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EFFECTIVE LEADERSHIP
FOR
QUALITY ACHIEVEMENT
AND
ORGANIZATIONAL LEARNING

by

STEPHEN WARD KING

A dissertation submitted in partial fulfillment of the
requirements for the degree of

DOCTOR OF PHILOSOPHY
in
SYSTEMS SCIENCE: BUSINESS ADMINISTRATION

Portland State University

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DISSERTATION APPROVAL

The abstract and dissertation of Stephen Ward King for the Doctor of Philosophy in Systems Science: Business Administration were presented March 7, 2002, and accepted by the dissertation committee and the doctoral program.

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ABSTRACT

An abstract of the dissertation of Stephen Ward King for the Doctor of Philosophy in Systems Science: Business Administration presented March 7, 2002.

Title: Effective Leadership for Quality Achievement and Organizational Learning.

This research tests a set of theoretical relationships drawn from the literature on leadership, quality assurance management and organizational learning. The quality management literature frequently cites the importance of leadership, but little research has been done to evaluate the linkages between leadership behaviors and the goals of quality management programs. This study adapts and integrates a Deming-based quality management model (Anderson, Rungtusanatham and Schroeder, 1994) with a multi-dimensional leadership model (Bass, 1985). It ties the foregoing to the five disciplines of the learning organization (Senge, 1990) to reveal how organizational learning is related to specific leadership behaviors and to the process management practices and process outcomes of work groups.

This cross-sectional correlational field study generated perceptual data from 615 subordinates of 104 work group leaders within 19 quality-focused organizations. Subordinates, work group leaders and executives completed self-administered surveys to provide a hierarchical system of measurement perspectives. A variety of previously validated survey instruments was used including the Multifactor Leadership Questionnaire (MLQ). Hypothesis testing using ordinary least squares (OLS)

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regression was conducted at the individual level and work group level of analysis. Multilevel modeling was used to test if OLS estimates were accurate recognizing that observations were nested within groups. Structural equation modeling was used to graphically illustrate the multivariate relationships.

The results indicate that transformational leadership behaviors are positively associated with teamwork, customer focus and commitment to continuous improvement and to the learning organization disciplines of shared vision and managing mental models. Laissez-faire leadership is negatively associated with customer focus. Active management by exception is positively associated with the use of process control methods. Use of process control methods are in turn related to increased process feedback to team members which encourages two other organizational learning disciplines, team learning and individuals' sense of personal mastery. Systems thinking (Senge's fifth discipline) and team learning are positively related to the degree to which work group leaders report the achievement of continuous improvement goals.

The unique contributions of this study stem from its use of multiple measurement perspectives (to avoid common method variance) and multilevel data to illustrate an overall system of relationships.

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This dissertation would not have been possible without the kind cooperation of executives, managers and employees of many corporations and not-for-profit organizations throughout the state of Oregon. The field research involved in this study allowed me to meet a large number of outstanding managers and quality professionals in a wide variety of industries and settings. It is my wish that this research will be of practical value to them and to other business leaders.

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Effective Leadership for Quality Achievement and Organizational Learning

Chapter 1: Introduction

Overview

This work develops and tests a new theoretical model that identifies the connections between leadership behaviors, characteristics of organizational learning, and quality management principles, practices and outcomes. Drawing upon Dean and Bowen's (1994) identification of quality management's essential underlying principles of customer focus, continuous improvement and teamwork, the proposed model adapts and integrates the Deming-based quality management model developed by Anderson, Rungtusanatham and Schroeder (1994) with the multi-factor leadership model developed by Bass (1985). The foregoing is then tied to the five disciplines of the learning organization as delineated by Senge (1990) to reveal how organizational learning is related to specific leadership behaviors and key quality management practices and outcomes. In addition, the proposed model incorporates the idea that environmental uncertainty may play a contingency role in moderating several of the foregoing relationships (Sitkin, Sutcliffe & Schroeder, 1994), as may leaders' hierarchical level and subordinates' self-efficacy.

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Central Research Questions

Five central research questions are addressed in this research. Each central research question has one or more hypotheses associated with it. The central research questions in this study are:

1. How do leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management?
2. How does the extent of adoption of quality management's underlying principles affect process management practices?
3. How do the basic quality-supportive process management practices affect quality-related process outcomes?
4. How are the disciplines of the learning organization associated with quality-related process management practices and process outcomes?
5. How do leadership behaviors affect the realization of the various disciplines of the learning organization?

The model developed in this research posits that specific leadership behaviors are responsible for the degree to which an organization is characterized by the key underlying principles of quality management, namely customer focus, teamwork and commitment to continuous improvement. These organizational characteristics in turn drive quality-supportive process management practices such as process feedback to organizational members and the use of process control methods. The model further predicts that quality-supportive process management practices are positively related to

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continuous improvement achievement and employee fulfillment, and that specific leadership behaviors encourage certain disciplines of the learning organization.

Underlying Models

The models forming the "building blocks" of this research include the leadership model developed by Bass (1985), the model of organizational learning disciplines articulated by Senge (1990) and the quality management model proposed by Anderson et al. (1994). The Bass leadership model conceptualizes leadership as a multi-dimensional construct consisting of transactional, transformational and laissez-faire components. Waldman (1994) notes that Bass posited that transformational leadership ought to result in "extra effort and performance beyond expectations" and that such behaviors are considered important to quality management approaches. Waldman also observes that little research has been done to test this assumption and that quality-focused organizations may provide an excellent environment to conduct such research. A basic aim of this research was to test the suggestion that transactional and transformational leadership behaviors are associated with the realization of quality management's essential principles and the process management practices and process outcomes that follow as a consequence.

Senge (1990) describes the learning organization as characterized by five characteristics or *disciplines*: shared vision, mental models, team learning, personal mastery and systems thinking. With respect Senge's formulation of organizational learning, the proposed model predicts that the frequency of specific leadership

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behaviors will be positively related to the extent of shared vision and use of mental models in organizations, and that certain quality-focused process management practices will support team learning and personal mastery. The proposed model further predicts that personal mastery will be positively related to employee fulfillment and that systems thinking will support the achievement of continuous improvement.

The general framework used in this study for modeling the linkages between leadership and quality-focused organizational variables is the model proposed by Anderson et al. (1994). Their model specifies a number of linkages between leadership, characteristics of the organizational system, process management, process outcomes and customer satisfaction. In this study, the foregoing models are adapted and integrated into a single theoretical model of testable relationships.

Study Design

This research is designed as a cross-sectional correlational field study using self-administered questionnaires. The responses from organizational members gathered with these questionnaires provide data of a *perceptual* nature. Although the design precludes the ability to manipulate the independent variables and firmly establish causal relationships, the study's main goal of identifying the relationships among the variables of interest is achieved. In this research, the case for causality is made on theoretical grounds rather then resting on the research design. For testing purposes, the elements of the proposed model were operationalized via survey-based instruments previously developed and validated by a variety of researchers: Bass and

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Avolio (1997), Dickson and Weaver (1997), Flynn, Schroeder and Sakakibara (1994), Frenkel, Korczynski, Shire and Tam (1999), Ganzach (1998), Miller (1967), Morrow (1997), and Truxillo, Bauer and Sanchez (2001). The variables associated with the disciplines of the learning organization were measured with a new survey instrument developed by Tetrick, Jones, Latting, Da Silva, Slack, Etchegaray and Beck (2000) at the University of Houston. In some cases the foregoing survey scales were adapted and modified to fit the needs of the present research.

Subject organizations for the research included only those that were demonstrably quality-focused. For this research, quality focus was indicated in either of two ways: (a) demonstration of an organization-wide quality-focused agenda, or (b) the successful implementation of a functioning quality system. With respect to the first indicator of quality focus, organizations pursuing quality-focused agendas are those that have made explicit, company-wide commitments to continuously improve products and processes to better meet the needs and expectations of their customers. Evidence of organizational commitment to a quality-focused agenda was demonstrated by an organization's receipt of an Oregon Quality Award, a state-level award based closely on the Malcolm Baldrige National Quality Award. The Oregon award process recognizes multiple levels of quality achievement, so organizations recruited for this study represented a range of success levels with respect to quality management achievements. For instance, the lowest award level indicates that the organization's leadership is committed to continuous improvement and that there are the beginnings

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of systematic approaches to quality management in place. The highest level award is indicative of an organization with outstanding approaches to quality with excellent sustained results. The second kind of organization eligible for inclusion in this research were those with a functioning quality system in place. For the present study, this organizational characteristic was indicated by ISO 9000 certification. ISO 9000 is a set of international standards published by the International Standards Organization in Geneva, Switzerland. These standards require organizations to document all processes affecting quality and require independent, periodic audits to validate that the organization is following its documented processes.

The quality-focused organizations studied in this research reflect a constrained sample with respect to the universe of all possible organizations. This degree of constraint is important and desirable. Inclusion of organizations lacking a quality focus would not fit within the theoretical framework of this research as it is predicated on organizations having a desire to achieve quality-focused ends. Secondly, the practitioner-oriented recommendations designed to follow from this research will mainly be of interest to managers within organizations pursuing quality aims.

Relevance

The proposed research is relevant to academics as well as practicing managers charged with achieving quality-focused objectives. Quality programs in American industry are ubiquitous (Masterson & Taylor, 1996). Although previous research has demonstrated that quality programs can have a positive effect on firms' financial

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performance (Hendricks & Singhal, 1997; Lemak, Reed & Satish, 1997), little research has been done to evaluate the linkages between specific leadership behaviors and quality-focused measures of organizational success (Waldman, Lituchy, Gopalakrishnan, Laframboise, Galperin & Kaltsounakis, 1998). The quality management literature frequently cites the importance of leadership (Choi & Behling, 1997; Deming, 1982, 1994; Evans & Lindsey, 1996; Feigenbaum, 1991), but leadership theory and research rarely explores the link between leadership and the goals of quality management programs (Avolio, 1994). This research identifies specific leadership behaviors that are significantly associated with the achievement of quality-focused organizational outcomes, and illustrates how the disciplines of the learning organization are connected to leadership behaviors and quality-focused practices and process outcomes.

Importance of the Topic

The topics of quality management and organizational learning are focal points of interest for organizational scholars and practicing managers. For both topics, a key concern for managers and researchers alike is how to best take advantage of these ideas. One of the answers to this question, applicable to both quality management programs and the ideas of organizational learning, has been to apply appropriate leadership. Various writers on each topic have suggested the kinds of leadership skills and behaviors that may be instrumental in this regard, but empirical research to evaluate these suggestions has been generally lacking.

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The paucity of such research is unfortunate, since the existence of quality programs in American industry is widespread. Masterson and Taylor (1996), citing a 1991 Conference Board survey, noted that "93% of manufacturing companies and 69% of service companies have implemented some form of quality management practices." Most U.S. firms have instituted quality improvement programs (Edwards, Collinson & Rees, 1998; Evans & Lindsey, 1996) and many have a distinct quality department (an organizational unit responsible for quality assurance) as part of their formal organizational structure. In addition, interest in how organizations learn has increased (Mumford, 1992). Articles in the peer-reviewed literature continue to be published, and scores of books on or relating to organizational learning have been published. Organizational learning has been generally recognized to be important to strategic performance (Fiol & Lyles, 1985) and the rate at which organizations learn has been cited as key to sustainable competitive advantage (Stata, 1989).

Growing interest in the attainment of quality-focused organizational outcomes is evidenced by increases in each of the following: the number of states that sponsor quality award programs, organizations' requests to states for information on quality award criteria, the number of applications received for such awards, and the growth in the number of organizations implementing ISO 9000 registered quality systems (see Figures 1.1 and 1.2 below). In 1991, there were 111 applications to state-sponsored quality award programs; by 1997 the figure had grown to 974 (United States Department of Commerce, 1998). During that same period of time the number of state

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quality award programs increased from 8 to 43, and the number of trained quality award examiners grew from 296 to 2,419 (*Ibid.*). Uzumeri (1997) describes the growth in ISO 9000 quality system registrations as "explosive." In January 1993, there were 893 ISO 9000 registered sites in the U.S.; by December 1995 that number had grown beyond 8,000 (Uzumeri, 1997). By December 1999, there were 33,054 ISO 9000 registered sites in the U.S., 190,248 in Europe, and a total of 343,643 across 150 countries (*The ISO Survey of ISO9000 and ISO14000 Certificates – Ninth cycle*).

Research has shown that quality programs can produce sustainable improvements in customer satisfaction (Simester, Hauser, Wernerfelt & Rust, 2000), and can lead to sustainable competitive advantage (Reed, Lemak & Mero, 2000). Leadership is considered an important aspect of successful quality management (Avolio, 1994). Nevertheless, there has been little research which examines the connection between specific leadership behaviors and aspects of quality management (Sosik & Dionne, 1997). Although Deming (1982, 1994) considered leadership to be of critical importance in quality-focused organizations, he did not suggest specific leadership approaches to implement his Fourteen Points (Sosik & Dionne, 1997). This is an important omission since the effectiveness of leadership styles varies across situations and contexts (Bass, 1990; Sosik & Dionne, 1997). The importance of leadership in effective quality management is further evidenced by its inclusion as one of the categories of the Malcolm Baldrige National Quality Award (Appendix B) and as an area of focus in various state-sponsored quality award and recognition programs.

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Puffer and McCarthy (1996) suggest that visionary leadership from the top of the organization is a prerequisite for successful implementation of a quality-focused agenda. Many organizations stumble or fail in their efforts to adopt company-wide quality management programs (Wilkinson, Marchington & Goodman, 1992) and often the failure is blamed on inadequate leadership (Puffer & McCarthy, 1996). But what kinds of leadership behaviors are likely to be most effective in organizations pursuing organizational objectives related to quality? A variety of propositions and approaches to answering this question has been offered (Andersen et al., 1994; Bass, 1985, Puffer & McCarthy, 1996; Shea & Howell, 1998; Sosik & Dionne, 1997; Waldman, 1993, 1994). However, there is a paucity of empirical research to support the foregoing theoretical work. Research findings on the specific kinds of leadership behaviors most closely associated with the achievement of quality-focused organizational objectives should prove valuable to those wishing to evaluate quality management theories and have practical importance to those directly engaged in quality management activities (Sosik & Dionne, 1997).

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Figure 1.1
U.S. Quality Award Programs

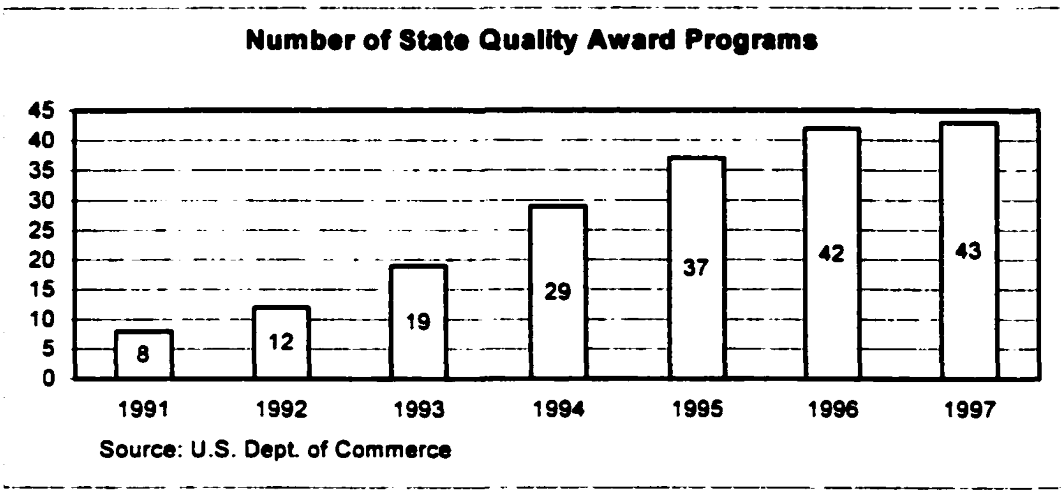
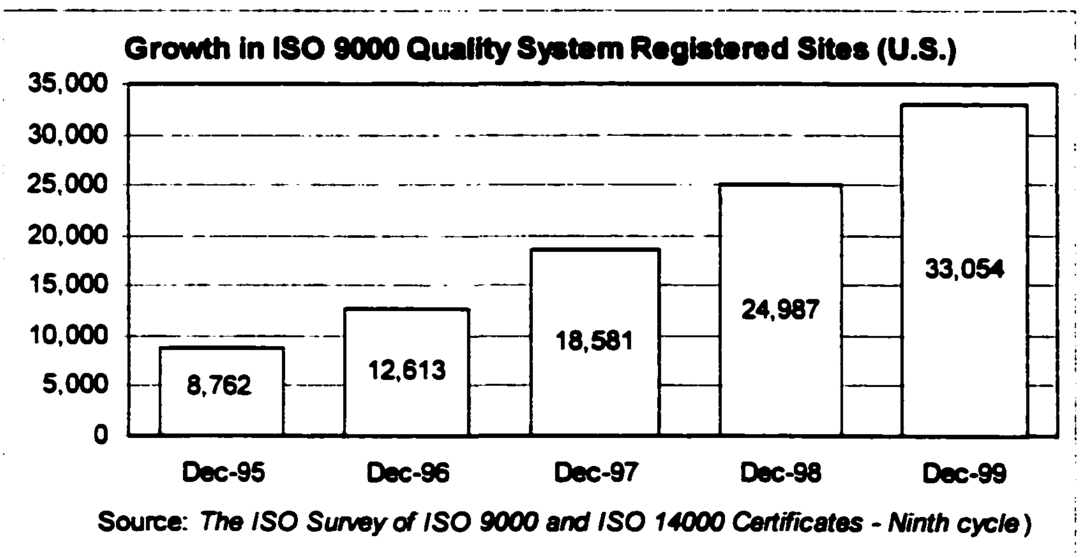


Figure 1.2
ISO 9000 Registrations in U.S.



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Chapter 2: Definitions

This chapter defines terms used in this study related to quality management, leadership, organizational learning, environmental uncertainty and systems.

Quality-Related Definitions

Baldrige Criteria (see also: Malcolm Baldrige National Quality Award)

The Baldrige Criteria consist of seven categories of quality-focused organizational performance measures:

1. Leadership
2. Strategic Planning
3. Customer and Market Focus
4. Information and Analysis
5. Human Resource Focus
6. Process Management
7. Business Results

Refer to Appendix B for a detailed definition of these categories. An organization's successful application for a Baldrige Award will lead to a site visit by a team of trained volunteer examiners who will assess to what degree the organization meets each of the award's seven performance categories.

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Continuous Improvement

"[T]he relentless quest to satisfy all customers through constant refinement of organizational processes and financial, mechanical and human resources" (Sosik & Dionne, 1997, p. 450). Also: "[A]n organization's ongoing quest for better work methods and organizational processes" (Morrow, 1997, p. 365).

Customer Focus

Understanding one's customers and "maintaining close relationships with customers and regularly seeking feedback from them" (Morrow, 1997, p. 365).

Deming Management Method

The "essence of the Deming management method [is] the creation of an organizational system that fosters cooperation and learning for facilitating the implementation of process management practices, which, in turn, leads to continuous improvement of processes, products, and services, and to employee fulfillment, both of which are critical to customer satisfaction, and, ultimately, to firm survival" (Anderson et al., 1994). Deming's method is enumerated in his Fourteen Points for Management.

ISO 9000

ISO 9000 is a set of international standards published by the International Standards Organization in Geneva, Switzerland. These standards require organizations to document all processes affecting quality and require

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independent audits to validate that the organization is following its documented processes.

Kaizen

A Japanese term, it means gradual, incremental and continuous improvement (Imai, 1986).

Malcolm Baldrige National Quality Award (MBNQA)

Named for a former U. S. Secretary of Commerce, the MBNQA is a national recognition program created by Public Law 100-107. It was signed into law by President Reagan in 1987. The award is designed to recognize organizations headquartered in the U. S. that excel in quality management and quality achievement (Evans & Lindsey, 1996). The award measures organizational performance using the Baldrige Criteria.

Quality

Of all the terms used in this proposal, quality is the most problematic to define. As Pirsig (1974, p. 178) observed, "you know what it is, yet you don't know what it is." Reeves and Bednar (1994) contrast and summarize the strengths and weaknesses of various definitions of quality, including quality as excellence, as value, as conformance to specifications, and as meeting and/or exceeding customers' expectations. Garvin (1988) offers eight dimensions of quality. For the purposes of this paper, quality is defined along the lines

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suggested by Deming (1982). Deming suggests that the meaning of quality is a function of one's perspective, thus implying that quality does not exist independently from a beholder and further that the perception of quality is idiosyncratic to the beholder. According to Deming (1982) quality can only be assessed by considering the interactions among three factors: the product (or service) itself, the customer and their experience with the product, and other aspects of the relationship between product and customer. This multiple perspectives approach to defining quality parallels Linstone's (1984) multiple perspectives framework, as shown below:

Linstone's Perspectives		Deming's "Three Corners of Quality"
T: Technical	→	The Product itself (specifications, objective performance)
O: Organizational	→	Service and support activities, warranty, training, etc.
P: Personal	→	The customer's personal use and experience with the product

Like Linstone's multiple perspectives, Deming's concept of quality distinguishes what is being looked at from how it is being looked at, and recognizes that "each perspective sees the world through a different filter" (Linstone, p. 44).

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Quality-Focused Outcomes

Organizational ends that are consistent with and supportive of the quality philosophies of Deming and other quality advocates, including goals such as continuous improvement, employee fulfillment and customer satisfaction. An array of quality-focused outcomes is operationalized by the Baldrige Criteria.

