	1	2	3	4	5	6	7
Support staff	1	2	3	4	5	6	7
Vendors	1	2	3	4	5	6	7

XIII. Competitive Environment

26. Please indicate how your firm compares to your competitors in your industry with respect to:

	Below Industry Average			Average with Industry			Above Industry Average
Breadth of your product line	1	2	3	4	5	6	7
Number of market segments served	1	2	3	4	5	6	7
Uniqueness of your products	1	2	3	4	5	6	7
Complexity of your products	1	2	3	4	5	6	7
Intensity of your planning efforts	1	2	3	4	5	6	7

27 Please circle the number that best characterizes conditions within your industry.

	Very Little			Moderate Amount			A great Deal of
Sales growth in the industry	1	2	3	4	5	6	7
Profitability in the industry	1	2	3	4	5	6	7
Occurrence of industry price wars	1	2	3	4	5	6	7
Intensity of industry price wars	1	2	3	4	5	6	7
Intensity of domestic competition	1	2	3	4	5	6	7
Intensity of international competition	1	2	3	4	5	6	7
Competition for resources (labor, etc.)	1	2	3	4	5	6	7
Cooperation with vendors	1	2	3	4	5	6	7
Difficulty in accessing distribution channels	1	2	3	4	5	6	7

28. Complexity and unpredictability arise from a variety of sources in the organizational environment. Help us characterize your industry environment by indicating the degree to which each of the following sources or factors describes your firm's competitive environment.

	Not at all Descriptive						Very Descriptive
Large number of direct competitors in the market	1	2	3	4	5	6	7
Intense competition in my local area or region	1	2	3	4	5	6	7
Markets/customers are dispersed globally	1	2	3	4	5	6	7
Suppliers are dispersed globally	1	2	3	4	5	6	7
Market share is concentrated with one or a very few competitors	1	2	3	4	5	6	7
Key competitors are unpredictable	1	2	3	4	5	6	7
Customers are unpredictable	1	2	3	4	5	6	7
Finding qualified workers is a problem	1	2	3	4	5	6	7
Finding qualified vendors is a problem	1	2	3	4	5	6	7
Government regulations adversely affect operations	1	2	3	4	5	6	7
New competitors frequently enter the market	1	2	3	4	5	6	7
Competitors frequently leave the market	1	2	3	4	5	6	7
Product life cycles are getting shorter	1	2	3	4	5	6	7
Products are getting more complex	1	2	3	4	5	6	7
Threat of forward integration by suppliers	1	2	3	4	5	6	7
Threat of backward integration by customers	1	2	3	4	5	6	7

29. Please indicate the life cycle stage of your primary product line on the scale below:

Introduction	=>	Growth	=>	Maturity	=>	Decline
1	2	3	4	5	6	7

XV. Organizational Performance

30 Next, we would like to ask you about overall company performance. Please circle the position on the scale that best reflects your company's performance in comparison to competitors in your industry.

	Below Industry Average			Average with Industry			Above Industry Average
Product Quality	1	2	3	4	5	6	7
Product performance	1	2	3	4	5	6	7
Level of Customer Service	1	2	3	4	5	6	7
Dependability of Delivery	1	2	3	4	5	6	7
Delivery Speed	1	2	3	4	5	6	7
Level of Technical Support	1	2	3	4	5	6	7
Ability to command premium prices	1	2	3	4	5	6	7
Inventory turnover	1	2	3	4	5	6	7
Market Share	1	2	3	4	5	6	7
Overall Profitability	1	2	3	4	5	6	7
Return on Sales	1	2	3	4	5	6	7
Return on Assets	1	2	3	4	5	6	7
Return on Investments	1	2	3	4	5	6	7

XVI. Organizational Demographics

31. We would like to know a little more about your organization:

Number of employees at your site

❑ Less than 50 ❑ 151-250
❑ 51-100 ❑ 251-500
❑ 101-150 ❑ greater than 500

32. How long has your firm, as it is currently structured, been in business?

_____ years

33. Is your organization a division of a corporation? ❑ yes ❑ no

34. Is your organization privately owned? ❑ yes ❑ no

If your organization is privately owned is it primarily family owned? ❑ yes ❑ no

If yes, what generation is the current ownership? ❑ 1st ❑ 2nd ❑ 3rd

Is a family member the senior manger? ❑ yes ❑ no

35. Please indicate which one of the following classifications best describes your industry:

- ❑ Food Products
- ❑ Textile Mills Products
- ❑ Apparel and Finished Products
- ❑ Lumber and Wood Products
- ❑ Furniture
- ❑ Paper and Allied Products
- ❑ Printing, Publishing, and Allied Products
- ❑ Chemical and Allied Products
- ❑ Rubber and Plastic Products
- ❑ Stone, Clay, Glass, and Concrete
- ❑ Primary Metals Industries
- ❑ Fabricated Metal Products
- ❑ Machinery, except Electrical
- ❑ Electrical and Electronic Machinery, Equipment and Supplies
- ❑ Transportation Equipment
- ❑ Measure and Control Instruments: Photo, Medical, and Optical Goods
- ❑ Miscellaneous Manufacturing

❑ Other _____

36. Is the workforce unionized? ❑ yes ❑ no

If yes, what percent of the eligible workforce is a member of the union?

- ❑ 0 - 25%
- ❑ 26% - 50%
- ❑ 51% - 75%
- ❑ 76% - 100%

37 Finally, we need to know a little bit about you, the individual completing the survey. Which of the following best describes the title (or primary job responsibility) of the person who took primary responsibility for filling out this survey?