Quality-Focused Organizations

The definitions below of quality-focused organizations borrow from the definitions offered for total quality management (TQM). Organizations that are focused on quality may or may not label themselves with the TQM moniker. A quality-focused organization is one which has:

- "An ongoing process whereby top management takes whatever steps necessary to enable everyone in the organization in the course of performing all duties to establish and achieve standards which meet or exceed the needs and expectations of their customers, both external and internal" (Miller, 1996, p. 157).
- A management approach grounded on the principles of continuous improvement, teamwork and customer focus (Dean & Bowen, 1994; Evans & Lindsey, 1996).
- A "company-wide effort that includes all employees, suppliers, and customers, and that seeks continuously to improve the quality of products

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and processes to meet the needs and expectations of customers" (Dean & Evans, 1994).

- "[A]n effective system for integrating the quality-development, quality-maintenance, and quality-improvement efforts of the various groups in an organization so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction" (Feigenbaum, 1991, p. 6).

Quality Program

A systematic, documented, and institutionalized set of practices and procedures within an organization used to assure and verify confidence in the processes used to design, manufacture and deliver goods and/or services that conform to specifications and meet or exceed the expectations of internal and external customers.

Quality Management

"Quality management is defined as an approach to achieving and sustaining high quality output" (Flynn, Schroeder & Sakakibara, 1994, p. 339).

Quality Management vs. Total Quality Management vs. "Non-quality Management"

The difference between firms engaged in quality management and those engaged in total quality management (TQM) is that in the latter case quality

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management practices are extended to the whole organization as opposed to a local or department-level implementation (e.g., in the production department only). Organizations that do not have a quality program in place may be termed non-quality focused organizations; these organizations may or may not produce goods and services that meet or exceed the expectations of customers on a consistent basis.

Total Quality

The "application of quality to every task in the organization" (Jackson, 1990, cited by Avolio, 1994).

Leadership-Related Definitions

Charismatic leader

"[O]ne who articulates an all-embracing goal or vision, shows confidence, is respected and trusted, turns threats into opportunities, effectively focus attention on the importance of the group's mission, and creates a strong desire for identification on the part of associates" (Bass & Avolio, 1997, p. 25).

Empowerment

"[C]reating conditions for heightened motivation through the development of a strong sense of personal self-efficacy" (Conger & Kanungo, 1988, cited by Nelson & Quick, 1995).

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Inspirational Leadership

An inspirational leader is one who "stimulates enthusiasm among subordinates for the work of the group and says things to build their confidence in their ability to successfully perform assignments and attain group objectives" (Bass, 1985, p. 67 citing Yukl & Van Fleet, 1982).

Teamwork

Teamwork is exemplified by using teams to solve problems and to solicit ideas and opinions prior to decision-making (Morrow, 1997); typified by "the high value which is attached to collaboration" (Morrow, p. 365).

Transactional Leadership

"Transactional leaders use formal rewards and punishments to manage followers; they formally or informally engage in deal making and contractual obligations" (Nelson & Quick, 1995). "Transactional leadership as described by Bass (1990) refers primarily to material exchange – for example, material compensation that is exchanged for fulfillment of the employment contract" (Graen & Uhl-Bein, 1995). The transactional leader speaks to the self-interest of the follower (Bass, 1990).

Transformational Leadership

"Transformational leadership is a process in which the leaders take actions to try to increase their associates' awareness of what is right and important, to

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raise their associates' motivational maturity and to move their associates to go beyond the associates' own self-interests for the good of the group, the organization, or society. Such leaders provide their associates with a sense of purpose that goes beyond a simple exchange of rewards for effort provided" (Bass & Avolio, 1997, p. 11).

Visionary Leadership

"The ability of management to establish, practice, and lead a long-term vision for the organization, driven by changing customer requirements, as opposed to an internal management control role. This is exemplified by clarity of vision, long-range orientation, coaching management style, participative change, employee empowerment, and planning and implementing organizational change" (Anderson, Rungtusanatham & Schroeder, 1994, p. 480).

Systems-Related Definitions

Interpretive Structural Modeling (ISM)

A methodology "to assist in the consideration of a set of elements according to some selected relation pertaining to the given problem context (thus called a 'contextual relation'), and to develop an 'organization chart' representing the way the elements are interconnected according to that contextual relation" (Lendaris, 1978b).

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Table 2.1

Definitions Associated with Bass's (1985) Model of Leadership and its Associated Multifactor Leadership Questionnaire (MLQ)

	Leadership Behavior	Definition	Sample Item from the Questionnaire
Transformational Leadership Factors	Idealized Influence (charisma)	Communicating an attainable vision; exhibiting attributes, values or behaviors that subordinates wish to emulate (including self-sacrifice for the good of the group); status as a role model; behavior that demonstrates high moral and ethical conduct.	Emphasizes the importance of having a collective sense of mission.
	Inspirational Motivation	The articulation of shared goals and of the leader's vision of a possible future. "The arousal and change in followers of problem awareness and problem solving, of thought and imagination, and of beliefs and values, rather than arousal and change in immediate action" (Bass, 1985, p. 99).	Articulates a compelling vision of the future.
	Intellectual stimulation	Encouraging followers to approach problems in new ways or from new perspectives, and to question previous assumptions.	Gets me to look at problems from many different angles.
	Individualized Consideration	Empathetic treatment of subordinates as unique individuals with unique developmental needs.	Treats me as an individual rather than just as a member of a group.
Transactional Leadership Factors	Contingent Reward	Exchange of rewards for subordinate's attainment of agreed-upon objectives.	Makes clear what one can expect to receive when performance goals are achieved.
	Management-by-Exception	Active form: monitoring of work processes and/or output to assure mistakes are not made. Passive form: corrective intervention by the leader when mistakes are brought to the leader's attention.	Focuses attention on irregularities, mistakes, exceptions, and deviations from standards.
	Laissez-Faire	Lack of transactions or agreements with subordinates; lack of feedback and low involvement with subordinates.	Avoids getting involved when important issues arise.

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System

"A system is a) unit with certain attributes perceived relative to its (external) environment, and b) a unit that has the quality that it internally contains subunits and those subunits operate together to manifest the perceived attributes of the unit" (Lendaris, 1986).

Organizational Learning-Related Definitions

[from Senge (1990) unless otherwise noted]

Organizational Learning

"Organizational learning is the ability of an organization to gain insight and understanding from experience" (McGill, Slocum & Lei, 1992).

"Organizational learning means the process of improving actions through better knowledge and understanding" (Fiol & Lyles, 1985).

Personal Mastery

Personal mastery is the "discipline of personal growth and learning." It involves focusing on what one genuinely wants and on one's own visions of a desired future state.

Systems Thinking

Systems thinking is a mental discipline for observing totalities and wholes rather than isolated parts, and observing interrelationships, patterns and processes rather than things and events.

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Shared Vision

Shared vision arises from the combined personal visions of organizational members and represents the collective sense of the purpose of the organization and where it's headed, along with a concomitant commitment to that purpose and direction.

Mental Models

Mental models are individuals' understanding of how the world works. Often tacit and deeply entrenched, mental models incorporate individuals' assumptions and generalizations about how things work or why they don't work. Managing mental models involves exposing and surfacing assumptions so they may be shared, discussed and tested.

Team Learning

Team learning is the group-based discovery of insights through dialogue and discussion.

Uncertainty Definition

Perceived Environmental Uncertainty (PEU)

A perceptual phenomenon in which an individual feels unable to assign probabilities to the likelihood of future events.

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Chapter 3: Literature Review

This chapter reviews the theoretical work and empirical research published in the scholarly literature on the relationships among leadership, organizational learning and organizational outcomes including quality-focused outcomes. This chapter also shows how the present research builds on or extends prior theory and research. In addition, a brief examination of the academic recognition afforded to studies of quality management is presented. It should be noted that a search of the peer-reviewed literature found no quantitative studies employing Senge's (1990) model of the learning organization except for Tetrick et al.'s (2000) development and initial validation of a survey instrument to measure Senge's learning disciplines.

Academic Recognition of Quality Management

There may be skepticism in some quarters of academia regarding the scholarly rigor of the quality management literature (beyond its well-established roots in quantitative methods such as statistical process control and acceptance sampling). In the last several years, peer-reviewed literature on quality management has appeared in various journals. The Academy of Management published a special issue devoted to the theoretical dimensions of total quality (*Academy of Management Review*, July 1994). Recent scholarly literature addresses a variety of quality-related topics and has been published in a diversity of peer-reviewed forums (Table 3.1).

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Table 3.1
Peer-reviewed Literature Sources on Quality Management

- *Academy of Management Journal*
- *Academy of Management Review*
- *Group & Organization Management*
- *Human Resource Development Quarterly*
- *Human Resource Management Journal*
- *Journal of Applied Behavioral Science*
- *Journal of Business and Psychology*
- *Journal of Individual Psychology*
- *Journal of Managerial Issues*
- *Journal of Marketing Research*
- *Journal of Operations Management*
- *Journal of Organizational Behavior*
- *Journal of Organizational Behavior Management*
- *Journal of Quality Management*
- *Organization Development Journal*
- *Organization Science*
- *Organization Studies*
- *Psychological Reports*
- *Quality Management Journal*
- *The International Journal of Organizational Analysis*

A large part of the difficulty in gaining academic recognition of quality management has likely been its lack of theoretical foundation (Flynn, Schroeder & Sakakibara, 1994). The prior lack of such theory has been at least partly responsible for the relative scarcity of the quality-oriented research to date. For all of their popularity, the work of the so-called quality gurus, such as Deming, Crosby, Juran and others, has been essentially prescriptive in nature (Gatewood & Riordan, 1997). Such is the case with Deming's Fourteen Points. Each point begins with a verb and constitutes an imperative statement (Anderson et al., 1994). For example, Point 3 is

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"Cease dependence on mass inspection" (Deming, 1982). This and Deming's other 13 points are universalistic, normative statements telling managers what they ought to do. Neither Deming nor the other popular "gurus" provide testable theories or offer nomological frameworks to help us understand how, when and under what organizational circumstances their prescriptions may be profitably applied.

However, the last several years has seen the appearance of specific, testable theories on the subject. For example, Waldman (1994) embraces a systems perspective in his development of a model that illustrates quality management's contribution to work performance theory. Hillmer and Karney (1997) and Anderson et al. (1994) analyze Deming and essentially work backward to an underlying theory from which Deming's prescriptions may be logically derived. Morrow (1997) and Shea and Howell (1998) have proposed that transformational leadership behaviors may affect quality-related organizational outcomes. These theories and others lay the foundations necessary for empirical research. In addition, a variety of measurement scales and survey instruments for quantifying quality-related constructs has been published (Morrow, 1997; Saraph, Benson & Schroeder, 1989; Zeitz, Johannesson & Ritchie, 1997) further supporting empirical research efforts. The publication of testable theories of quality management and related assessment instruments has established the viability of quality-focused management as a legitimate area of academic inquiry and empirical research.

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Theoretical Basis of the Present Research

This research draws from the theories of leadership, quality management and learning organizations. The quality management theories forming the basis of this research are drawn chiefly from Anderson et al. (1994) and Sosik and Dionne (1997), both of which are largely predicated on Deming (1982, 1994). According to Gartner and Naughton (1988), the theory underlying Deming's writings can be traced back to the general systems theory of Kast and Rosenzweig (1972) and the statistical process control theory developed by Shewhart in the 1920s and 1930s. The leadership theory used in the present research is drawn from Bass's (1985) work on transformational leadership. Bass's work grew out of James MacGregor Burns's (1978) qualitative examination of charismatic political leaders (Howell & Avolio, 1993) as well as House's (1977) theory of charismatic leadership (Van Fleet & Yukl, 1982) which stems from ideas originating from Weber's early work on charisma (Bass, 1990). The learning organization theory used in this research is drawn chiefly from Senge (1990) since his approach combines the notions of organizational learning with systems thinking and organizational adaptation (Argyris, 1999).

This research is designed to test the suggestion that specific components of transformational leadership (e.g. intellectual stimulation, inspirational motivation, etc.) and components of transactional leadership (e.g. passive and active forms of management by exception) will be associated in certain ways with the manifestation of quality-supportive principles within organizations pursuing quality-focused agendas.

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Quality-focused agendas are organizational ends that are consistent with and supportive of the quality philosophies of Deming and other quality advocates, and include goals such as continuous improvement in product and service quality, employee fulfillment and customer satisfaction. In addition, this research tests part of the quality management model developed by Anderson et al. (1994) that suggests quality-focused process management practices will lead to continuous improvement outcomes and employee fulfillment. Furthermore, this research tests the idea that the disciplines of the learning organization, as articulated by Senge (1990), have a bearing on the achievement of quality-focused process outcomes (e.g., continuous improvement), and that certain disciplines are affected by specific kinds of leadership behaviors.

Leadership and Quality Management

The development of leadership theories and the practice of quality management share the common objectives of improving organizational performance and enhancing the work experience of organizational members (Puffer & McCarthy, 1996). But it is unclear what specific leadership behaviors are most effective in organizations pursuing quality-focused agendas. A number of propositions and approaches have been presented by various authors. For example, Anderson et al. (1994) offer a model of quality management that illustrates how leadership relates to organizational systems, process management and process outcomes. Puffer and McCarthy (1996) identify a number of key differences in the leadership requirements

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of quality-focused organizations versus traditional organizations. Bass (1985) posits that transformational leadership ought to result in "extra effort and performance beyond expectations" and Waldman (1993, 1994) notes that such behaviors are considered important to management approaches like organization-wide quality management. Sosik and Dionne (1997) advance a theoretical framework for exploring the relationship between the quality management behavior factors derived from Deming and dimensions of leadership drawn from Bass's full range leadership development model. Sosik and Dionne (1997, p. 448) cite Avolio (1994) in observing that at least nine of Deming's Fourteen Points "imply the concept of leadership." Shea and Howell (1998), drawing on Bandura's (1986) social cognitive theory, assert that effective implementation of a quality-focused agenda will depend upon the extent to which leaders espouse its principles and enhance their subordinates' self-efficacy. Taken together, these authors provide a theoretical basis for an empirical examination of the relationship between leadership and quality-focused organizational characteristics and process outcomes. The ideas of the foregoing authors are discussed in further detail below along with an explanation of how each supports the present research.

Deming and Transformational Leadership

Many individuals have made substantial contributions to the field of quality management. However, W. Edwards Deming (1900-1993) is perhaps the most notable quality figure of the twentieth century. Anderson et al. (1994) attribute the

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paucity of empirical work substantiating Deming's approach to quality management to the lack theory to guide such research. In an effort to fill this void, these authors conducted a Delphi study to derive the theoretical basis of Deming's directives. To this end, a seven member Delphi panel drawn from academe and industry was assembled. Each member had been professionally involved with Deming; some had instituted Deming's Fourteen Points in organizations while others had authored scholarly articles on quality management. Panel members were asked to identify the underlying concepts of Deming' Fourteen Points and operationalize each. This work resulted in 37 concepts that were then reduced by manual cluster analysis to yield seven abstract concepts: visionary leadership, internal and external cooperation, learning, process management, continuous improvement, employee fulfillment and customer satisfaction.

The identification of visionary leadership as a key factor underlying Deming's approach to quality is highly salient to the present research. Visionary leadership represents the efforts of managers to establish a long-term vision of the organization's future predicated on an external (customer-oriented) perspective. According to Anderson et al. (1994), visionary leadership is allied to transformational leadership by virtue of management's role in leading continuous improvement and the quest to translate the envisioned future state of the organization into social reality.

From the above underlying concepts, Anderson et al. (1994) constructed a systems-focused model of organizational performance that they propose encapsulates

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the management theory implied by Deming's prescriptions (reproduced below as Figure 3.1). Their model of Deming's approach to quality management illustrates numerous cause and effect relationships and a variety of feedback loops. They refer to their model as a relations diagram or an interrelationship digraph and note that the construction conventions are derived from Warfield (1976) and Senge (1990). The model was formulated by having the Delphi panel identify the management concept underlying each of Deming's Fourteen Points. The panel was then asked to consider each possible pairwise connection between the identified concepts and ask "is this concept a cause or an effect?" The model development process Anderson et al. describes roughly parallels the process described by Malone (1975), Warfield (1976), and Lendaris (1978a, 1979) called Interpretive Structural Modeling or ISM, except that Anderson et al. do not mention using software to reduce the number of pairwise comparisons that must be considered under ISM's assumption of transitivity among relationships. To use the terminology of ISM, the *elements* of the ISM process were the concepts or building blocks of quality management, and the *contextual relationship* considered in each pairwise comparison was causal direction.

The relations digraph in Figure 3.1 provides the basis for Anderson et al.'s (1994) theoretical statement regarding Deming's management method:

> The effectiveness of the Deming management method arises from leadership efforts toward the simultaneous creation of a cooperative and *learning organization* to facilitate the implementation of process

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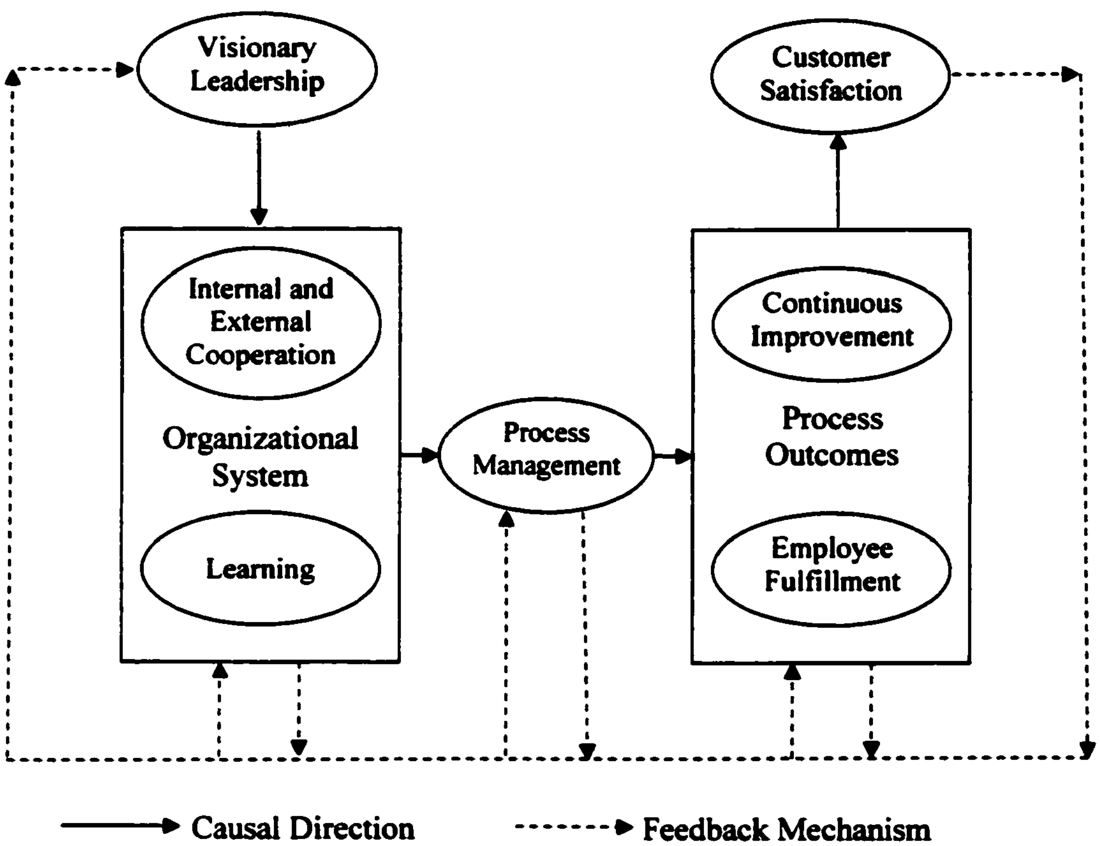
Figure 3.1
Anderson, Rungtusanatham and Schroeder's (1994) Proposed Theory of Quality Management Underlying the Deming Management Method



management practices, which, when implemented, support customer satisfaction and organizational survival through sustained employee fulfillment and continuous improvement of process, products, and services (1994, pp. 480-481, emphasis added).

The element driving the Anderson et al. (1994) model is visionary leadership, which results in an organizational system characterized by internal and external

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cooperation (i.e., teamwork) and organizational learning. These organizational system characteristics drive process management, which in turns results in process outcomes that include continuous improvement and employee fulfillment. Those process outcomes result in customer satisfaction, which feeds back to all segments of the model. In addition, reciprocal feedback linkages exist between the subsystems of the organizational system, process management and process outcomes. Anderson et al.'s model of quality management is germane to the present research in that it posits visionary leadership (an element of Bass's (1985) transformational leadership model) as the principal causal driver of organizational system characteristics and quality-oriented organizational outcomes such as continuous improvement and customer satisfaction.

Anderson et al. (1994) compare the theory that they suggest underlies Deming's approach with that of Taylor's scientific management and with Lawrence and Dyer's (1983) theory of readaptive organizations. According to Anderson et al., the differences between Taylorism and the theory underlying Deming's approach are significant: extrinsic vs. intrinsic motivation, management control vs. visionary leadership, and owner-centered concerns (e.g., maximizing earnings or return on invested capital) vs. customer-centered concerns (e.g., service level or product reliability). Despite these differences, similarities exist between the two theories with respect to their emphasis on the scientific approach, organizational improvement, optimization and training.

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Organizational readaptation is illustrated by an organization's continuous adaptation to its environment and by improvement in organizational processes. According to Anderson et al. (1994), Lawrence and Dyer's (1983) theory of readaptive organizations holds that organizations succeed best by placing a balanced priority on innovation (using information from the environment) and efficiency (wisely allocating scarce resources). According to this theory, the most suitable environment for effective readaptation is one characterized by intermediate levels of information complexity and resource scarcity. The readaptive process is sustained by organizational learning which enables innovation.

The similarities between Lawrence and Dyer's (1983) theory and Anderson et al.'s (1994) conception of the theory underlying Deming's approach is in the use of the systems approach, attention to continuous organizational adaptation and improvement, and emphasis on the importance of leadership and organizational learning. However, Anderson et al. point out that Lawrence and Dyer's theory emphasizes organizational differentiation with respect to where learning best takes place (i.e., with specialists vs. involving all employees as Deming recommends), a greater emphasis on mechanistic controls, and a bias toward internal competition predicated on extrinsic motivation.

Anderson et al.'s Model and the Deming Management Method

A possible objection to choosing Anderson et al.'s (1994) model as a general framework for evaluating the linkages between leadership and quality-focused

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organizational variables lies in its predication upon Deming's approach to quality management. Anderson et al.'s model was developed by analyzing the management theory implied by Deming's prescriptions and his famous Fourteen Points. The question may be raised, is this model appropriate for studying organizations that have not explicitly based their approach to quality management on Deming's writings? It is proposed that Anderson et al.'s model has general applicability to organizations with demonstrated commitment to quality management practices, since according to Anderson et al.:

> [T]he theoretical essence of the Deming management method concerns the creation of an organizational system that fosters *cooperation and learning* for facilitating the implementation of process management practices, which, in turn, leads to *continuous improvement* of process, products, and services, and to employee fulfillment, both of which are critical to *customer satisfaction*, and, ultimately, to firm survival. Implicit in this theoretical statement is the crucial role that organizational leadership plays in ensuring the success of quality management ... (1994, p. 473, emphasis added).

Thus the key elements in the theory underlying Anderson et al.'s (1994) model parallel the principles identified by Dean and Bowen (1994) as fundamental to quality management in general: teamwork, continuous improvement and customer focus. Furthermore, numerous writers have identified leadership as critical to the success of

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quality management (Choi & Behling, 1997; Evans & Lindsey, 1996; Feigenbaum, 1991; Puffer & McCarthy, 1996).

A further justification for developing and testing theoretical models based partly on Deming's work lies in the close coupling between his prescriptions for management with systems ideas and the idea of organizational learning. Deming embraces a strong systems orientation that is broadly inclusive. Deming sees a production system as including not only the various steps of manufacturing, but also suppliers, distribution, customers, consumer research, design and more. Deming comments that:

> In spite of the fact that management is responsible for the system, or for lack of the system, I find in my experience that few people in industry know what constitutes a system. Many people think of machinery and data processing when I mention system. Few of them know that recruitment, training, supervision, and aids to production workers are part of the system (1982, p. 366).

Appreciation for a system is one of the four elements of what Deming calls the System of Profound Knowledge. This system "provides a map of theory by which to understand the organizations that we work in" (Deming, 1994, p. 92). The other elements of the System of Profound Knowledge are knowledge of variation, theory of knowledge, and psychology. Knowledge of variation refers to comprehending the dynamics of processes, measurement methods, mathematical techniques, etc. Theory

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of knowledge refers to recognizing the importance of operational definitions, having theories that are useful in predicting the future and understanding the difference between information and knowledge. Psychology refers to an understanding of human motivation, team dynamics and an appreciation and acceptance of individual differences. At least two elements of Deming's System of Profound Knowledge correspond with Senge's (1990) disciplines of a learning organization. What Deming calls knowledge of systems, Senge calls systems thinking. And what Deming calls knowledge of variation, Senge might include within the idea of mental models. Furthermore, Deming emphasized in his four-day seminars that it is critical that the aim of the system be clear to all organizational members (Deming, 1997). This parallels Senge's emphasis on shared vision. Deming understood that failure to take a systems view of organizations leads to unintended consequences, negative effects on unexpected parts of the organization, and oftentimes collateral damage in the form of worker morale and motivation. Without a systems view, organizational learning is hampered or blocked.

Leadership Requirements in Quality-Focused Organizations

Puffer and McCarthy (1996) submit that there are several key differences in the leadership requirements of quality-focused organizations versus traditional organizations. First, strategic leadership takes on a more important role in quality-focused organizations because quality management emphasizes the necessary alignment between internal systems and the environment. Second, in quality-focused

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organizations visionary leadership plays a more important role in part due to the reliance on a shared vision to guide individual activities. Third, reward systems must be more carefully designed in quality-focused organizations to encourage the innovation and creativity necessary to fuel continuous improvement. Fourth, teamwork and empowerment are more critical in quality-focused organizations because of the emphasis on serving the customer and effectively addressing customer problems. Each of these four views supports a focus on leadership as a key determinant of quality management success. It may be argued that the forgoing attributes are necessary in most organizations. While they may be necessary in most organizations, they may not be present in all organizations to the degree necessary to sustain successful quality management efforts.

Although Puffer and McCarthy (1996) do not explicitly use the term transformational leadership, the concept is implied in their use of the term visionary leadership. For example, several items of Bass's (1985) Multifactor Leadership Questionnaire tap the attribute of visionary leadership (e.g., "articulates a compelling vision of the future" and "emphasizes the importance of having a collective sense of mission"). In contrast, Evans and Dean (2000) specifically identify the transformational leadership model as "right out of the TQ [total quality] playbook." They cite Deming's emphasis on the importance of constancy of purpose, focusing on long-term goals and the importance of inspiring organizational members as congruent with transformational leadership behaviors.

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Transformational Leadership

Bass's (1985) transformational leadership model grew out of James MacGregor Burns's (1978) qualitative examination of charismatic political leaders (Howell & Avolio, 1993) as well as House's theory of charismatic leadership (Yukl & Van Fleet, 1982). While Burns thought of leaders as operating on a bipolar continuum with transformational and transactional endpoints (Seltzer & Bass, 1990), this paradigm was modified by Bass who hypothesized that transformational leadership was composed of several factors, and that transformational leadership may augment transactional leadership with respect to effectiveness (Bass, 1985, 1990).

In his Pulitzer Prize-winning book *Leadership*, Burns wrote that "The transforming leader recognizes and exploits an existing need or demand of a potential follower. But, beyond that, the transforming leader looks for potential motives in followers, seeks to satisfy higher needs, and engages the full person of the follower" (1978, p. 4). Thus, Burn's transformational leader is not merely charismatic. According to House (1977), the charismatic leader has a need to exert influence on people, is self-confident and holds strong convictions (Yukl & Van Fleet, 1982).

Bass's conceptualization of leadership holds that leaders exhibit a combination of transactional and transformational leadership behaviors in varying amounts and intensities (Bass, 1985). But he also observed that an individual leader's style may be dominated by one or the other pattern. Drawing examples from political life, Bass saw Charles de Gaulle as representing an extreme transformational style of leadership,

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Lyndon Johnson as an extremely transactional leader, and Franklin Roosevelt as balanced in this regard. Waldman and Yammarino (1999) note that Shamir (1995) agrees that leaders may be seen as charismatic by their followers and simultaneously engage in transactions with them.

Bass (1985) theorized that the factors comprising transformational leadership would include charismatic leadership, inspirational leadership, intellectual stimulation and individualized consideration. Bass developed a questionnaire to measure the various factors of transformational leadership based on factor analysis of his research. The survey instrument was dubbed the Multifactor Leadership Questionnaire (MLQ) to reflect the author's view of leadership as a multidimensional construct. A considerable body of research has embraced the idea of Bass's multi-factor leadership; the MLQ has been the basis for over 100 research investigations, theses and doctoral dissertations (Bass & Avolio, 1997).

Rationale for Using Bass's Model of Leadership

Sosik and Dionne (1997) put forth a strong argument for selecting Bass's (1985) model of leadership over other possible leadership frameworks for examining the relationship between leadership styles and quality management practices. They note that Bass's model incorporates a range of leadership styles (transformational, transactional and laissez-faire), as opposed to other models that are unidimensional or portray a single leadership style. They note that Bass's model has been widely researched and that its dimensions are amenable to leadership training. Furthermore,

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Waldman (1994) notes that transformational leadership processes are congruent with the type of leadership advocated by Juran, Deming and others. These observations support the selection of Bass's leadership model as appropriate for the present research.

In summary, there are numerous reasons for favoring Bass's (1985) model of leadership for the present research:

1. Its multi-dimensional conceptualization of leadership encompasses a range of leadership styles; other models tend to conceive of leadership along a uni-dimensional continuum.
2. It has been used to study leadership across a variety of industries and in a number of organizational settings.
3. It has been well-researched in terms of its psychometric properties and predictive validity.
4. Its construction is amenable to providing feedback to leaders for leadership training and development.

Social Cognitive Theory

Shea and Howell's (1998) work is relevant to the present research in that they offer an explanation as to *why* transformational leadership ought to be particularly important in achieving quality-oriented organizational outcomes. Shea and Howell assert that the success of organization-wide quality management "largely depends on individuals choosing to espouse its principles and expend efforts towards its success"

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(p. 8). This leads these authors to explore the usefulness of Bandura's (1986) social cognitive theory as a framework of analysis on quality management implementation effectiveness. The aim of this approach is to explain how leader behaviors influence the cognitive processes of followers and consequently affect quality-consistent behavioral choices.

Social cognitive theory is based on the idea of individual self-efficacy. Self-efficacy is the set of beliefs an individual holds regarding their ability to complete certain tasks and achieve specific goals. Individuals with high self-efficacy believe that their efforts will lead to success. Sources of individual self-efficacy include past experience, the efforts of role models, the influence efforts of others, and self-assessment of one's current capabilities (Nelson & Quick, 1995). As "agents of verbal persuasion" (Shea & Howell, 1998, p. 12), leaders of quality-aspiring organizations are in a position to articulate a compelling vision of a future that includes positive quality-focused outcomes. One of the hypotheses of the present research posits that self-efficacy will moderate the relationship between the degree of process feedback afforded to individual organizational members and their sense of personal mastery. That is, individuals with high self-efficacy will demonstrate a stronger connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.

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Organizational Learning

Organizational learning has been described in various ways over the past twenty-plus years of writings on the subject. It has been defined in terms of new insights or knowledge, or new structures, systems or actions (Fiol & Lyles, 1985). It is not the same as individual learning nor is it merely the sum of learning over all organizational members. Senge defines the organization that learns as "an organization that is continually expanding its capacity to create its future" (1990, p. 14). Senge's learning organization engages in both adaptive or single-loop learning and generative or double-loop learning. Single-loop learning involves the detection and subsequent correction of error or mismatch between a present level of performance and a target level of performance within a given set of variables. This kind of learning is illustrated by simple cybernetic control. Instances of single-loop learning are reflected in the incremental improvements achieved in the *kaizen*-like continuous improvement efforts described by Imai (1986). In contrast, double-loop learning involves questioning deeply held assumptions and examining the "governing variables" of the system (Argyris, 1999). It is double-loop or generative learning that can adjust the rules an organization operates by or modify its operating assumptions (Fiol & Lyles, 1985). Organizational learning may be transmitted to individuals by a variety of means, including organization histories, policies, norms and standard operating procedures.

Organizational learning is especially important in quality-focused organizations since only through such learning can organizations develop the

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institutional mechanisms necessary for the continual refinement of production and service delivery processes. Hackman and Wageman (1995) assert that effective quality management is "about as learning-oriented as it is possible for a management program to be." Therefore, the inclusion of organizational learning is essential in a comprehensive theory of quality management.

Quality Management and Learning Organizations

A number of connections exist between the fundamental principles of quality management and the characteristics of learning organizations. Senge states that "the quality movement as we have known it up to now in the United States is in fact the first wave in building learning organizations – organizations that continually expand their ability to shape their future" (1992a, p. 31). Senge notes that learning organizations and quality management share the same goal – "to make continual learning a way of organizational life, especially improving the performance of the organization as a total system" (1992a, p. 31). He goes on to comment that this goal can only be achieved by departing from the command and control form of management where thinking and decision-making occur at the top of the organizational hierarchy, to thinking and decision-making at all organizational levels. Senge is essentially highlighting the importance of shared leadership and teamwork in learning organizations. Teamwork is one of the three key underlying principles of quality management according to Dean and Bowen (1994).

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A key quality management principle that demonstrates the connection between quality management and learning organizations is the principle of continuous improvement. Continuous improvement, one of Dean and Bowen's (1994) three basic principles of quality management, is an organization's ongoing pursuit to continually, incrementally refine organizational process to better satisfy customers (Morrow, 1997; Sosik & Dionne, 1997). Sustaining continuous improvement achievements may be difficult without creating a learning organization, and organizational learning is enhanced when organizations adopt and utilize quality management practices (Evans & Dean, 2000).

One of quality management's basic methodologies for continuous improvement is Deming's (1982) PDSA (Plan, Do, Study, Act) cycle. The PDSA cycle consists of planning a change designed to improve the current state of affairs, doing a limited or small-scale implementation of the change, studying the results to check for the anticipated benefits or unanticipated consequences, and then acting to implement the (possibly modified) change full-scale. We can therefore think of the PDSA cycle as a procedural manifestation of organizational learning.

The continuous improvement of organizational processes is sometimes referred to as *kaizen* (Imai, 1986). *Kaizen*, a Japanese term, means gradual, incremental and continuous improvement. Imai suggests that successful *kaizen* practices in Japan are based on non-financial rewards and intrinsic motivation – improvement efforts are undertaken by employees chiefly because everyone intrinsically values improvement.

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Intrinsic motivation to improve one's self (personal mastery) and to learn (team learning) are key characteristics of the learning organization.

In addition, Nevis, DiBella and Gould (1995) comment that learning is a systems-level phenomenon because the learning persists within the organization even if the organizational actors change. Continuous improvement that is institutionalized, via written procedures or other transmission vehicles, therefore constitutes organizational learning. Section 8.5.1 of the ISO 9000: 2000 requirements and part of the Baldrige Award examination process involves seeking evidence of systems to effect continuous improvement. Viewed within the foregoing context, these criteria seek evidence of enterprise-wide systems to assure ongoing organizational learning.

Leadership and Learning Organizations

Several authors have theorized about the kind of leadership necessary for creating and sustaining learning organizations. An understanding of this is important to the present research since the measures of leadership selected for this study need to capture the kinds of leadership behaviors most likely to be found in learning organizations. Rolls (1995) has asserted that the leader who exhibits transformational leadership behaviors embodies the leadership characteristics necessary for mastery of Senge's (1990) five learning disciplines. Yeung, Ulrich, Nason and Von Glinow (1999) believe that leadership for organizational learning capability requires leaders who demonstrate a commitment to learning through candor, reality testing and communicating a vision. The Baldrige criteria itself also recognizes the linkage

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between an organization's leadership and organizational learning: "To be successful, leadership must ensure that the organization captures and shares learnings" (*1999 Criteria for Performance Excellence*, p. 29).

Learning organizations require a leader who builds commitment among an organization's members to a shared vision (Senge, 1990). Leaders in organizations emphasizing continuous improvement need to communicate a clear common purpose or vision, encourage teamwork, empower organizational members and encourage risk taking (Locke & Jain, 1995). However, this leadership style is in contrast to what Senge sees as the prevailing style of Western leadership in which leaders set the direction and then manipulate people with extrinsic rewards. Leaders in learning organizations, Senge says, will be those who teach and inspire. Teaching and inspirational leadership behaviors are effectively tapped by Bass's multidimensional leadership model. For example, within the transformational leadership dimension lies the leadership behaviors of intellectual stimulation and inspirational motivation. Intellectual stimulation is tied to the extent to which leaders encourage followers to approach problems in new ways or from new perspectives, and to question previous assumptions. These leadership behaviors may consequently encourage the formulation of mental models. Inspirational motivation behaviors are tied to the leader's articulation of group goals and of the leader's vision of a possible future. Thus inspirational motivation should lead to the formation of shared vision.

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Prior Empirical Research

This section reviews the prior empirical research on the relationships among leadership, organizational learning and organizational outcomes including quality-focused outcomes, and shows how the present research extends this work.

Leadership Studies

Transformational Leadership and Business Unit Performance

Studies have found transformational leadership behaviors more strongly correlated with macro-level business outcome measures (e.g., overall business unit performance) than transactional behaviors (Howell & Avolio, 1993; Seltzer & Bass, 1990). For example, research to examine whether transformational leadership is predictive of business unit performance was performed by Howell & Avolio (1993). The authors studied 78 senior managers and 322 of their subordinates in a large Canadian financial institution. Business unit performance was measured as the percentage of key business goals met by each manager and was drawn from the organization's MBO (management by objectives) system.

The Howell and Avolio (1993) study found a significant positive relationship in their correlational study between business unit performance and three constructs constituting transformational leadership (charisma, intellectual stimulation, and individualized consideration). The three transformational factors together accounted for 25% of the variance in business unit performance. Their study also found that

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support for innovation moderated business unit performance. Using all of the leadership measures, the authors' unmoderated model explained 47 percent of the variance in business unit performance while the moderated model explained 64 percent. This finding is congruent with Bass's (1985) theory that transformational leaders will be more effective in innovative organizational climates. The present study extends this research to examine organizational outcomes of specific interest to organizations focused on quality-oriented measures of success, such as continuous improvement and customer focus.

Leadership and Quality Achievement

The role of leadership in the achievement of quality improvement efforts was investigated by Waldman et al. (1998) in a qualitative study of three Canadian organizations (a hospital, a manufacturing company and a national police force). Research was conducted from interviews, observations and document reviews. Waldman et al. found that the frequency of transformational and transactional leadership behaviors varied as a function of hierarchical level. Transformational leadership behaviors were mentioned more frequently in connection with quality improvement efforts for leaders further up the management ladder. Also, the degree of leadership focus on quality improvement coincided with the degree of the program's success. Of the three organizations studied, only one organization's quality improvement initiative was deemed successful over the long-term by virtue of a continuing organizational commitment to quality improvement and an apparent

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permanent culture shift. In the other two organizations, wavering organizational commitment led to cynicism about organizational change and a lack of sustained success.

Waldman et al.'s (1998) findings are important to the design of the present research. Their study suggests that the hierarchical level of a leader is important in the nature of the relationship between transformational leadership behaviors and the success of quality improvement initiatives. Informed by these findings, the present study posits that transformational leadership behaviors are positively associated with teamwork, customer focus and continuous improvement commitment, and that these relationships are moderated by the hierarchical level of the leader (Hypothesis 2a and Hypothesis 2b respectively).

Leadership for Quality and Level of Analysis

Flynn et al. (1994) studied 716 employees of 42 U.S. plants in the transportation parts, electronics and machinery industries and found that quality performance indicators, such as the percent of items shipped without rework, was related to top management support (including leadership), quality information, process management, product design practices, workforce management, and supplier and customer involvement. Flynn et al.'s theoretical model of the structure of these relationships bears some similarity to Anderson et al.'s (1994) model in that the principal driver of the quality system includes factors related to leadership. However, Flynn et al. used a uni-dimensional scale of leadership that differs substantially from

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Bass's (1985) multi-dimensional model. Flynn et al.'s work focused on leadership across multiple hierarchical levels (department heads, plant management and top management) and spanned a broad range of "leadership" activities encompassing leaders' acceptance of quality goals, leader's reward practices, and policies and business practices. In contrast, the present research focuses on leadership as a set of specific observable personal behaviors and examines relationships at the work group level and individual level of analysis.

Organizational Learning and Other Studies

There is a general lack of empirical research on learning organizations (Luthans, Rubach & Marsnik, 1995). A search of the peer-reviewed literature found no quantitative studies employing Senge's (1990) model of the learning organization except for Tetrick et al.'s (2000) development and initial validation of a survey instrument to measure Senge's learning disciplines. This section reviews the parts of the Tetrick et al. study most germane to the present research, as well as several other relevant empirical studies.

Organizational Learning and Group-Level Outcomes

Of the several hypotheses tested by Tetrick et al. (2000) in validating their organizational learning assessment survey, one is particularly salient to the present research. Based on Argyris and Schon's (1978) suggestion that organizational learning will result in innovative behaviors at the group level, Tetrick et al.

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hypothesized that systems thinking will be positively associated with group innovation. This hypothesis was confirmed using a sample of 343 employees of a large government agency: systems thinking was positively correlated with group innovation ($r = .36, p < .01$). Group innovation is not the same construct as continuous improvement achievement, a variable measured in the present study, but there are similarities. Group innovation is a multistage process that deals with recognizing problems and generating, evaluating and implementing novel or adapted solutions (Scott & Bruce, 1994), while continuous improvement achievement is the successful refinement of work methods or organizational processes to better satisfy the needs of customers. Despite the difference in the constructs, Tetrick et al.'s finding lends credence to the idea that systems thinking may be related continuous improvement achievement.

Quality-Supportive Principles and Work-Related Outcomes

Morrow (1997) used Dean and Bowen's (1994) identification of the three core principles of quality management (teamwork, continuous improvement and customer focus) to determine their relationship with several work-related outcomes. These outcomes included job satisfaction, communication and organizational climate. After controlling for organizational tenure and degree of exposure to total quality management methods, Morrow's survey-based correlational study found a positive relationship between employees' perceived adoption of the core quality principles and job satisfaction, communication and favorable perceptions of organizational climate.