- ❑ Owner/Partner/Proprietor
- ❑ Chief Executive Officer
- ❑ Chief Operating Officer
- ❑ President
- ❑ Vice-President of Operations
- ❑ Vice-President of Quality
- ❑ Other Vice-President
- ❑ Plant Manager
- ❑ Operations Manager/Production Manager
- ❑ Quality Manager/Quality Director
- ❑ Middle Manager-Operations
- ❑ Middle Manager-Other
- ❑ Design Engineer/Product Development
- ❑ Manufacturing Engineer/Production Engineer
- ❑ Industrial Engineer/Management Engineer
- ❑ Quality Engineer
- ❑ Quality control technician
- ❑ Statistician
- ❑ Front-line supervisor/foreman
- ❑ Production worker
- ❑ Quality Consultant
- ❑ Management Consultant

❑ Other _____

38. For how many years have you been associated with this organization?

Total years _____ In your current position _____

39. Is there anything else you would like to tell us about your organization's overall quality management process, or are there any comments you would like to make concerning this survey or its subject matter? If so, please use this space for that purpose.

Your contribution to this research effort is greatly appreciated!

If you would like a summary of the results, please print your name and address on the back of the return envelope (NOT on this questionnaire) and we will be glad to send you one.

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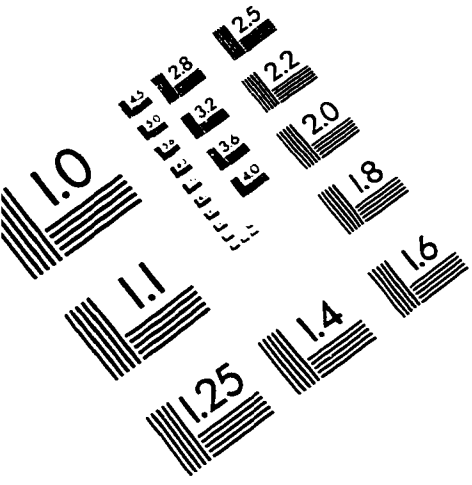
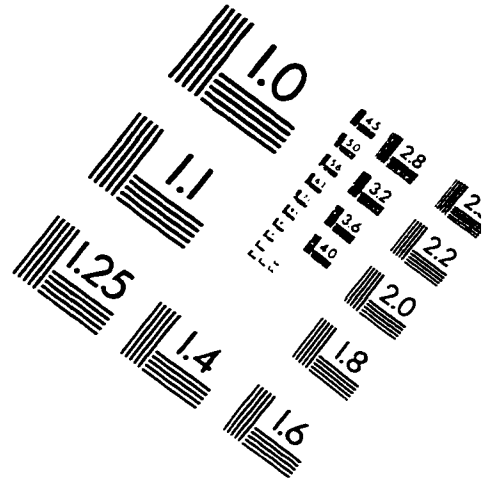
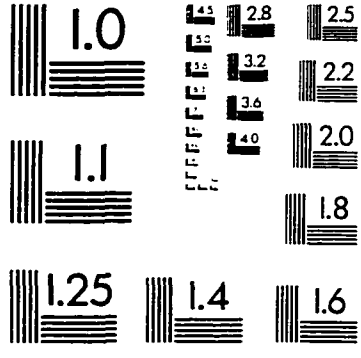
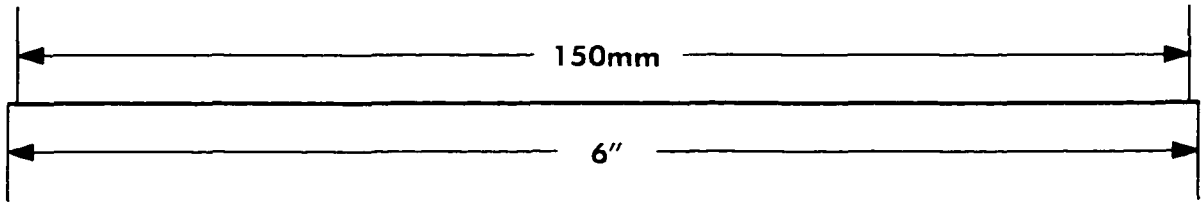
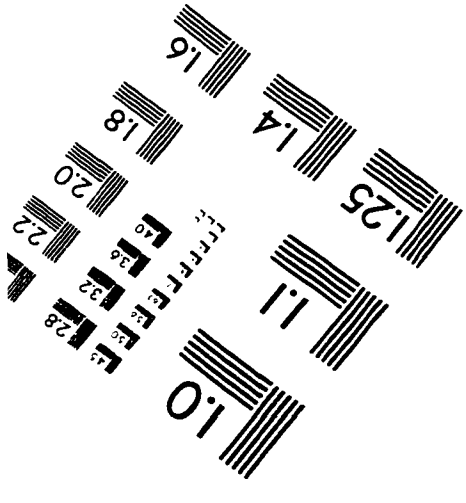
IMAGE EVALUATION TEST TARGET (QA-3)

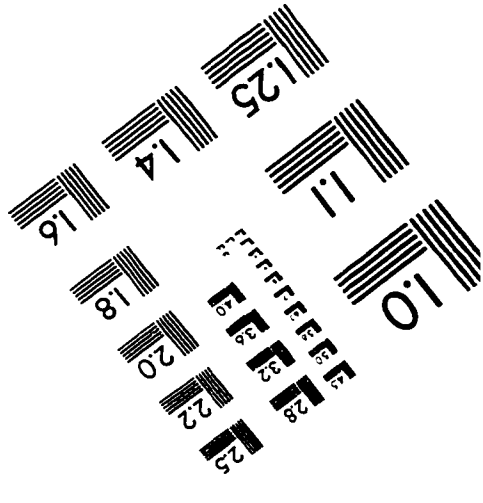












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