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The present research extends Morrow's (1997) work to examine how the three core quality-supportive principles fit into a larger framework of quality-related and organizational learning constructs. Job satisfaction is reflected in the present research as "employee fulfillment" which encompasses the idea of job satisfaction. Morrow's survey instrument is used in the present research (in modified form) to measure each work group's level of adoption of the core principles of quality management.

Quality Management and Environmental Turbulence/Uncertainty

Allen (1999) found in a study of 94 organizations that environmental turbulence was positively correlated with the extent to which quality-related language appeared in organization's formal strategic statements. Edwards et al. (1998) found in their combination quantitative-qualitative study of six diverse, large unionized organizations in the U.K. that employee's acceptance of quality principles is positively associated with a controlled work environment and high job security. If one asserts that a controlled work environment and high job security are more likely to be present under conditions of low environmental uncertainty, then this study suggests that factors related to environmental uncertainty may have a bearing on organizational members' acceptance of management principles supportive of quality management activities. Both of the foregoing studies suggest that environmental uncertainty may play a role in the success of quality management activities.

Coulthard (1998) found mixed support for the hypotheses that high quality-achieving work groups are positively associated with managers who encourage

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systems thinking, promote customer-focused quality and facilitate various kinds of improvement activities. The equivocal results in Coulthard's study may be partly due to idiosyncrasies with the four organizations in her sample (as she suggests), or perhaps to substantially different degrees of environmental uncertainty faced by each organization. For example, if environmental uncertainty moderates the strength or nature of the relationship between systems thinking and the degree of quality achievement of the work group then there may be no observable main effect. The present research will investigate the role environmental uncertainty plays in such relationships.

Organizational Structure and Quality Program Effectiveness

Tata, Prasad and Thorn (1999) examined the connection between organizational structure and the effectiveness of quality management programs. They studied the responses of 89 managers and supervisors representing a variety of manufacturing organizations. After controlling for various Baldrige-related criteria, they found that the more respondents described their firm as organic in nature, the more their quality management program was described as effective. Tata et al. concluded that organizations with flexible, organic structures are more likely to realize successful outcomes from their quality programs than organizations with mechanistic structures. This finding is relevant to the present research because organic structures are characterized (in part) by "the adjustment and continual redefinition of individual tasks through interaction with others" and the "development of shared beliefs about

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the values and goals of the concern" (Burns & Stalker, 1961). The first of the foregoing characteristics is realized in learning organizations by team learning, while the latter characteristic is parallel to Senge's (1990) notion of shared vision. We may infer from Tata et al.'s research that organizational learning may play a role in determining the effectiveness of quality management programs. The present research is designed to examine the nature and strength of the relationships among quality management practices and the disciplines of the learning organization.

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Chapter 4: Development of Hypotheses

Overview

Each of the hypotheses tested in this research are associated with one of five central research questions. Each central research question has one or more hypotheses associated with it. The central research questions are:

1. How do leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management?
2. How does the extent of adoption of quality management's underlying principles affect process management practices?
3. How do the basic quality-supportive process management practices affect quality-related process outcomes?
4. How are the disciplines of the learning organization associated with quality-related process management practices and process outcomes?
5. How do leadership behaviors affect the realization of various disciplines of the learning organization?

The central research questions and the hypotheses that stem from them can be best understood by first explaining the nature of the constructs or variables to be studied. This chapter provides an overview of this study's independent and dependent variables, and then summarizes the hypotheses. Next, the theoretical treatment

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leading to the development of each hypothesis is presented. The sources of the measurement instruments used in this study are shown in Table 4.1 (below), along with a list of the scales that operationalize each construct. The validity and reliability of each measurement scale is reviewed and discussed in Chapter 5.

Leadership Constructs

Several measures of leadership serve as independent variables in this research. These measures capture the three major non-orthogonal factors or dimensions of leadership as proposed by Bass (1985): transactional leadership, transformational leadership and laissez-faire leadership. Transactional leadership is a leadership style based on an exchange of rewards for job performance or compliance to standards, or alternately the threat of sanctions for non-performance or non-compliance. In contrast, transformational leadership involves motivating followers to transcend their self-interest to work toward goals that move the organization toward a future state that the leader puts forth as a compelling vision of the future. Laissez-faire leadership, on the other hand, is an absence of active leadership exemplified by non-involvement and detachment. See Chapter 2 and Table 2.1 for more detailed definitions of these terms and definitions of their various sub-dimensions.

Transactional leadership and transformational leadership include several correlated component factors, while laissez-faire leadership is measured as a single factor. Inspirational motivation, one of the sub-dimensions of transformational leadership identified by Bass (1985), corresponds to Anderson, Rungtusanatham and

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Table 4.1

Constructs and their Measurement Scales

Constructs	Scales	Source
Leadership Behaviors	Transactional Leadership • Contingent Reward • Management-by-Exception (Active) • Management-by-Exception (Passive) Transformational Leadership • Idealized Influence (Attributed) • Idealized Influence (Behavior) • Inspirational Motivation • Intellectual Stimulation • Individualized Consideration Laissez-faire Leadership	Bass & Avolio, 1997
Quality-Supportive Principles	• Teamwork • Customer Focus • Continuous Improvement Commitment	Morrow, 1997. Gatewood & Riordan, 1997
Process Management Practices	• Process Control • Feedback	Flynn, Schroeder & Sakakibara, 1994
Process Outcomes	• Continuous Improvement Achievement	Frenkel, Korczynski, Shire & Tam, 1999
Process Outcomes	• Employee Fulfillment	Miller, 1967
Organizational Learning	• Shared Vision • Mental Models • Team Learning • Personal Mastery • Systems Thinking	Tetrick, Jones, Latting, Da Silva, Slack, Etchegaray & Beck, 2000
Perceived Environmental Uncertainty	• General uncertainty • Technological uncertainty • State uncertainty • Internationalization • Uncertainty regarding growth	Dickson & Weaver, 1997
Self-Efficacy	• Self-efficacy	Truxillo, Bauer & Sanchez (2001)
Leader-Member Exchange Quality	• LMX	Graen & Uhl-Bien, 1995; Bauer & Green, 1996

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Schroeder's (1994) conception of visionary leadership. This is important, since visionary leadership is the key driver in the quality management model proposed by Anderson et al. (1994). This correspondence is substantiated by an inspection of the questionnaire items comprising Bass's inspirational motivation scale; for example: "talks optimistically about the future" and "articulate a compelling vision of the future." Table 4.2 shows the questionnaire items associated with leadership.

Table 4.2
Questionnaire Items for Leadership

The question stem is: "My immediate supervisor ..."
The response scale runs from "not at all" to "frequently if not always".

Transformational Leadership

Idealized Influence (Attributed)

1. Instills pride in me for being associated with him/her
2. Goes beyond self-interest for the good of the group
3. Acts in ways that builds my respect
4. Displays a sense of power and confidence

Idealized Influence (Behavior)

1. Talks about their most important values and beliefs
2. Specifies the importance of having a strong sense of purpose
3. Considers the moral and ethical consequences of decisions
4. Emphasizes the importance of having a collective sense of mission

Inspirational Motivation

1. Talks optimistically about the future
2. Talks enthusiastically about what needs to be accomplished
3. Articulates a compelling vision of the future
4. Expresses confidence that goals will be achieved

Intellectual Stimulation

1. Re-examines critical assumptions to question whether they are appropriate
2. Seeks differing perspective when solving problems
3. Gets me to look at problems from many different angles
4. Suggests new ways of looking at how to complete assignments

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Table 4.2 (continued)
Questionnaire Items for Leadership

Transformational Leadership (continued)

Individualized Consideration

1. Spends time teaching and coaching
2. Treats me as an individual rather than just as a member of a group
3. Considers me as having different needs, abilities, and aspirations from others
4. Helps me to develop my strengths

Transactional Leadership

Contingent Reward

1. Provides me with assistance in exchange for my efforts
2. Discusses in specific terms who is responsible for achieving performance targets
3. Makes clear what one can expect to receive when performance goals are achieved
4. Expresses satisfaction when I meet expectations

Management-by-Exception (Active)

1. Focuses attention on irregularities, mistakes, exceptions, and deviations from standards
2. Concentrates his/her full attention on dealing with mistakes, complaints, and failures
3. Keeps track of all mistakes
4. Directs my attention toward failures to met standards

Management-by-Exception (Passive)

1. Fails to interfere until problems become serious
2. Waits for things to go wrong before taking action
3. Shows that he/she is a firm believer in "If it ain't broke, don't fix it."
4. Demonstrates that problems must become chronic before taking action

Laissez-faire Leadership

1. Avoids getting involved when important issues arise
2. Is absent when needed
3. Avoids making decisions
4. Delays responding to urgent questions.

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Quality Management Constructs

The quality management constructs used in this research include quality-supportive principles, process management practices, and quality-focused process outcomes. Scales to operationalize these constructs are drawn from a variety of sources in the peer-reviewed literature (see Table 4.1, above). Measures for quality-supportive principles include teamwork, customer focus and continuous improvement commitment. Process management practices are measured with scales that capture the extent to which process control practices (like statistical process control) are used and the extent to which process feedback is communicated to organizational members. Quality-related process outcomes are measured with scales for continuous improvement achievement and employee fulfillment. Each of these measurement scales were selected for their fit with the concepts suggested by the Anderson et al. (1994) model. Table 4.3 shows the questionnaire items associated with the quality management constructs.

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Table 4.3
Questionnaire Items for Quality Management Scales

Quality Principles

Customer Focus

1. The people my work unit serves (i.e., our customers) meet with us regularly.
2. My co-workers have a good understanding of who their customers are.
3. The people my work unit serves (i.e., our customers) give us feedback on the quality of our work.
4. People in my work unit maintain close contact with the people we serve.
5. My work unit responds promptly to customer requests, needs and problems.
6. My work unit makes a real effort to keep our customers satisfied.

Continuous Improvement Commitment

1. My work unit understands the concept of "continuous improvement."
2. My work unit has accepted the goal of continuous improvement.
3. We are committed to continuous improvement in our work.
4. My boss really believes we can improve our work continuously.

Teamwork

1. My work unit uses teams to solve problems.
2. Our work unit has embraced the team concept.
3. Many work problems are being solved through team meetings.
4. During team meetings, we make an effort to get all team members' opinions and ideas before making a decision.

Process Management Practices

Process Control

1. Processes in our work group are designed to be "fool proof."
2. A large percent of the equipment or processes in our work group are currently under statistical quality control.
3. We make extensive use of statistical techniques to reduce variance in processes.
4. We make extensive use of written procedures and/or work instructions in our work group.

Process Feedback

1. Charts showing quality levels are readily available to me.
2. Charts showing schedule compliance are readily available to me.
3. Charts plotting the frequency of production or processing problems are readily available to me.
4. I am frequently told whether I am doing a good job.

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Table 4.3 (continued)
Questionnaire Items for Quality Management Scales

5. Information on quality performance is readily available to me.
6. Information on productivity is readily available to me.
7. My manager frequently comments about the quality of my work.

Process Outcomes

Continuous Improvement Achievement

1. Implement successful new ways to solve problems.
2. Find better ways to do your work.
3. Put new ways of accomplishing goals into practice.
4. Successfully deal with non-routine or unique problems.
5. Improve results by doing things in a new way.
6. Improve the quality of your work.

Employee Fulfillment

1. I really feel a sense of pride or accomplishment as a result of the type of work I do
2. My work gives me a feeling of pride in having done the job well
3. I very much like the type of work that I am doing
4. My job gives me a chance to do the things that I do best
5. My work is my most rewarding experience
6. I like my job very much

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Learning Organization Constructs

Senge's (1990) five disciplines of the learning organization consist of shared vision, mental models, team learning, personal mastery and systems thinking. Refer to Chapter 2 for definitions of these terms. These variables have been operationalized by a 48-item survey instrument developed by Lois Tetrick (2000) and her colleagues at the University of Houston. The validity and reliability of their five measurement scales is reviewed and discussed in Chapter 6. The questionnaire items shown below (Table 4.4) are a subset of the items developed by Tetrick et al. A subset of items was used to reduce the total number of questionnaire items to a more manageable number. Appendix A1 describes the pilot study performed as a part of the present research to identify a parsimonious subset of items, including a check of the abbreviated scale's dimensionality and internal consistency reliability.

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Table 4.4
Questionnaire Items for Organizational Learning

Personal mastery
1. I am always trying to make my goals a reality.
2. If my life is not going the way I want, I change things.
3. I know how to work toward the future that I have chosen for myself.
4. I willingly change my strategies to better meet my personal goals.
5. I am committed to my personal growth.

Managing Mental Models
1. In my organization I am criticized for doing things a new way.
2. My coworkers think I am stubborn.
3. People in this organization say I don't understand their point of view.

Team Learning
1. This work group contributes to my growth.
2. People in my work group help me do a better job.
3. My work group often discusses opportunities for improvement.

Shared Vision
1. In our organization we are all working together toward the same future.
2. In our organization we all agree on what our mission is.
3. We are all committed to the long term goals of our organization.

Systems Thinking
1. In our organization we understand how to improve the way the organization functions.
2. In our organization we know how to make things work properly.
3. We know how to make changes to improve the organization as a whole.

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Overview of Hypotheses

This research is designed to test the following hypotheses relating to leadership, quality management and the disciplines of the learning organization. Each of the variables in these hypotheses was measured by the perceptions of organizational members. Several of the relationships are hypothesized to include a moderating effect (e.g., Hypothesis 2b).

Research Question 1: How do leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management?

H1: Active and passive management by exception are negatively associated with continuous improvement commitment and teamwork.

H2a, b: (a) Transformational leadership behaviors are positively associated with teamwork, customer focus and continuous improvement commitment. (b) There is a stronger positive relationship between transformational leadership behaviors and teamwork, customer focus and continuous improvement commitment in work groups with leaders at higher management levels than with leaders at lower levels.

H3: Laissez-faire leadership is negatively associated with teamwork, customer focus and continuous improvement commitment.

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Research Question 2: How does the extent of adoption of quality management's underlying principles affect process management practices?

H4: The more a work group is characterized by quality-supportive principles (teamwork, customer focus and continuous improvement commitment), the more process management practices are characterized by process control mechanisms and process feedback systems.

Research Question 3: How do the basic quality-supportive process management practices affect quality-related process outcomes?

H5a, b: (a) The more process management practices include process control methods and process feedback to organizational members the more frequently continuous improvement is achieved. (b) There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty than under conditions of high perceived environmental uncertainty.

H6: The more process management practices include process control methods and process feedback to organizational members, the greater employee fulfillment.

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Research Question 4: How are the disciplines of the learning organization associated with quality-related process management practices and process outcomes?

H7: The more individuals feel a sense of personal mastery, the greater their degree of employee fulfillment.

H8a, b: (a) The more process feedback is made available to organizational members, the more individuals feel a sense of personal mastery. (b) Individuals with high self-efficacy demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.

H9: The more process management practices include quality-related process feedback to organizational members, the more team learning occurs.

H10a, b: (a) The more systems thinking occurs the more frequently continuous improvement is achieved. (b) There is a stronger positive relationship between systems thinking and continuous improvement achievement under conditions of high perceived environmental uncertainty than under conditions of low perceived environmental uncertainty.

Research Question 5: How do leadership behaviors affect the realization of various disciplines of the learning organization?

H11: The inspirational motivation component of transformational leadership is positively associated with shared vision.

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H12: The intellectual stimulation component of transformational leadership is positively associated with managing mental models.

A comprehensive treatment of the theoretical development of each of the above hypotheses is presented below, after a presentation of modifications to the model proposed by Anderson et al. (1994) which lays the groundwork for the hypotheses dealing with the interrelationships among leadership behaviors, quality-supportive principles, process management practices and process outcomes.

The Anderson et al. Model

The central questions of this research synthesize the ideas behind the theoretical quality management model developed by Anderson et al. (1994) with the essential principles underlying quality management identified by Dean and Bowen (1994), the leadership model developed by Bass (1985), and the characteristics of the learning organization suggested by Senge (1990). This section includes a description of how the original Anderson et al. model (shown in Figure 3.1 above) was adapted and incorporated into the model tested in the present study. The modifications to Anderson et al.'s model are reflected in Figure 4.1. The disciplines of the learning organization are subsequently added to the modified Anderson et al. model and are reflected in Figure 4.2. The relationships depicted in Figure 4.2 are those that were tested in this research. Keys to the various hypotheses to be tested (e.g., H1, H2a, etc.) are shown adjacent to each arrow (causal direction) in Figure 4.2.

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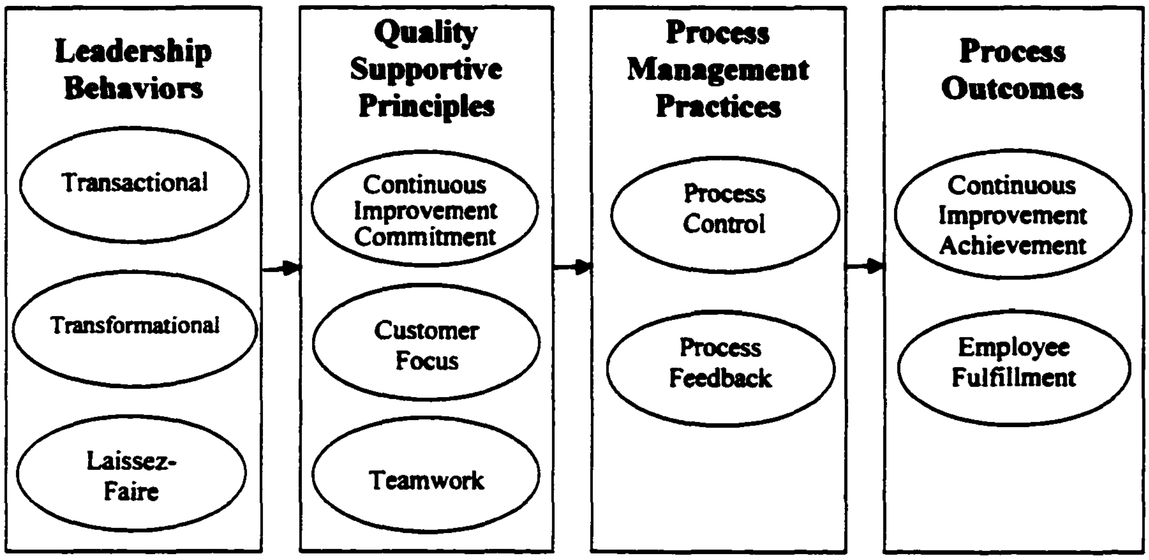
Figure 4.1
Modification of Anderson et al.'s (1994) Model



Modification of the Anderson et al. Model

The quality management model suggested by Anderson et al. (1994) was modified and augmented in a number of ways to support the central research questions of the present research. The nature of these changes and additions and the justification for them are described below.

Leadership Factors

Anderson et al.'s (1994) construct of leadership is implemented and expanded as shown in Figure 4.1 as three distinct factors of leadership: transactional, transformational and laissez-faire. Anderson et al.'s model includes only visionary leadership. The use of Bass's (1985) model of leadership in the revised model allows

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for the explicit testing of visionary leadership as included in the Anderson et al.'s model (visionary leadership is reflected in Bass's transformational leadership construct) for its effect on the subsequent dependent variables as well as the role of other kinds of leadership behaviors.

Organizational System – Quality-Supportive Principles

Anderson et al. (1994) see visionary leadership as capable of establishing an organizational system characterized by "internal and external cooperation" and "learning." Anderson et al. group these items together and collectively label them as the "organizational system." The modified model in Figure 4.1 proposes that the constructs of Anderson et al.'s organizational system may be represented by what Dean and Bowen (1994) found to be the basic underlying principles of quality management, namely customer focus, teamwork and continuous improvement. The modified model renames this collection of variables "quality-supportive principles." The modified model splits Anderson et al.'s concept of internal and external cooperation apart and conceptualizes each organizational system characteristic separately. It is proposed that Anderson et al.'s concept of internal cooperation is analogous to the notion of teamwork (i.e., cooperation among actors inside the organization). Likewise, external cooperation (cooperation between organizational actors and parties who are outside the organization) is closely related to the notion of customer focus.

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The third construct within Anderson et al.'s (1994) organizational system is learning. In the modified model (Figure 4.1) the position originally occupied by learning is replaced by continuous improvement commitment. This is justified on the basis that transformational leadership behaviors will inspire followers to pursue continuous improvement in internal organizational processes while transactional leadership behaviors will reward such efforts. As will be seen later, the final model (Figure 4.2) incorporates learning but in an expanded form to include each of the learning disciplines as formulated by Senge (1990). Note also that the modified model draws a distinction between *commitment* to continuous improvement and the *achievement* of continuous improvement outcomes. The former represents intent, while the latter represents the fruits of that intent.

Customer Satisfaction

The final element of Anderson et al.'s (1994) original model is customer satisfaction. Customer satisfaction is omitted from the modified model because it is unlikely that the organizational members who will be the focus of this research will be in a position to adequately estimate customer satisfaction.

Feedback Linkages

The Anderson et al. (1994) model includes a number of feedback paths among its elements. While Anderson et al. make a theoretical case for the existence of such feedback paths, the resulting model is so highly interconnected as to make separating

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out these phenomena difficult if not impossible to test in the context of this study's research setting. As a result, the feedback linkages are omitted from the modified model.

Organizational Learning & Environmental Uncertainty

The model proposed by Anderson et al. (1994), shown in its original form in Figure 3.1 (above) includes learning as an important aspect of the organizational system. The model tested in this research (Figure 4.2) illustrates how the disciplines of the learning organization (as defined by Senge, 1990) have been incorporated. In addition, environmental uncertainty was tested as a moderator in two of the hypothesized relationships (H5b and H10b). Uncertainty is conceptualized here as an environmental characteristic surrounding the illustrated variables within a system boundary.

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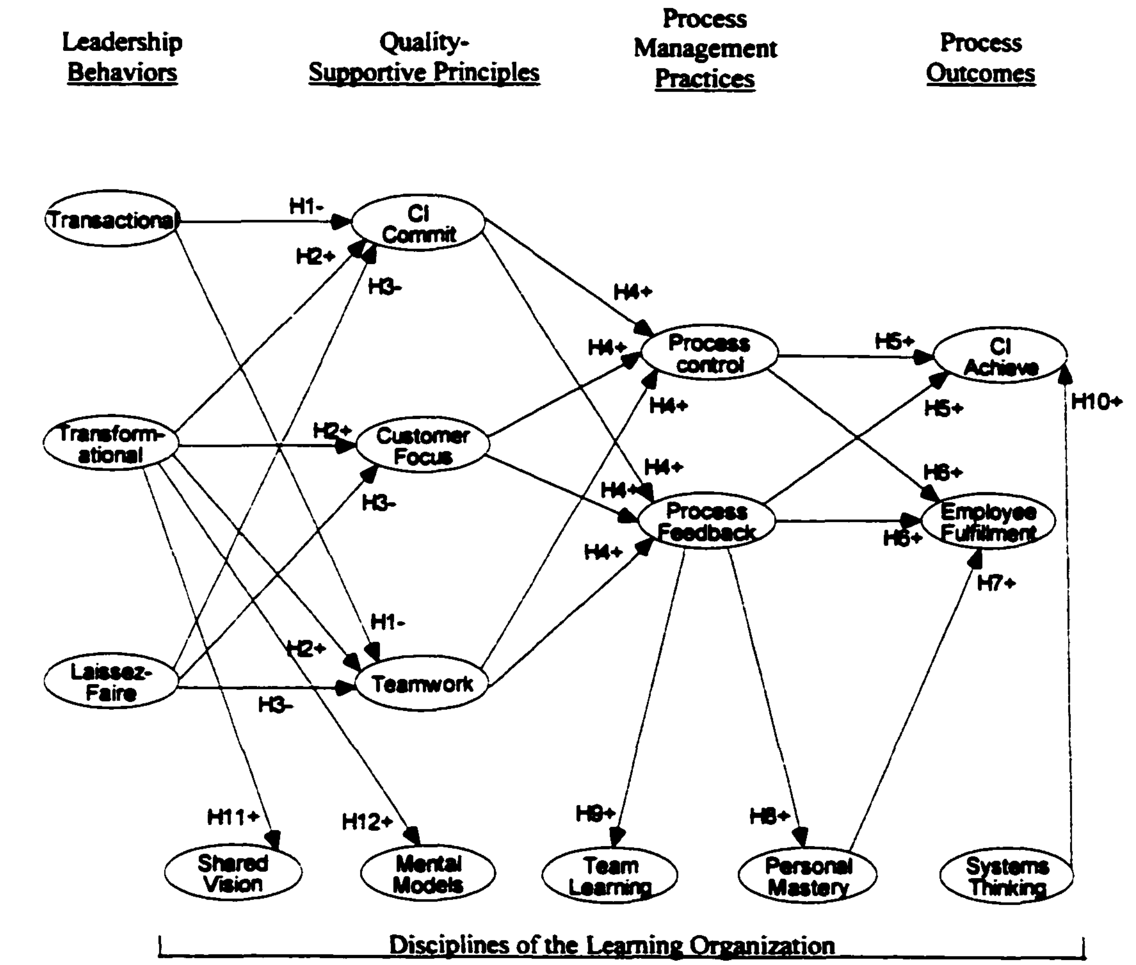
Figure 4.2

Theoretical Model for Testing



Note. For clarity, control variables and moderators are not illustrated in the figure. Moderated hypotheses (e.g., H2a and H2b) are illustrated together (e.g. as H2). The component factors of transactional and transformational leadership are also not shown. CI = continuous improvement. H = hypothesis; +/- indicates direction of the theorized relationship.

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Development of Hypotheses

This section presents the theoretical development of each hypothesis, organized by central research question.

Research Question 1: How do leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management?

Sosik and Dionne (1997) suggest that corrective transactional leadership (i.e., the active and passive forms of MBE - management by exception) is not supportive of effective quality management. Avolio (1994) observes that early quality control approaches tended to focus on worker monitoring and error detection, a management style predicated on the notion that workers are at low levels of development and maturity and cannot be trusted. Sosik and Dionne comment that MBE leadership behaviors are likely to result in reluctance on the part of followers to take risks associated with change efforts or other improvement initiatives, or to engage in the teamwork necessary to accomplish such ends. Based on this literature, the following hypothesis is suggested:

> H1: Active and passive management by exception are negatively associated with continuous improvement commitment and teamwork.

That is, the more frequently leaders practice management by exception, the lower subordinates' commitment to continuous improvement and the less frequently teamwork will be used to solve problems.

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Waldman (1994) suggests that transformational leadership behaviors are consistent with the type of leadership advocated by various quality management authorities. Transformational leaders create in followers the perception that change is desirable and needed, develop an organizational culture supportive of change initiatives, encourage subordinates to question assumptions and embrace multiple perspectives in problem-solving (Bass, 1985). Avolio (1994) suggests that the essential components of transformational leadership contribute to the achievement of continuous improvement in products and services. For example, intellectual stimulation (a component of transformational leadership) is a catalyst for continuous improvement since it encourages followers to question assumptions and look at problems from different angles. Another component of transformational leadership, individualized consideration, is a probable mechanism for building commitment to continuous improvement (Waldman, 1993). As Avolio (1994) observes, people learn in different ways and need to develop themselves and improve their work at different rates and in different ways. Sosik and Dionne (1997) posit that transformational leadership encourages teamwork by "(a) moving followers to rise above their own self-interests for the good of the team (Bass & Avolio, 1994); (b) creating a sense of joint mission and ownership (Covey, 1991); (c) articulating a holistic vision and demonstrating ways to collectively achieve the vision (Conger, 1989)." Organizations with a demonstrated commitment to quality have by definition embraced the importance of customer focus. Managers and supervisors in such organizations

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transmit that customer focus to subordinates by espousing customer-centered values and beliefs. Talking about one's most important values and beliefs, and considering the moral and ethical consequences of one's decisions are behaviors that characterize transformational leadership (Bass, 1985). Based on the foregoing, the following hypothesis is suggested:

> H2a: Transformational leadership behaviors are positively associated with teamwork, customer focus and continuous improvement commitment.

The importance of transformational leadership in the foregoing quality-related outcomes may vary across management levels (Waldman, 1993). Dean and Bowen (1994) observe that the quality management literature stresses the salience of leadership (especially transformational leadership) at the senior management and executive levels, and suggest that it may be less important further down the hierarchy. In addition, Waldman et al.'s (1998) multiple case, qualitative study of Canadian organizations supported the idea that the hierarchical level of a focal leader moderates the nature of the relationship between transformational leadership behaviors and the success of quality improvement initiatives. The following hypothesis is suggested:

> H2b: There is a stronger positive relationship between transformational leadership behaviors and teamwork, customer focus and continuous improvement commitment in work groups with leaders at higher organizational levels than with leaders at lower levels.

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Sosik and Dionne (1997) suggest that laissez-faire leadership is incompatible with the leadership behaviors necessary for effective quality management. Sosik and Dionne cite research reviewed by Bass (1990) that connect laissez-faire leadership with lack of task concentration, work quality problems and poor productivity. Teamwork requires task and socioemotional support from leaders and commitment to continuous improvement requires leaders to encourage subordinates to seek out new opportunities to improve the status quo (Sosik & Dionne, 1997). One may further posit that maintaining subordinates' focus on the needs and desires of customers requires leaders to actively espouse and reiterate this objective. Thus each of Dean and Bowen's (1994) quality-supportive principles require the presence (not the absence or indifference) of leadership. Based on the foregoing, the following hypothesis is suggested:

H3: Laissez-faire leadership is negatively associated with teamwork, customer focus and continuous improvement commitment.

Research Question 2: How does the extent of adoption of quality management's underlying principles affect process management practices?

Teamwork is important for quality-focused process management practices such as process control and process feedback. Teams and their associated meetings provide a forum for problem-solving and peer-to-peer and leader-subordinate discussions of quality performance and productivity. In addition, Anderson et al. (1994) note that

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Deming believed that effective process management required cooperation and knowledge sharing among organizational members, not competition. Customer focus involves knowing who one's customers are, meeting with them regularly, soliciting their feedback, and making a conscious effort to satisfy their needs (Gatewood & Riordan, 1997; Morrow, 1997). Knowledge of customer requirements brings into focus what specific quality characteristics or specifications are important to the customer and hence helps define what characteristics ought to be measured and controlled. Thus the more fully the customer's expectations are understood, the more effectively work groups can design their process management practices. Work groups' commitment to continuous improvement is satisfied by putting into place means for monitoring the quality of processes (process feedback) and mechanisms to sustain quality at high levels (process control). Based on the foregoing, the following hypothesis is suggested:

> H4: The more a work group is characterized by quality-supportive principles (teamwork, customer focus and continuous improvement commitment), the more process management practices are characterized by process control mechanisms and process feedback systems.

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Research Question 3: How do the basic quality-supportive process management practices affect quality-related process outcomes?

Both Deming (1982) and Feigenbaum (1991) strongly emphasize the use of statistical control theory in detecting and resolving problems and improving quality in production and service systems. The process control theory proposed by Shewhart in 1924 posits that there are two causes of loss in any production system: those due to common causes, and those due to special or assignable causes (Mitra, 1993). Common causes are losses or defects that occur because of random, chance variations that are an inherent part of the system. Special causes are the result of some novel or special event. Control chart theory affords a systematic method to detect the existence of a special cause by examining a statistical chart of the performance of the process over time. Process control practices and the feedback of process control information to organizational members directly involved in the process enables the achievement of continuous improvement. These practices give organizational members the information they need and the tools necessary to undertake efforts to reduce variation in product and service quality and hence achieve quality improvement. The foregoing suggests a main effect between process management practices and continuous improvement achievement:

H5a: The more process management practices include process control methods and process feedback to organizational members the more frequently continuous improvement is achieved.

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It is possible, however, that the nature and strength of this hypothesized relationship may be contingent on the level of environmental uncertainty perceived by the organization. Perceived environmental uncertainty exists when the organization's environment is unpredictable by the organization's executives. "Perceptions of environmental uncertainty occur when executives are unable to predict future changes in components of the environment or possess an incomplete understanding of the relationships among components of the environment" (Buchko, 1994, citing Milliken, 1987). When environmental uncertainty is low, customer requirements are well known or predictable and the task environment is routine. In such situations, process management practices such as statistical process control may be effectively used to maintain output consistency, and standard quality management methods will be useful for making small, incremental improvements in production and service delivery processes. When organizational uncertainty is high, customer requirements are dynamic, information about customer needs may be incomplete, and the associated task environment is non-routine. In such uncertain situations, standard quality assurance techniques for fine-tuning processes (e.g., statistical process control) may be less useful.

Sitkin et al. (1994) have suggested that as task, product/process or organizational uncertainty increases, it becomes increasingly difficult to satisfy the prerequisites for quality management techniques like statistical process control. These prerequisites include a definable quality characteristic to measure, a stable system of

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production, and a repetitive process. Under conditions of high uncertainty, an organization's understanding of customer requirements must be continually rediscovered through organizational learning. One of the definitions of organizational learning is it is a process of detecting and correcting error (Argyris, 1977). In the present case the error involved is the degree of mismatch between customer requirements and the actual output of a production or service delivery process. Continuous improvement achievement represents a narrowing of the gap between what is required and what is actually delivered. The foregoing gives rise to the following moderated hypothesis:

> H5b: There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty than under conditions of high perceived environmental uncertainty.

The hypothesized effect of the moderating variable is illustrated in Figure 4.3.

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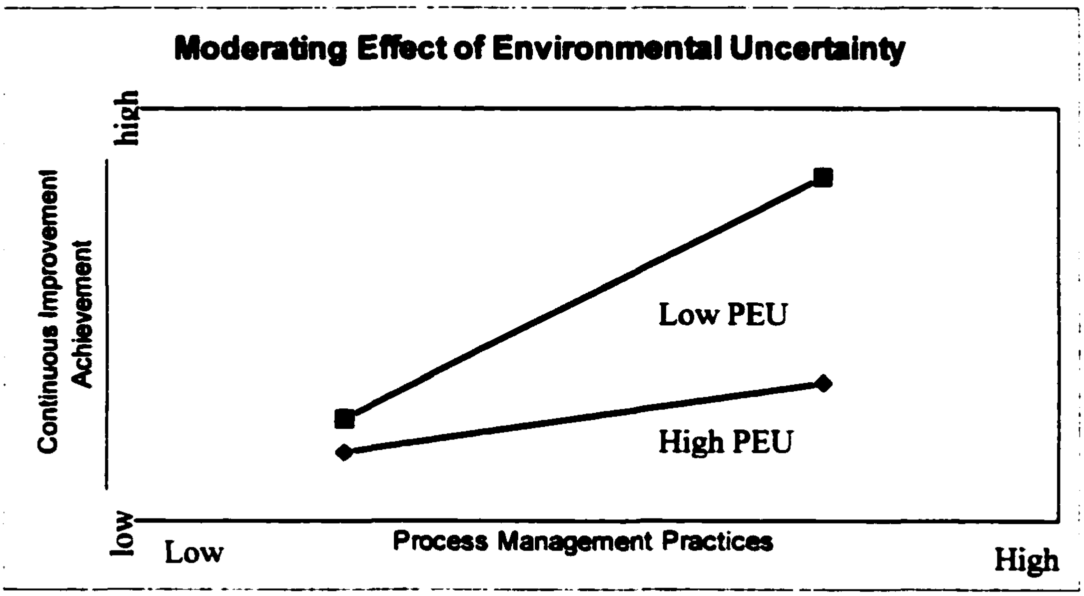
Figure 4.3
Illustration of Hypothesis 5b



Feedback to organizational members that leads to knowledge of work results and subsequently to various kinds of personal and work outcomes, such as job satisfaction, has been previously hypothesized (Hackman & Oldham, 1976) and tested in various settings with generally supportive results (Muchinsky, 1996; Nelson & Quick, 1995). Based on Hackman and Oldham's Job Characteristics Model, it may be suggested that use of process control methods contributes to worker autonomy (one of the model's "core job dimensions") since it allows workers more complete participation in quality management efforts, as suggested by Anderson et al. (1994). Prior research in connection with the Job Characteristics Model has included a focus on the relationships among autonomy, feedback and *job satisfaction*. A related but

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separate notion is *employee fulfillment*. Job satisfaction is a broad construct that encompasses satisfaction with pay, promotion opportunities, supervision, rewards, working conditions, coworkers and communication (Spector, 1997). In contrast, employee fulfillment is conceptualized in this research as the extent to which an organization satisfies its members' needs for pride of workmanship, achievement and meaningful accomplishment. Process control and process feedback practices allow workers to know how, when and under what circumstances their efforts are producing desired results, and affords ongoing opportunities to improve those results, thereby fulfilling workers' intrinsic needs for achievement and accomplishment. Based on the foregoing, the following hypothesis is suggested:

H6: The more process management practices include process control methods and process feedback to organizational members, the greater employee fulfillment.

Since workers' overall satisfaction is an outcome that is known to be influenced by the quality of the leader-member relationship (Gerstner & Day, 1997) it was deemed advisable to control for this effect. The quality of the leader-member relationship is effectively operationalized by an instrument known as LMX, a set of survey questions focusing on the general working relationship between leader and subordinate. An additional variable that may have a bearing on employee fulfillment is one's tenure with the organization (Morrow & McElroy, 1987). Both LMX and

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organizational tenure were included in this study's research questionnaire for use as control variables.

Research Question 4: How are the disciplines of the learning organization associated with quality-related process management practices and process outcomes?

Organizational learning is important to the success of quality-focused organizations since only through learning can organizations capture and retain the knowledge necessary to continually refine and improve business processes responsible for product and service quality. Consequently, organizational learning is an essential component of a comprehensive theory of quality management. Furthermore, as quality management's basic methods and techniques pick the low-hanging fruit of improvement opportunities in any given organization, the increasingly difficult problems and challenges that remain may require more sophisticated problem-solving techniques and thinking. The seven basic tools of quality improvement (the process flow diagram, control chart, Pareto diagram, cause and effect diagram, check sheet, scatter plot and histogram) may fall short when applied to situations characterized by non-linear systems with multiple cause-and-effect relationships and feedback loops. It is in these cases that systems thinking, managing mental models and team learning may be necessary to push forward the goals of improved product and service quality.

We should expect to find characteristics of the learning organization present in organizations that have adopted quality management systems such as the international

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ISO 9000 standard or the U.S. government GMP (Good Manufacturing Practices) system. This is because organizational learning requires institutional *mechanisms* or *learning systems* for the retention of organizational memory (Fiol & Lyles, 1985; Stata, 1989). One way this is accomplished in practice is by formal documented systems for business process such as new product development and engineering change control. Such learning-enabling systems are explicitly required by ISO 9000 standards and government GMP quality regulations (*ANSI Q94*, 1987; *Code of Federal Regulations, Title 21*, Subpart F, Section 820.100, 1993). Furthermore, such documented processes and procedures may make the organization's mental models explicit and accessible to all organizational members, leading to a shared understanding of how the organization works or is expected to work. Organizational learning theorists have suggested that organizational change in and of itself does not necessarily imply organizational learning (Fiol & Lyles, 1985) and therefore a comprehensive model of quality management must maintain a clear distinction between the constructs of change achievement and the elements of organizational learning.

In Senge's (1990) conceptualization of organizational learning, he describes "creative tension" as the dynamic gap between current reality and one's personal vision of a desired future. Commitment by organizational members to continuous improvement establishes the creative tension that Senge says is central to personal mastery, one of Senge's learning disciplines. This tension is not stress in the sense of

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anxiety or distress, rather it is a kind of eustress like that described by Yerkes and Dodson (1908) in which an optimal level of stress or psychological arousal is associated with maximum task performance. Senge is not the first writer to note the importance of stress and tension in organizational learning. Fiol and Lyles (1985) note that the learning process requires the existence and manipulation of tension between constancy and change.

Personal mastery is Senge's (1990) term for the "discipline of personal growth and learning." It involves focusing on what one genuinely wants and on one's own visions of a desired future state. Senge elaborates on this by stating that "The essence of personal mastery is learning how to generate and sustain creative tension in our lives." Process feedback enables personal mastery by supplying the information related to one's personal performance (current reality) that can then be used to focus one's attention and energy. Process feedback may include information on defect rates, schedule compliance, and in general the measured or perceived quality of one's work. This information, along with a sense of the levels at which one wishes to perform, allows individuals to construct and maintain creative tension. The foregoing leads to the following hypothesis:

H7: The more individuals feel a sense of personal mastery, the greater their degree of employee fulfillment.

As mentioned above, the degree of an individual's satisfaction (and hence level of fulfillment) may be affected by the quality of the leader-member relationship.

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Therefore, as was the case with Hypothesis 6, it was deemed advisable to control for this effect when testing H7. Leader-member exchange quality, LMX, is used as a control variable to partial out this effect.

Personal mastery is the "discipline of personal growth and learning" (Senge, 1990). Process feedback should have a positive effect on personal mastery since it affords needed information on one's level of success and degree of goal attainment. Self-efficacy should also have a positive effect on one's sense of personal mastery since individuals who harbor strong beliefs that personal effort will lead to goal achievement will be more strongly committed to personal growth and more sharply focused on the future. Self-efficacy is the belief in one's ability to successfully accomplish tasks, overcome obstacles and reach goals (Bandura, 1997). Consequently self-efficacy is included as a control variable to partial out the effects of self-efficacy on personal mastery. The foregoing leads to the following hypothesis:

H8a: The more process feedback is made available to organizational members, the more individuals feel a sense of personal mastery.

The strength of the relationship between feedback and sense of personal mastery may be a function of one's self-efficacy. As applied here, an individual with high self-efficacy believes that he or she can effectively use process feedback to achieve work-related goals. In contrast, one with low self-efficacy may believe that they are relatively powerless to positively affect the achievement of work-related

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goals, and that process feedback won't help them. Consequently self-efficacy will be tested as an interaction term to carry the moderating effect of self-efficacy on feedback. The foregoing suggests the following:

H8b: Individuals with high self-efficacy demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.

Team learning is the process of aligning and cultivating the abilities of team members to enable the team to achieve the results it wants (Senge, 1990). We may differentiate a team from a mere group in that a team consists of limited number of people with complementary skills committed to a common purpose who hold themselves mutually accountable for the production of a collaborative work product (Katzenbach & Smith, 1993). Senge's idea of team learning involves insightful group thinking about complex issues, coordinating the actions of team members and fostering other teams toward team learning. Effective team learning requires the ability of the team to engage in genuine *dialogue* as opposed to mere *discussion* in which conflicting points of view are heaved at one another until one side wins or the other side acquiesces. Dialogue involves surfacing assumptions, balancing inquiry and advocacy, and building new common ground of shared assumptions (Senge, 1990; Schein, 1993). Effective dialogue is sometimes constrained by *defensive routines* that prevent valid information from being surfaced or communicated and make certain

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topics undiscussable (Argyris, 1999). These defensive routines may originate with our pro-social desires to avoid embarrassing or threatening others and upsetting the comfortable status quo.

The model tested in this research posits that process feedback enables team learning by providing objective information to individuals and groups regarding defect rates, productivity, schedule compliance, etc. This information allows team members to better understand the interrelationships among actions taken at a variety of levels (e.g., individual, work group, department) and the effects later manifested at a variety of outcome levels (component or process level, subassembly level, finished product level, etc.). The foregoing leads to the following hypothesis:

> H9: The more process management practices include quality-related process feedback to organizational members, the more team learning occurs.

According to Lendaris (1986), "A *system* is a) a unit with certain attributes perceived relative to its (external) environment, and b) a unit that has the quality that it internally contains subunits and those subunits operate together to manifest the perceived attributes of the unit." Systems thinking is an approach to help us think about total systems and their components (Churchman, 1968). Senge (1990) defines systems thinking as a mental discipline for observing totalities and wholes rather than isolated parts, and observing interrelationships, patterns and processes rather than things and events. Systems thinking is important because the world has grown in

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complexity and interdependencies such that our traditional thinking and problem solving approaches are less effectual (Richmond, 1991). Systems thinking is difficult because our thought processes tend to be focused around simple linear cause-and-effect relationships and event-dominated thinking instead of a process orientation with loops, circular causality, feedback paths and balancing factors (Senge, 1990). The discipline of systems thinking also puts the beholder of the system into the system itself to reveal that one's own actions may create the problems one experiences.

Continuous improvement is the ongoing achievement of incremental enhancements to an organization's processes, products and services in the relentless effort to improve the satisfaction of its external customers, organizational members and business partners. It is posited that the achievement of continuous improvement may be greatly aided by effective systems thinking. This is possible since accurate perception by organizational members of the interrelationships among variables in production and service delivery systems affords insight into the leverage points of the system. Leverage points are the points in a system that are most amenable to effective intervention. As Senge (1990, p. 64) points out:

> Tackling a difficult problem is often a matter of seeing where the high leverage lies, a change which – with a minimum of effort – would lead to lasting, significant improvement. The only problem is that high-leverage changes are usually highly *nonobvious* to most participants in the system.

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Systems thinking affords participants in the system (managers and workers) the ability to observe the structures that lie beneath complex situations, to identify susceptible leverage points for effective quality improvements, and to avoid unintended negative consequences. The foregoing suggests a main effect between system thinking and continuous improvement achievement:

> H10a: The more systems thinking occurs the more frequently continuous improvement is achieved.

It is also possible that the strength of the foregoing hypothesized relationship may be contingent on the level of environmental uncertainty faced by the organization. Organizational actions taken on the governing variables of the production or service delivery system to narrow the gap is a manifestation of what Argyris calls single-loop learning. In contrast, double-loop learning occurs when mismatches are corrected by changing the variables that are acted upon, or questioning and rethinking the underlying objectives of the system (Argyris, 1977, 1999). Sitkin et al. (1994) have hypothesized that when uncertainty is low, conventional quality control practices will lead to effective outcomes; when uncertainty is high, practices associated with learning (what they call total quality learning) will lead to effective outcomes. That is, Sitkin et al. hypothesize an interaction effect and a contingency theory approach. Using Argyris's terminology, it is suggested that degree of environmental uncertainty is responsible for determining the relative extent of success of single-loop learning vs.

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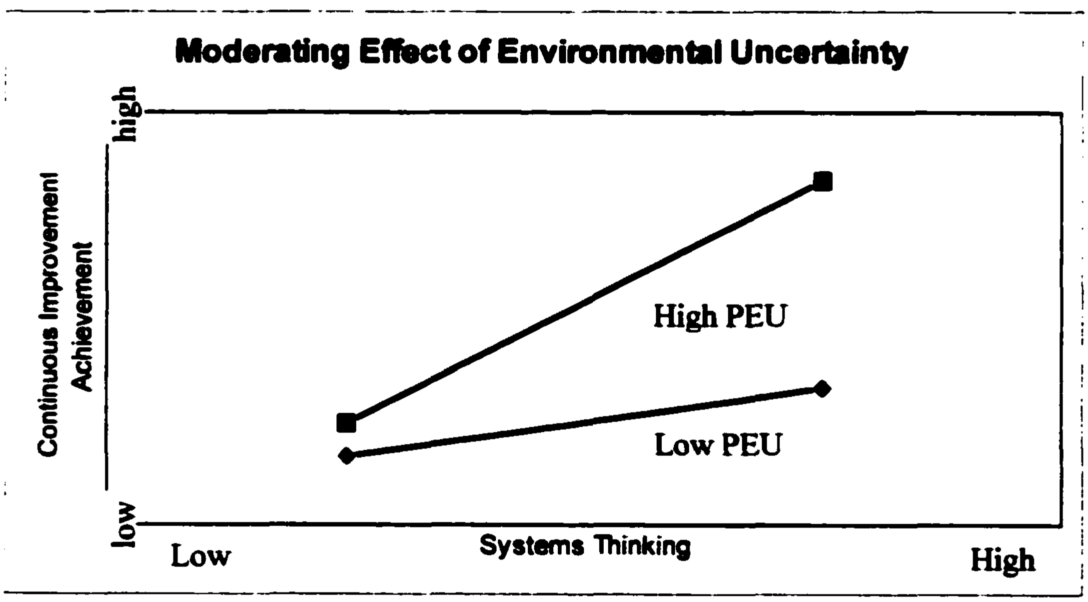
double-loop learning toward continuous improvement achievement. The foregoing leads to the following hypothesis:

H10b: There is a stronger positive relationship between systems thinking and continuous improvement achievement under conditions of high perceived environmental uncertainty than under conditions of low perceived environmental uncertainty.

The effect of the moderating variable, perceived environmental uncertainty (PEU), is illustrated graphically in Figure 4.4

Figure 4.4
Illustration of Hypothesis 10b



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Research Question 5: How do leadership behaviors affect the realization of various disciplines of the learning organization?

Shared vision arises from the individual personal visions regarding the future of the organization that are common to the people in the organization (Senge, 1990). Shared vision is the knowledge of what the organization is about and where it is going and a concomitant commitment to that direction. Kofman and Senge (1993) suggest that learning organizations are communities committed to a common future. Shared vision is important to organizational learning because it provides a united direction and focus for learning (Senge, 1990). A component of transformational leadership, inspirational motivation reflects a leader's articulation of the group's goals and expression of a desired future state for the organization. Leaders who exhibit inspirational motivation behaviors speak optimistically about the future and talk to subordinates about compelling and important goals that need to be accomplished. Leaders in organizations with a demonstrated commitment to quality-focused organizational outcomes may be expected to contain leaders who espouse the virtues and importance of quality management practices and related outcomes. This may have the effect of encouraging organizational members to adopt common language and frames of reference that will lead to shared beliefs about the future (Schein, 1992). The foregoing leads to the following hypothesis:

H11: The inspirational motivation component of transformational leadership is positively associated with shared vision.

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Mental models are one's mental images of the world and one's beliefs and theories regarding how the world works (Forrester, 1971; Senge, 1990, 1992b). According to Senge, mental models affect what we see, and we observe selectively according to what our mental models predispose us to see. Forrester asserts that managerial actions are undertaken based on mental models. One of the troubles with mental models is that often they are tacit and operate in one's subconscious (Senge, 1990). Examining mental models lets us focus on exposing our hidden assumptions to ourselves and to others so that a better understanding of the truth can be obtained leading to more accurate and insightful actions. Since mental models operate at the level of our most deeply held assumptions, they determine or at least affect what we see by helping to form perceptual filters. What is observed is a function of the observer and his cognitive filters and biases (Lendaris, 1986). A new problem, question or opportunity confronting the organization is seen through perceptual filters that ask how will this situation affect or fit in with established standard operating procedures, policies and practices (Linstone, 1984). Mental models affect decisions and actions because they affect what we perceive (Senge, 1992b). Managing mental models requires individuals to become aware of the assumptions that underlie one's thought processes and consciously examine those that can affect work-related decision making (Tetrick et al., 2000). Transformational leadership entails behaviors aimed at the intellectual stimulation of subordinates, specifically encouraging followers to approach problems in new ways or from new perspectives and to question previous assumptions. Such leadership behaviors may

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consequently encourage organizational members to surface their assumptions and examine and actively manage their mental models. This leads to the following hypothesis:

> H12: The intellectual stimulation component of transformational leadership is positively associated with managing mental models.

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Chapter 5: Research Method

Overview

This section discusses the types of organizations included in the study, sampling strategy, analytic techniques, level of analyses, aggregation of responses, measurement perspectives, statistical power, and the mechanics and logistics of the research process.

Types of Organizations Studied

A primary focus of this research is quality management. Consequently, organizations selected for inclusion in the study were those that were demonstrably pursuing quality-focused organizational outcomes. The selection of organizations actively engaged in quality-focused management practices follows the advice of Dean and Bowen that firms implementing organization-wide quality management programs "may be provocative sites for studying the relevance of leadership" (1994, p. 399). Furthermore, the practical relevance of the findings of this research will be strongest among leaders in quality-focused organizations.

Two major attributes were considered to be a positive indication of an organization's commitment to quality-focused aims: (1) The organization had a quality management system certified to ISO 9000 standards, or (2) the organization had received a major (e.g., state-level or national) quality award. This section

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discusses each indicator and its rationale as a basis for the selection of organizations. Also, since this research was conducted using on-site visits by the researcher, for practical reasons the subject organizations were located within the state of Oregon.

ISO 9000 Organizations

ISO 9000 is a set of international standards published by the International Standards Organization in Geneva, Switzerland. These standards require organizations to document processes affecting quality and require independent and periodic audits to validate that the organization is following its documented processes. ISO 9000 certification is recognized by about 100 countries, and certification is required for shipment of some U.S. goods to foreign markets (Evans & Lindsay, 1996). In 1999, more than 33,000 U.S. companies were ISO 9000 certified (*The ISO Survey of ISO 9000 and ISO 14 000 Certificates – Ninth Cycle*, 2000).

ISO9000 certification is an appropriate criterion for an organization's inclusion in this research since:

(a) Certification indicates that a quality system has been developed, deployed and is functioning.

(b) The quality system includes a full range of quality management tools including process control techniques, defined quality measurement methodologies, control of nonconforming product, a corrective action system, internal quality audits, employee training in quality techniques, etc.

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(c) Certification indicates that the senior management of the organization recognizes the importance of actively managing quality by supporting the overhead and administrative costs associated with running the quality system as well as the costs of gaining and retaining certification.

(d) There are over 200 such firms in the state or Oregon and they span a variety of industries and organization sizes.

Quality Award Organizations

The Malcolm Baldrige National Quality Award, named for a former U. S. Secretary of Commerce, is a national recognition program that began in 1987. The award is designed to recognize U.S. organizations that excel in quality management and quality achievement (Evans & Lindsey, 1996). The award measures organizational performance using the Baldrige Criteria (Appendix B), a set of seven elements that include assessments of leadership, strategic planning, customer focus, use of information, human resource practices, process management and organizational results. Sixty-eight state and regional organizations sponsor Baldrige-based quality awards (Russo, 2001), including the state of Oregon.

Receipt of a state-level, Baldrige-based quality award is an appropriate criterion for an organization's inclusion in this research since:

(a) The state award recognizes various levels of accomplishment toward quality-focused aims, affording a sample with a range of organizational achievement related to quality management practices and outcomes. This diversity of

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achievement among subject organizations alleviates some concern for the sample representing a restriction in range in the variables of interest.

(b) Since the state quality award is based on the Malcolm Baldrige National Quality Award, receipt of the award indicates that there is an organization-wide focus on quality aims.

(c) The Oregon Quality Award recipients represent a variety of organizations including educational, government, manufacturing and service organizations.

It should be noted that ISO 9000 certification and receipt of a Baldrige-based quality award are not equivalent indicators with respect to the nature and success of an organization's quality system. The requirements for ISO 9000 certification are a subset of the Baldrige criteria (Evans & Lindsay, 1996). The Baldrige criteria go beyond the requirements of ISO 9000 by dealing directly with attainment of customer satisfaction, continuous improvement achievement and business results.

Sampling Strategy

To summarize the foregoing section, the sample universe for this research consisted of organizations located in the state of Oregon with a quality system certified to ISO 9000 standards and/or organizations whose approach to quality management has been recognized by receipt of the Baldrige-based Oregon Quality Award. Potential participants (organizations) for this research were randomly drawn from past recipients of the Oregon Quality Award and from the 200-plus ISO 9000

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certified organizations in Oregon. The intent was to obtain an approximately equal number of participating organizations of each type. Drawing participants from both types of organizations afforded diversity within the sample with respect to the degree to which quality aims are being achieved to mitigate range restriction problems in the quality-focused variables.

An upper limit of eight was placed on the number of work groups sampled from any one organization to prevent large organizations with many work groups from dominating the sample. A goal of at least three work groups per organization was set for practical research reasons, and a lower limit of three individuals per work group was set to facilitate the aggregation of responses to form group measures. The sampling strategy is summarized in Figure 5.1. This approach produced a sample of 105 work groups from 19 organizations. The sample equated to an average of 5.5 work groups per organization. The sample yielded responses from 632 individual work group members (excluding supervisors and managers).

Figure 5.1
Summary of Sampling Strategy

18-20 Organizations	X	Avg. ~5 Work Groups per organization	X	Avg. ~7 Employees per work group
9-10 ISO9000 & 9-10 Award Winners		Minimum 3 (goal) & Maximum 8 per organization		Minimum 3 per work group

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Analytic Techniques

This study employs three analytic techniques to test hypotheses and examine relationships among variables. The techniques used are ordinary least squares regression, multilevel modeling and structural equation modeling. Each of these analytic techniques is briefly described below.

Ordinary Least Squares Regression

This study employs various forms of ordinary least squares (OLS) regression testing. Regression testing rests upon a number of important statistical assumptions. These assumptions include independent observations, normality of measures, homoscedasticity among variables, absence of outliers and other assumptions. The plausibility of the assumptions of regression testing is evaluated within the context of each hypothesis test in the Results chapter. The specific forms of OLS regression used in this study include bivariate correlation, multiple regression and canonical regression.

Bivariate Correlation

Bivariate correlation analysis is appropriate when the relationship to be tested consists of a single independent variable and a single dependent variable. An r statistic indicating the strength of the relationship is produced along with an associated p value of significance. Three hypotheses in this study are tested using bivariate correlation analysis.

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Multiple Regression

Multiple regression is appropriate when a single dependent variable is to be predicted from several independent variables. An R^2 statistic indicates the strength of the multivariate relationship while an F test indicates statistical significance. Standardized coefficients (betas) indicate the relative unique contribution of each independent variable to predicting the outcome variable. Also, t tests of statistical significance accompany each coefficient. The adjusted R^2 statistic is also reported which compensates for the optimistic bias of R^2 when it is computed from a small sample. Multiple regression can also be executed in a hierarchical sequence of steps to partial out the effect of one or more variables to identify incremental contributions to R^2. Hierarchical regression is employed in several hypothesis tests in this study. The effect of moderator variables may also be assessed in a regression analysis by adding an additional variable (the product of the moderator and independent variable) to the regression equation to carry the interaction term. Four of the hypotheses in this study include moderator effects.

Canonical Regression

Canonical correlation is appropriate when there are multiple independent variables (IVs) and dependent variables (DVs) and when both can be measured on a continuous scale. This technique provides an R^2 that quantifies the strength of the relationship between the set of IVs and the set of DVs. This method yields one or

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more functions with standardized canonical coefficients (one coefficient for each IV and DV) that allow one to interpret one or more *patterns* of relationships between the canonical variates (the set of IVs and the set of DVs). Each canonical function is a linear combination of the canonical variates that maximizes their linear relationship. A multivariate test of the relationship yields an F statistic for significance and a Wilks' Lambda (Λ) for the variance *un*accounted for by the first function. The number of possible canonical functions that can be obtained is determined by the number of variables in the smaller of the two sets of variables. The data analytic algorithm used in canonical correlation testing produces an orthogonal (uncorrelated) solution in that the functions obtained are independent from one another. F tests are used to determine if canonical functions beyond the first are significant.

Multilevel Modeling

The data gathered in this study are hierarchically structured. That is, individuals are nested within work groups and work groups are nested within organizations. Data at the individual level can be referred to as measurements at the micro level, and data at the group level as measurements at the macro level. The macro level is also sometimes referred to as the context. Contextual factors may influence the nature of relationships at the micro level (Kreft & de Leeuw, 1998). For example, several of the hypotheses in this study were constructed at the individual level of analysis. It is possible that contextual factors (variables at the work group level) have a bearing on the nature and strength of relationships at the individual level

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(Hackman, 1992). Likewise, relationships detected at the work group level may be a function of variables at the organization level.

The hierarchical nature of clustered data may "produce sizable pockets of similarity among the individuals comprising each group" (Heck & Thomas, 2000, p. 1). Nested data therefore have the potential to violate a basic assumption of OLS regression analysis, namely the independence of observations. This situation represents a threat to the validity of findings made under such conditions. In order to obtain measures at the group level, this study used aggregation methods (e.g., within-group means). Aggregation presents several risks. One well known risk is termed the ecological fallacy, making statements about individual level effects on the basis of aggregated results (Robinson, 1950). This is avoided by making no such inferences. But another risk of aggregation is to ignore the hierarchical nature of the data such that analysis distorts the relationships under investigation (Snijders & Bosker, 1999, p. 14). This type of risk is particularly salient to the present research because the OLS regression and modeling methods used in this research do not themselves explicitly take into account the hierarchical nature of the data.

An analytical technique that explicitly considers hierarchically organized data is multilevel modeling. Multilevel modeling is sometimes referred to as hierarchical linear modeling (HLM), contextual modeling or random effects modeling. Multilevel modeling avoids the aggregation problem by analyzing multiple levels simultaneously (Heck & Thomas, 2000, p. 6). The question is then, does this study's particular data

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set call for multi-level analysis? To make this determination, Heck and Thomas suggest partitioning the variance of dependent variables into within-group and between-group components. If the variation between groups is small (i.e., there is homogeneity between groups) then there is no call for multilevel analysis. A statistic that describes the homogeneity of groups is the intraclass correlation coefficient (ICC or ρ). If ρ is low, then groups are similar to one another and a single-level analysis is sufficient. If ρ is high, then groups are dissimilar and a multilevel analysis may afford greater insight into higher-order factors that help explain relationships. In the present context, ρ may be defined as "the proportion of the variance in the outcome variable that is between the second-level units" (Kreft & de Leeuw, 1998, p. 9). The presence of intraclass correlation leads to inflated Type 1 error levels in OLS regression, and this effect increases as group size increases (Barcikowski, 1981). Consequently, the significance levels in this study from OLS regression were rechecked using multilevel modeling. Multilevel modeling was not used as a replacement to OLS regression in this study for practical reasons. The multilevel software package used (HLM Version 5) was not as flexible and versatile as the software used for OLS regression (SPSS Version 10).

Structural Equation Modeling

Structural equation modeling (SEM) combines factor analysis and regression to enable simultaneous testing a set of specified relationships among independent and dependent variables. SEM is also known as analysis of covariance structures or causal

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modeling, and it includes (as special cases) path analysis and confirmatory factor analysis (Ullman, 1996). In this study SEM is used to provide a graphic illustration of the unique effects among the identified multivariate relationships. SEM provides two other benefits. First, various goodness-of-fit measures afforded by SEM provide indications of how well the overall model fits the implied population covariance matrix. Second, the modification indices produced by SEM suggest additional (exploratory) findings that may be useful in formulating future research.

Level of Analysis

Level of analysis refers to the entity to be focused on in a research project. For example, the level of analysis may be set at the individual, group or industry level. Level of analysis is important in both the theoretical development and statistical analysis phases of research since a study's conclusions may differ depending on the level of analysis chosen (Klein, Dansereau & Hall, 1994). An attention to levels issues is also important in the design of research since the level of the data source (e.g., individual, organizational, etc.) and the level of data analysis (i.e., the degree of data aggregation) must both be congruent with the level of the theory.

Theories and research designs may also span several levels. Multilevel research involves theorizing and measuring phenomena at more than one level. Multilevel theories bridge the divide between micro and macro foci, and recognize the interaction and interdependencies among system levels (Klein, Tosi & Cannella, 1999). The micro focuses on individuals and groups, while the domain of the macro is

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organizations and environment. Multilevel research helps to explain under what conditions micro-level phenomena occur (i.e., the context) to give a contingency-based understanding of interrelationships. However, multilevel research can be difficult and risks becoming "a jumble of moderating and mediating variables and relationships at several levels of analysis" (Klein et al., 1994, p. 244). Proper application of multilevel modeling techniques (see discussion above) helps sort out the complexity and identify the importance of variables at different measurement levels.

This study includes hypotheses at various levels of analysis as well as hypotheses that span levels. Some hypotheses are formulated at an individual level (e.g., H7: The more individuals feel a sense of personal mastery, the greater their degree of employee fulfillment). Other hypotheses are formulated at the work group level (e.g., H9: The more process management practices include quality-related process feedback to organizational members, the more team learning occurs). The data aggregation issues involved in group-level hypotheses testing are discussed in the next section. Still other hypotheses are formulated across levels (e.g., H10b: Perceived environmental uncertainty will moderate the effect between systems thinking and continuous improvement achievement). This last example fits the definition of a cross-level hypothesis wherein "higher-level variables are hypothesized to moderate the relationship of two of more lower-level variables" (Klein et al., 1994, p. 246). Table 5.1 shows the level of analysis associated with each hypothesis in this research.

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Table 5.1
Hypotheses by Level of Analysis

Hypotheses at the Group Level of Analysis

H1: Active and passive management by exception are negatively associated with continuous improvement commitment and teamwork.

H2a,b: (a) Transformational leadership behaviors are positively associated with teamwork, customer focus and continuous improvement commitment. (b) There is a stronger positive relationship between transformational leadership behaviors and teamwork, customer focus and continuous improvement commitment in work groups with leaders at higher management levels than with leaders at lower levels.

H3: Laissez-faire leadership is negatively associated with teamwork, customer focus and continuous improvement commitment.

H4: The more a work group is characterized by quality-supportive principles (teamwork, customer focus and continuous improvement commitment), the more process management practices are characterized by process control mechanisms and process feedback systems.

H9: The more process management practices include quality-related process feedback to organizational members, the more team learning occurs.

H11: The inspirational motivation component of transformational leadership is positively associated with shared vision.

Hypotheses at the Individual Level of Analysis

H6: The more process management practices include process control methods and process feedback to organizational members, the greater employee fulfillment.

H7: The more individuals feel a sense of personal mastery, the greater their degree of employee fulfillment.

H8a,b: (a) The more process feedback is made available to organizational members, the more individuals feel a sense of personal mastery. (b) Individuals with high self-efficacy demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.

H12: The intellectual stimulation component of transformational leadership is positively associated with managing mental models.

Hypotheses at a Cross Level of Analysis

H5a,b: (a) The more process management practices include process control methods and process feedback to organizational members the more frequently continuous improvement is achieved. (b) There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty than under conditions of high perceived environmental uncertainty.

H10a,b: (a) The more systems thinking occurs the more frequently continuous improvement is achieved. (b) There is a stronger positive relationship between systems thinking and continuous improvement achievement under conditions of high perceived environmental uncertainty than under conditions of low perceived environmental uncertainty.

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Aggregation of Responses

Each variable in this study is measured at the individual level through a written survey instrument. Consequently, aside from basic demographic measures, each variable is of a perceptual nature. For hypotheses at the group level, the individual measurements taken within work groups were aggregated to form a group-level measure. The appropriateness of aggregating individual perceptions to form a group-level measure can be justified on both theoretical and statistical grounds. Responses are properly aggregated to form a group measure when the construct under study is a group phenomenon, such as teamwork. One may expect a certain degree of homogeneity within work groups with respect to members' assessments of the level of teamwork. To establish statistically that a measurement construct is valid at the group level, the individual survey responses for that variable must possess homogeneity within groups. Opposing the needed homogeneity within groups is the tendency of individuals to respond to questionnaire items somewhat differently owing to any number of factors. To achieve a degree of homogeneity for measures of a group nature, outliers within groups were deleted prior to data aggregation. Elimination of outliers was important, since outliers have a particularly deleterious impact on canonical correlation (Tabachnick & Fidell, 1996, p. 199). Outliers were identified using Tukey's boxplots (also known as box-and-whisker plots). These plots afford convenient visualization of within-group distributions. Following Tukey's conventions, within-group values more than 1.5 interquartile ranges below the 25th

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percentile or above the 75^{th} percentile were flagged as outliers and eliminated prior to group-level aggregation. This process necessitated visual inspection of over 1,600 boxplots. For each scale at the group level approximately 20 individual responses (out of over 600) were eliminated.

Responses were maintained at the individual level (not aggregated) when the construct under study was a personal phenomenon, such as employee fulfillment. One may expect heterogeneity within work groups with respect to employee fulfillment, since not all members of a work group will feel equally fulfilled. Other examples of variables that were maintained at the individual level are personal mastery and managing mental models. Tables 5.2, 5.3 and 5.4 show the aggregation of survey responses for hypotheses at the group, individual and cross level of analysis.

Measurement Perspectives

The choice of using work group members' or leaders' perspectives for measuring each variable was made on the basis of which type of rater was in the best or most logical position to make the assessment. The measurement of leadership constructs was made by the aggregated perceptions of work group members. This follows from Bass's observation that leaders' self-ratings have a propensity to be contaminated by social desirability bias and tend to "relate poorly or not at all to various dependent variables" (1990, p. 889). In measuring *commitment* to continuous improvement, individual work group members are in the best position to report their

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personal degree of commitment. On the other hand, measuring continuous improvement *achievement* was made on the basis of work group leaders' perceptions, since work group leaders or managers are in a better position to judge achievement of group goals. Tables 5.2, 5.3 and 5.4 show the measurement perspective employed for each variable within each hypothesis.

Table 5.2
Measurement Perspective and Response Aggregation for Individual-Level Hypotheses

	Hypothesis IV indicated by *italics* DV indicated by <u>underline</u>	IV Measurement	DV Measurement
H6	The more process management practices include *process control* methods and *process feedback* to organizational members, the greater <u>employee fulfillment</u>.	Group members' individual perceptions	Group members' individual perceptions
H7	The more individuals feel a sense of *personal mastery*, the greater their degree of <u>employee fulfillment</u>.	Group members' individual perceptions	Group members' individual perceptions
H8a	The more *process feedback* is made available to organizational members, the more individuals feel a sense of <u>personal mastery</u>.	Group members' individual perceptions	Group members' individual perceptions
H12	The *intellectual stimulation* component of transformational leadership is positively associated with <u>managing mental models</u>.	Group members' individual perceptions	Group members' individual perceptions

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Table 5.3
Measurement Perspective and Response Aggregation for Group-Level Hypotheses

	Hypothesis IV indicated by *italics* DV indicated by underline	IV Measurement	DV Measurement
H1	*Active and passive management by exception* are negatively associated with <u>continuous improvement commitment and teamwork</u>.	Group members' aggregated perceptions	Group members' aggregated perceptions
H2a	*Transformational leadership behaviors* are positively associated with <u>teamwork, customer focus and continuous improvement commitment</u>.	Group members' aggregated perceptions	Group members' aggregated perceptions
H3	*Laissez-faire leadership* is negatively associated with <u>teamwork, customer focus and continuous improvement commitment</u>.	Group members' aggregated perceptions	Group members' aggregated perceptions
H4	The more a work group is characterized by *teamwork, customer focus and continuous improvement commitment*, the more process management practices are characterized by <u>process control and process feedback systems</u>.	Group members' aggregated perceptions	Each group leader's perception
H5a	The more process management practices include *process control* methods and *process feedback* to organizational members the more frequently <u>continuous improvement</u> is achieved.	Group members' aggregated perceptions	Each group leader's perception
H9	The more process management practices include quality-related *process feedback* to organizational members, the more <u>team learning</u> occurs.	Group members' aggregated perceptions	Group members' aggregated perceptions

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Table 5.3 (continued)

	Hypothesis IV indicated by *italics* DV indicated by <u>underline</u>	IV Measurement	DV Measurement
H10a	The more *systems thinking* occurs the more frequently <u>continuous improvement</u> is achieved.	Each group leader's perception	Each group leader's perception
H11	The *inspirational motivation* component of transformational leadership is positively associated with <u>shared vision</u>.	Group members' aggregated perceptions	Group members' aggregated perceptions

Table 5.4

Moderator Measurement Perspectives

	Hypothesis with Moderator	Perspective for Moderator Measurement
H2b	There is a stronger positive relationship between transformational leadership behaviors and teamwork, customer focus and continuous improvement commitment in work groups with leaders at higher organizational levels than with leaders at lower levels.	Leader (self-report of title)
H5b	There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty (PEU) than under conditions of high PEU.	Organization's CEO or similar high-level executive
H8b	Individuals with high self-efficacy demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.	Individual
H10b	There is a stronger positive relationship between systems thinking and continuous improvement achievement under conditions of high PEU than under conditions of low PEU.	Organization's CEO or similar high-level executive

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Power Analysis

A power analysis reveals the likelihood that a particular research design will produce statistically significant results. Power level is the proportion of studies that can be expected to detect a statistically significant effect and reject the null hypothesis. Statistical power computations were performed for the linear regression and bivariate correlation testing portions of the study to indicate the needed sample sizes. Power computations were performed using a commercial software package (SPSS Sample Power, Version 1.2). Because this software supports a limited range of research designs, the sample sizes necessary for the canonical regression, confirmatory factor analysis and structural equation modeling portions of the study were estimated using guidelines from the statistical literature.

Separate sets of power analysis computations were performed prior to gathering data. The first set focused on the study's bivariate correlation tests. Bivariate correlations are used to test Hypotheses 9, 11 and 12. Some of these hypotheses are formulated at the individual level, and some are formulated at the work group level. Consequently, the number of individuals studied and the number of work groups studied are both relevant to the power analysis. The second set of power computations concern the study's linear regression testing. Linear regression is used to test Hypotheses 3, 6 and 7. Another set of power computations were performed for the moderated regression testing (i.e., testing interaction effects) associated with Hypotheses 5b, 8b and 10b.

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The focus of each of the proceeding power analyses is two-fold. First, a power computation is performed to determine the minimum sample size *n* required for statistically significant results for a specified power level. A second analysis is done to compute the power level given a specified (expected) sample size. In both cases, certain global assumptions are stated and justified.

Assumptions for Power Analysis

In this research the null hypothesis in the linear regression and bivariate correlation tests is that the correlation in the population is zero. That is, the null hypothesis is that there is no relationship between the independent and dependent variables. Thus the first assumption for power analysis is that the population correlation is zero. Another necessary assumption in power analysis is the level of alpha, which is the probability of Type I error (errantly rejecting the null hypothesis when it is true). The value of alpha chosen for this power analysis is the conventional .05 level. For power analysis computations in which a desired minimum power level is specified, a power of .80 is used. A power of .80 indicates that 80% of studies of a given design could be expected to detect a statistically significant effect. Cohen (1988) offers .80 as a power level that is "reasonable" in the absence of rationale to choose another level.

Another major assumption in power analysis is the expected effect magnitude. In the present context, the effect magnitude is the expected correlation between the independent and dependent variables. It is difficult to estimate the expected

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correlation among variables in the absence of similar prior research. Nevertheless, some estimate must be made. Cohen (1988) provides basic guidelines for what one may consider small, medium and large effect sizes in the context of linear regression. These guidelines are reflected in Table 5.5, below.

Table 5.5
Cohen's Conventions for Social Science Research

Effect characterization	Effect Size
Small	r = .1
Medium	r = .3
Large	r = .5

In choosing an appropriate effect size for power analysis one should be concerned not only with statistical significance but practical significance as well. With an r of .1, the proportion of variance explained is just 1%. This degree of explanation is unlikely to be of much practical value to a manager interested in applying the findings of this research. With an r of .3, the proportion of variance explained is 9%. Many correlations in behavioral science are in the neighborhood of this value (Cohen, 1988). This correlation magnitude may be considered the minimum explanatory power that would be considered meaningful (i.e., important to detect) within the context of the present research. Therefore, this power analysis will be predicated on detecting an effect size as small as .3. The value of *n* yielded by the analysis will be the minimum number of individuals or groups needed to detect this effect size at a specified power level. Conversely, the power level yielded by the

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analysis will be the proportion of studies of a specified sample size that may be expected to detect an effect of this magnitude.

A final assumption needed to conduct a power analysis is a determination of whether to use one-tailed or two-tailed tests. The hypotheses in this study are tested using one-tailed tests since each hypothesis predicts the direction of the theorized relationship. Nevertheless, this power analysis assumes two-tailed tests since any findings that the correlation between variables is opposite to that theorized would be useful information and could indicate a flaw in the theory underlying the hypothesis. It should be noted that two-tailed tests are inherently less powerful than one-tailed tests, all things being equal, so it is more conservative to assume a two-tailed situation for the power computation.

To recap, in this power analysis the global assumptions are:

1. Alpha level = .05
2. Two-tailed tests of significance
3. Null hypothesis of zero correlation in the population
4. A "medium" effect size (e.g., $r = .3$ or $R^2 = .10$)
5. Minimum acceptable power = .80

Power of Bivariate Correlation Testing

Power analysis found that for a medium effect size (tested against a null hypothesis of zero correlation in the population), an alpha of .05 two-tailed, and a minimum acceptable power of .80, the needed sample size for bivariate correlation

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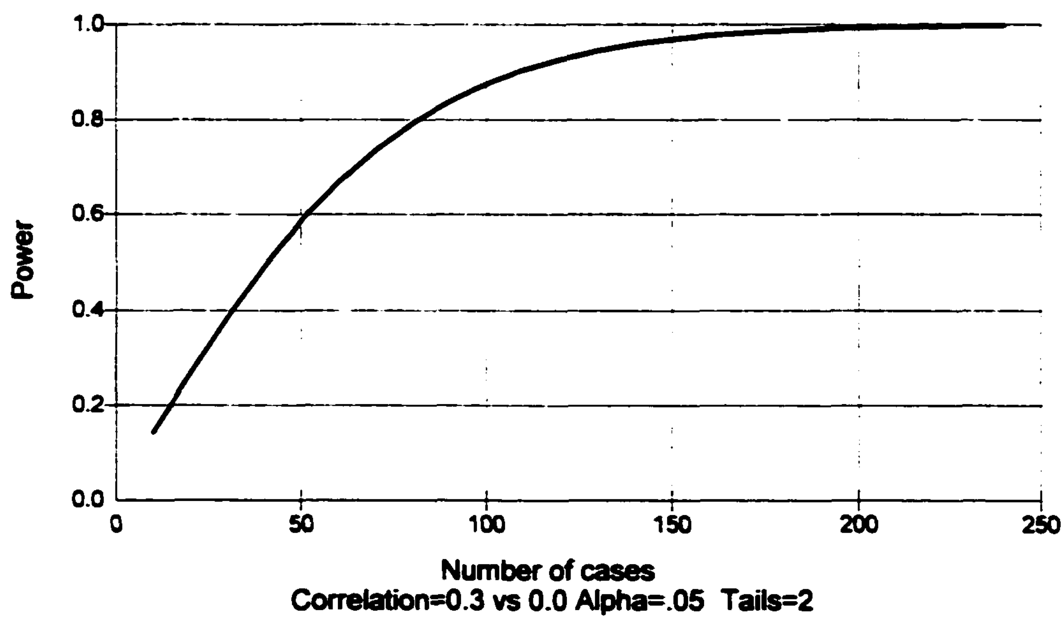
testing is 82. This means that 80% of studies with a sample size of 82 can be expected to detect a statistically significant medium-size effect and reject the hull hypothesis that the correlation between variables is zero. The study's planned sample sizes exceeded the minimum n indicated by power analysis for analysis at both the group level (planned $n \approx 100$) and individual level (planned $n \approx 600$). Alternately, power analysis was run with the planned value of $n = 100$ and power was computed. This found that a sample of 100 work groups yielded a power of .88. For a sample of 600 (i.e., at the individual level of analysis) the power level approaches 1.0, indicating that close to 100% of studies can be expected to detect a statistically significant effect and reject the hull hypothesis that the correlation between variables is zero. The interplay among the various elements of power analysis is graphed below.

Figure 5.2
Power as a Function of Sample Size: One Sample Correlation



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Power of Linear Regression Testing

In performing power analysis for linear regression it is necessary to specify the number of variables in the predictor set (the IVs). Hypothesis 7 involves one predictor variable, H6 includes two predictor variables and H3 includes three predictor variables. For this power analysis, the specified effect size is an R^2 of .10. This effect magnitude was selected as the smallest effect that would be important to detect, in the sense that any smaller effect would not be of substantive significance. Given the global assumptions (stated above) and two predictor variables, a power of .80 can be achieved with a sample size of 90. For three predictor variables, a power of .80 can be achieved with a sample size of 103. In this last case a sample size of 100 falls short for the effect size ($R^2 = .10$) we're trying to detect. However, if we recompute power and specify a sample size of 100 work groups and three predictor variables, we find a power of .84 can be achieved if the R^2 is 0.11. With just two predictor variables, a sample of 100 work groups will provide a power of .84 with an effect size as small as .10. We conclude from the foregoing that the linear regression testing in this research is likely (i.e., the power is at least .80) to detect an effect size (R^2) as low as .11 with a sample of 100. This is most relevant to H3 which is tested at the group level; H6 and H7 are both tested at the individual level were the expected sample size is large.

The interplay among the elements of the power analysis for multiple linear regression may be visualized by plotting sample size versus power. The two graphs below illustrate the relationship for linear regression with an effect size (R^2) of 0.10,

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an alpha of .05, a sample size of 100, no covariates and two predictor variables (Figure 5.3) or three predictor variables (Figure 5.4).

Figure 5.3
Power as a Function of Sample Size: Multiple Regression, Two Predictors

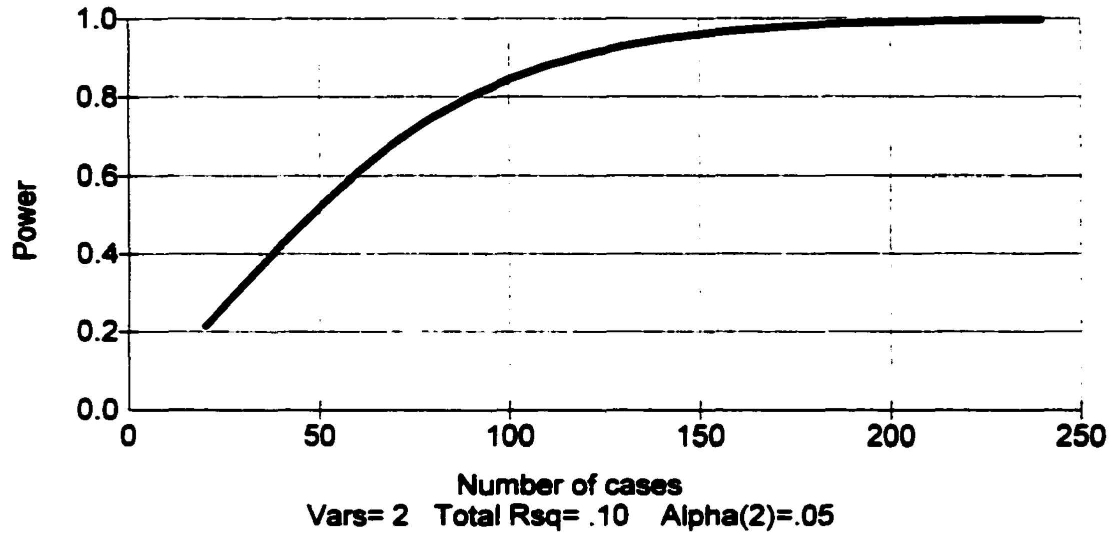
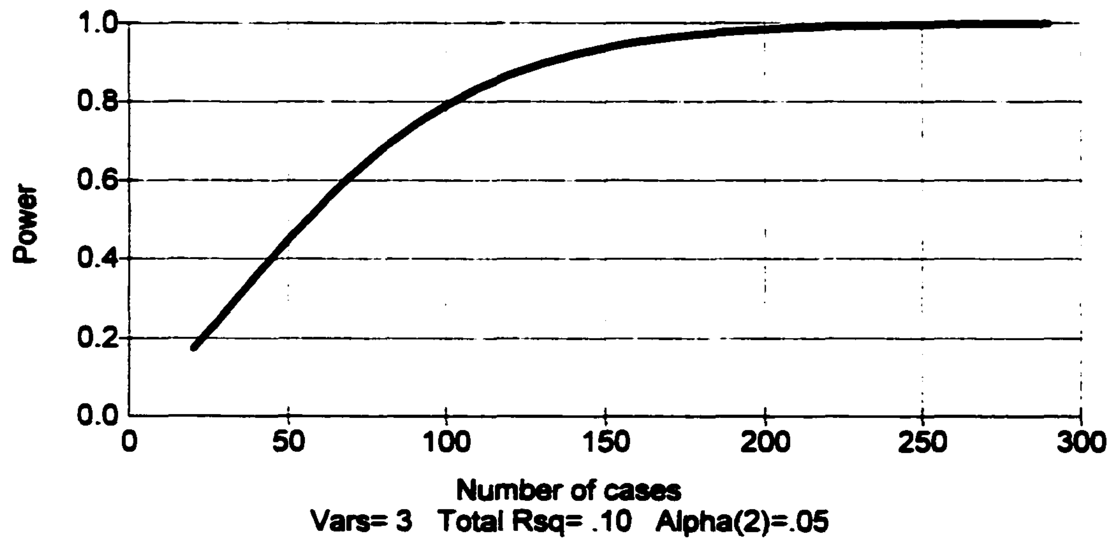


Figure 5.4
Power as a Function of Sample Size: Multiple Regression, Three Predictors



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Power of Linear Regression Testing with Interaction Effects

Four hypotheses in the study include moderating variables. It is important to consider the power aspects of interaction testing since moderated multiple regression testing often suffers from inadequate statistical power (Aguinis & Pierce, 1999). The statistical significance of moderating variables was tested by entering them into regression equations as interaction terms as described by Baron and Kenny (1986). Hypotheses with moderating variables include H2b, H5b, H8b and H10b. Each of these hypotheses is formulated at the group level except H8a and H8b which are formulated at the individual level. Consequently this section presents two power analyses, one for the group-level sample size and one for the individual-level sample size.

Hypothesis 8b is illustrative in evaluating the power of a moderated relationship at the individual level of analysis. Hypothesis 8b states:

> Individuals with high self-efficacy demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.

The power analysis for this hypothesis assumes the presence of covariates to evaluate their possible affect on power. Some demographic variables may have a relationship with sense of personal mastery or self-efficacy so it is reasonable to consider them as possible covariates. The power analysis for this model assumes a sample size of 700 individuals and arbitrarily assumes two covariates. Power is computed for each set of

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variables: the covariates (demographic variables), the principle independent variable (feedback), and the interaction term (feedback X self-efficacy). We observe that if the increment to R^2 from the interaction term is .01, the power for the increment is just .71. But if the increment to R^2 from the interaction term increases to .02, the power for the increment jumps to .96. The same effect on power holds for the covariates' increment to R^2. All other things being equal, as the number of covariates increases, power decreases. On the other hand, as the increment to R^2 for the covariate set increases, power for the main variable set increases. We conclude that the effect size (R^2) of the interaction needs to be at least .02 to be reliably detectable with a sample size of 700. The same is true for the effect size of any 2-variable covariate set used. This is a very small effect magnitude, so we conclude that the expected sample size will be satisfactory to investigate the moderated relationship hypothesized in H8b.

Hypothesis 5b is illustrative in evaluating the power of a moderated relationship at the group level of analysis. Hypothesis 5b states:

> There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty than under conditions of high perceived environmental uncertainty.

The power analysis for this hypothesis assumes no covariates and a sample size of 100 work groups. Power is computed for each set of variables in the regression model: the two independent variables (control methods and feedback), and one interaction term

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(environmental uncertainty X control methods). The power for the set of IVs is .86 at a medium effect size (R^2) of .10, which is satisfactory. However, we observe that the increment to R^2 from the interaction term must be at least .09 for power to exceed .80. If the interaction term's R^2 is only .05, power is just .55. We conclude that the effect size (R^2) of the interaction needs to be at least .09 to be reliably detectable with a sample size of 100 work groups.

Power for Confirmatory Factor Analysis

A confirmatory factor analysis is used to verify the expected factor structure of the MLQ leadership survey instrument. Tabachnick and Fidell (1996) suggest a minimum of 300 cases for successful factor analysis. The planned sample size of over 600 organizational members easily met this requirement.

Power for Structural Equation Modeling

A variety of suggestions has been offered on the minimum sample size needed for structural equation modeling (Schumacker & Lomax, 1996, p. 20). Between 5 and 10 cases per variable has been recommended depending on parametric assumptions. This ratio was easily achieved for models constructed at the individual level of analysis where the sample size exceeded 600. In contrast, at the level of the work group ($n \approx 100$) the ratio of cases to variables is much less favorable.

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Power for Canonical Correlation Testing

Canonical correlations are used in this research to test, for example, the multivariate relationships between leadership behaviors and various quality-focused measures. A 10:1 ratio of cases to IVs is recommended for canonical correlations depending on the reliability of the scales (Tabachnick & Fidell, 1996, p. 198). Hypotheses H1, H2 and H4 consist of two, five and three independent variables, respectively. With five IVs (i.e., the five scales of transformational leadership behaviors from the MLQ) and assuming observed reliabilities of around .80, 50 cases are required using this rule, so the planned sample size of 100 work groups was judged adequate for canonical correlation testing.

Mechanics and Logistics of the Research

This section describes the procedures used to gather data, including obtaining university approval for the study, compiling the sample, soliciting participation from organizations, selecting and eliciting the cooperation of group leaders within participating organizations, administering the survey and entering data.

Step 1: University Approval

University sanctioning for the field work was obtained prior to contacting potential research participants. Approval was obtained via the university's established approval process for the use of human subjects according to the Human Subjects

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Research Review Committee (HSRRC) policies and guidelines of Portland State University.

Step 2: Compile Sample

The sample universe for this research included the approximately two hundred organizations in Oregon with a quality system certified to ISO 9000 standards, plus the thirty-six organizations which have received an Oregon Quality Award. A list of organizations in Oregon with quality systems certified to the ISO 9000 standard was obtained from a web-based database maintained by the publishers of *Quality Digest* magazine. The list of Oregon Quality Award recipients was obtained from the Oregon Partnership for Excellence, the organization that manages the Baldrige-based award process. A random selection process was used to draw names from each list of organizations. A roughly equal number of organizations of each type were pursued.

Step 3: Solicit Participation

Once the sample of organizations was compiled, telephone calls were made to randomly selected organizations to identify an appropriate contact individual within each organization. The contact person sought was the most senior individual within the organization responsible for quality management. Exemplary titles included vice president of quality, quality manager, ISO 9000 program director, etc. An introductory letter was then sent to each identified individual outlining the research in broad terms. A sample solicitation letter is shown in Appendix D. The letter indicates that the

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recipient could expect a telephone call from the principle researcher to find out if the organization would be willing to participate in the research.

Step 4: Elicit Cooperation

A follow-up telephone call was placed to the organization's contact person about one week after the solicitation letter was mailed. During the phone call the contact person was asked to meet with the researcher for fifteen minutes. It was explained that the purpose of the meeting was to review the contents of the letter, answer any questions, and find out if the organization would be willing to participate in the study. Only infrequently did the contact person reject the offer of a meeting and decline participation at that point. Generally a date for the meeting was set, and this meeting usually occurred in the contact person's office.

During the meeting, and after a review of the letter and an overview of the research, the contact person often stated that they needed to confer with other managers or officials in their organization before a final answer on participation could be given. Follow-up calls were then planned and later placed. If the answer was positive, a second on-site meeting was scheduled to select participants (group leaders and their subordinates) within the organization. The foregoing process was repeated until the necessary number of participating organizations was obtained.

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Step 5: Selection of Individual Participants

Specific individuals with supervisory responsibilities (work group leaders) were identified during the second meeting with the contact person. This meeting often included a member of the organization's human resources department. In small organizations (those with eight or fewer supervisors) all supervisors with three or more direct reports were selected for the study. Selection here meant that the supervisor would be asked to complete a survey, and be asked for their permission to distribute a survey to their direct subordinates. In large organizations (those with more than eight supervisors) the identification of supervisors was accomplished using a random selection process. The contact person would usually communicate with the identified supervisors to request their participation, although sometimes the researcher was asked to do this during an additional on-site meeting.

In cases in which a supervisor had more then ten direct reports, a random selection process was offered to reduce the number of subordinates who would be surveyed. This was done to minimize the inconvenience to the participating work group. Occasionally supervisors who had more than ten direct reports actively requested that all of their subordinates be included in the survey. These supervisors explained that they wished to give the impression to their group that the opinion of all of their subordinates was valuable and desired. This request was accommodated whenever made.

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Once an organization's participants were identified and all necessary parties had agreed to the process, a date (or sometimes multiple dates) was (were) selected for administering the survey.

Step 6: Survey Administration

Surveys were administered in one of two ways. In three organizations, surveys for each work group were assembled together into a survey packet containing blank survey forms, instructions and No. 2 pencils. These survey packets were delivered to the internal coordinator within the organization who subsequently distributed the forms and stamped return envelopes to participating group members. Because analysis of the data requires matching the responses from individual group members to those of their respective leaders, all survey forms were coded (in a footer on the survey form) with a designation reflecting the identity of the organization and the work group within the organization. For example, the footer "Survey Form 12.3" meant that the survey was distributed to organization number 12, work group number 3. Completed survey forms were then either mailed back to the researcher using the provided envelopes or picked up in person.

For most organizations, however, survey administration was conducted in-person by the researcher. This assured that all study protocols were strictly adhered to. Participating leaders in the organization were called together in a group setting at a prearranged date and time along with their direct reports (subordinates). The physical setting was frequently the organization's cafeteria or other large meeting room. Often

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this meeting was accompanied by a lunch hosted by the researcher. The purpose of the survey was explained to the assembled individuals along with instructions for completing the survey forms. Individuals were told that the survey was voluntary and that they could turn in a blank survey if they did not wish to participate. Surveys were then systematically handed out by the researcher. A common collection envelope was provided to gather the completed survey forms. Occasionally some organizational members were not present at the meeting due to travel, illness, etc. A survey form and stamped return envelope were left for those individuals.

Step 7: Data Entry

Completed survey forms were scanned into an SPSS data file using optical scanning equipment and form scanning software (Remark Version 5.5 from Principia Products, Inc.). This method was chosen for its efficiency and to minimize data entry errors.

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Chapter 6: Measurement Scales

Overview

The constructs in this study were operationalized for measurement via various survey-based test instruments. Measurement scales were drawn from the work of a variety of researchers: Bass and Avolio (1997), Dickson and Weaver (1997), Flynn, Schroeder and Sakakibara (1994), Frenkel, Korczynski, Shire and Tam (1999), Ganzach (1998), Miller (1967), Morrow (1997), Tetrick et al. (2000), and Truxillo, Bauer and Sanchez (2001). This section reviews the validity, reliability and psychometric properties of each of the measurement scales used in this research.

Leadership Measures

Most experimental research on leadership prior to 1978 focused on transactional leadership (Bass, 1990). More recently, however, considerable empirical work on transformational leadership has been conducted. Bass (1985) proposed that transformational leadership consists of several non-orthogonal factors, including idealized influence, inspirational motivation, intellectual stimulation and individualized consideration. To facilitate research on transformational leadership, Bass (1985) developed and refined a questionnaire to measure the dimensions of transformational leadership based on factor analysis of his research. Bass's survey instrument was dubbed the Multifactor Leadership Questionnaire (MLQ) to reflect the author's view of leadership as a multidimensional construct consisting of three higher

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order constructs (transactional, transformational and laissez-faire leadership) and multiple lower order constructs (Figure 6.1).

Figure 6.1
The Multifactor Leadership Model (Factor Structure of MLQ-5X Revised)

Transformational Leadership
- Idealized Influence (Attributed)
- Idealized Influence (Behavior)
- Inspirational Motivation

} Charismatic behaviors

- Intellectual Stimulation
- Individualized Consideration

Transactional Leadership
- Contingent Reward
- Management-by-Exception (Active)
- Management-by-Exception (Passive)

Laissez-faire Leadership

Outcomes of Leadership
- Extra Effort by Associates
- Individual and Group Effectiveness
- Satisfaction with the Leader

} Not used in this research

Bass and Avolio (1997) have refined the MLQ over the past fifteen years. The publisher of the MLQ offers several versions of the instrument:

1) MLQ-5X Revised (45 items). This form is used to rate a focal leader. The instrument yields nine leadership factors using four items per leadership dimension, and yields three scales of leadership outcomes from nine items.
2) MLQ-5X Revised (63 items). This form adds two additional test items per leadership dimension. The authors recommend this form for training and coaching purposes, while the shorter form is recommended for research purposes (Bass & Avolio, 1997).

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The present research uses the shorter form of the MLQ survey instrument based on the recommendation by Bass and Avolio (1997) that the shorter form is more suitable for research purposes, while the longer form is preferred for training and development. The MLQ items measuring leadership outcomes (satisfaction with leadership, extra effort and effectiveness) were not used since this research focuses on quality-related outcome variables (e.g., continuous improvement achievement). The major scales and subscales of Bass's Multifactor Leadership Model are reflected in Figure 6.1. The questionnaire items associated with each scale appear in Table 4.2.

The Multifactor Leadership Questionnaire (MLQ) has been employed in many research investigations since it was first introduced in 1985 and is widely used (Den Hartog, Van Muijen & Koopman, 1997). It has been successfully used to research the connection between leadership behaviors and organizational outcomes. A meta-analysis of leadership research using the MLQ found that its transformational leadership measures were reliable and positively predicted work unit performance across studies (Lowe, Galen & Sivasubramaniam, 1996). However, the number of distinguishable factors comprising the transformational leadership dimension has varied across studies and various studies have employed different forms (revisions) of the MLQ instrument (Avolio, Bass & Jung, 1999; Bass & Avolio, 1997; Bycio, Hackett & Allen, 1995; Den Hartog et al., 1997; Tepper & Percy, 1994).

The MLQ has been revised by Bass to address the various criticisms raised. The current revision of the focal leader-focused instrument is referred to as Form 5X

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Revised; this form reflects the nine-factor leadership model shown in Figure 6.1. This revision of the MLQ was tested (Bass & Avolio, 1997) using a nine sample validation set (*N* ranged from 45 to 457) and a five sample independent cross-validation set (*N* ranged from 189 to 549). The sample populations were drawn from a variety of U.S. organizations, including business firms, public agencies, not-for-profit organizations and public sector organizations. Construct validity, reliability and factor structure were examined. Confirmatory factor analysis (using LISREL VII) for the nine-factor model yielded a Goodness of Fit Index of .91, exceeding the .90 threshold recommended by Bentler (1990) and Bollen (1989) [cited by Bass]. In addition, a Root Mean Square Residual (RMSR) of .04 was attained, satisfying the .05 threshold suggested by Jöreskog and Sorbom (1989). These fit indices, as well as others used by Bass, were better for the nine-factor structure than for one, two, three, and five-factor alternative models. Table 6.1 summarizes the descriptive statistics of the instrument. The MLQ items are rated on a five-point scale: (5) frequently, if not always, (4) fairly often, (3) sometimes, (2) once in a while, and (1) not at all.

Prior research with the MLQ has shown some of its scales to be highly correlated (Bass & Avolio, 1997; Bycio et al., 1995; Den Hartog et al., 1997). This is to be expected, since (as discussed above) Bass (1985) sees leadership as a combination of transactional and transformational behaviors exhibited in varying frequencies. Table 6.2 shows the intercorrelations among MLQ factor scores reported by Bass and Avolio (1997). The first five factors in the table belong to the higher

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Table 6.1
Descriptive Statistics of the MLQ Form 5X Revised

Factor	Mean	*SD*	Reliability	SEM
Idealized Influence (Attributed)	2.56	.84	.90	.37
Idealized Influence (Behavior)	2.64	.85	.91	.39
Inspirational Motivation	2.64	.87	.94	.42
Intellectual Stimulation	2.51	.86	.93	.37
Individualized Consideration	2.66	.93	.93	.26
Contingent Reward	2.20	.89	.91	.33
Management-by-Exception (Active)	1.75	.77	.81	.48
Management-by-Exception (Passive)	1.11	.82	.87	.42
Laissez-Faire	0.89	.74	.88	.41

Note. Reliability is Spearman-Brown's estimated reliability formula. SEM is standard error of measurement. Source: Bass and Avolio (1997, p. 53).

Table 6.2
Intercorrelations Among MLQ Factor Scores

Factor	1	2	3	4	5	6	7	8
1. Idealized Influence (Attributed)								
2. Idealized Influence (Behavior)	.79							
3. Inspirational Motivation	.85	.86						
4. Intellectual Stimulation	.76	.84	.85					
5. Individualized Consideration	.82	.82	.87	.84				
6. Contingent Reward	.68	.69	.73	.70	.75			
7. Management-by-Exception (Active)	-.12	-.03	-.10	-.08	-.12	.03		
8. Management-by-Exception (Passive)	-.54	-.54	-.55	-.52	-.54	-.34	.28	
9. Laissez-Faire	-.53	-.54	-.51	-.47	-.49	-.29	.18	.74

Note. Correlations shown are from the authors' validation sample (N=1,394). Correlations from a cross-validation set (N=1,490) were similar. Source: Bass and Avolio (1997, pp. 64-65).

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order factor of transformational leadership. The sixth, seventh and eighth factors belong to the higher order factor of transactional leadership.

Quality-Focused Measures

The quality-focused variables in this research include Morrow's (1997) measures of quality principles, Flynn, Schroeder and Sakakibara's (1994) measures of process management practices, Frenkel, Korczynski, Shire and Tam's (1999) measure of continuous improvement achievement, and an employee fulfillment measure derived from Miller (1967) and Ganzach (1998). This section reviews the origin, properties, validity and reliability of each of these measures.

Quality-Supportive Principles

Dean and Bowen (1994) examined the quality management literature and concluded that three core principles are present throughout the various approaches to quality management. These principles are teamwork, continuous improvement and customer focus. Morrow's (1997) questionnaire operationalizes Dean and Bowen's fundamental quality principles. Morrow used Dean and Bowen's framework to construct a survey instrument to assess to what degree quality management's fundamental principles have become part of an organization's culture. Morrow's 12-item questionnaire contains four questions for each scale measuring Dean and Bowen's three quality management principles.

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Morrow's (1997) research focused on the relationship between the three quality management principles and job satisfaction, communication and perceptions of the work environment. Morrow's questionnaire was tested on 2,249 employees of a large public sector Midwestern transportation agency. Morrow evaluated the adequacy of his measures in terms of their descriptive statistics, factor structure, reliability and intercorrelation. Morrow's sample yielded the full response range of 1 (*strongly disagree*) to 5 (*strongly agree*) for each question. Means were near the center of each scale (2.59 to 3.36) and standard deviations ranged from .68 to .87.

To confirm the dimensionality of the three quality management measures, Morrow (1997) employed principal axis factoring with oblique rotation. Oblique rotation recognizes that some degree of factor intercorrelation is expected. Morrow's analysis yielded a simple factor structure (i.e., no multiple loadings). The three factors together accounted for 58.2% of the observed variance. Intercorrelations among Morrow's three scales ranged from .45 to .57. Morrow comments that the measures for the three quality-focused measures "are distinct but as Dean and Bowen (1994, p. 396) suggest, 'mutually reinforcing' and likely sharing common antecedents. Taken together, these results suggest that three distinct and reliable measures of TQM were formulated" (Morrow, 1997, p. 371).

The reliability of each of Morrow's (1997) scales (using Cronbach's alpha) was .69 for customer focus, .74 for continuous improvement, and .81 for teamwork. While the latter two measures exceed the conventional .70 standard for acceptable

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reliability (Nunnally, 1978, p. 245), Morrow's measure for customer focus falls short by .01. In contrast, Gatewood and Riordan's (1997) customer focus scale yielded a Cronbach's alpha of .79 on a sample size of 281 Canadian life insurance company employees. The present research combines two of the items from Gatewood and Riordan's customer focus scale with Morrow's customer focus scale in order to improve internal consistency reliability. Table 4.3 reflects Morrow's questionnaire items including the additional two items from Gatewood and Riordan (questions 5 and 6 of the customer focus scale). The two items borrowed from Gatewood and Riordan were slightly reworded for consistency with Morrow's terminology. The items from Morrow's original scale cover the domain of customer focus with respect to knowledge of who the customer is, frequency of communication with the customer, receipt of feedback from the customer and maintaining close contact with the customer. The two borrowed items from Gatewood and Riordan broaden the customer focus scale's domain coverage by adding one item for responsiveness to the customer and one item for commitment to customer satisfaction; these two additional items should also improve the content validity of the scale. Gatewood and Riordan's other two items were not used. One of these items, "This company expects employees to provide the same level of customer service to fellow employees as it does to external customers" was not used since some organizations might emphasize the primacy of satisfying external customers (i.e., paying customers) over satisfying one's fellow employees (i.e., internal customers). The other item from Gatewood and Riordan that

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was not used was "It is clear in our day-to-day work that the customer comes first." This was rejected on the basis that the expression "the customer comes first" has become a cliché at this point.

As discussed previously, the hypotheses in the present research draw a distinction between *commitment* to continuous improvement and the *achievement* of continuous improvement. An inspection of Morrow's (1997) 4-item scale for continuous improvement indicates that it is focused on *commitment* to continuous improvement rather than its actual achievement. An example of Morrow's survey items for continuous improvement is "I am committed to continuous improvement in my work." Therefore Morrow's continuous improvement scale is appropriate for placement in the block of the test model (Figure 4.2) labeled Quality-Supportive Principles, while a different scale is necessary to measure continuous improvement achievement in the model's Process Outcomes block.

Neither Morrow (1997) nor Gatewood and Riordan (1997) reported any subsequent analysis to cross-validate the validity and reliability of their measures with a hold-out sample or with another independent sample. The present research helps to serve this purpose.

Process Management Practices

The test model's (Figure 4.2) process management construct is operationalized using two (modified) scales from Flynn et al.'s (1994) eleven measures of quality management, specifically their process control scale and their feedback scale. The

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process control scale measures the extent to which statistical process control techniques are used in the organization and the use of what the Japanese call *poka-yoka* (or error-proofing) work methods. The feedback scale measures the extent to which quality-related information is freely shared within an organization and the extent of superior-subordinate feedback on work quality.

Flynn et al. (1994) pre-tested their instrument at 12 plants and ultimately assessed their scales for reliability and validity on a sample of 716 employees of 42 U.S. plants in the transportation parts, electronics and machinery industries. The plants were selected randomly from industry directories. Responses to the survey questions were scored on a scale from 1 to 5, with 1 indicating strong agreement with the statement and 5 indicating strong disagreement. The means, standard deviations and reliability coefficients obtained by Flynn et al. are shown below in Table 6.3.

Table 6.3
Descriptive Statistics of Flynn et al.'s Process Management Practices

Factor	Mean	*SD*	Reliability
Process Control	3.12	.87	.85
Feedback	2.68	.44	.76

Note. Reliability is Cronbach's alpha. Source: Flynn et al. (1994, p. 357).

Content validity of the scales was established by the authors' review of the quality literature and by interviews of subject matter experts during the pre-test phase of the instrument's development. Construct validity was established by a principle

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components factor analysis. Their analysis found that individual test items loaded strongly only on the factor that the items were intended to measure. Criterion-related validity was established by a correlation analysis with respect to two criterion variables, namely the percent of items shipped without rework and the perceived degree to which the plant's quality program contributed to its distinctive competence.

Some modifications were made to the two scales drawn from Flynn et al. (1994) to align them with the level of analysis of the present research and to improve content validity (Table 4.3, Process Management Practices). Recognizing the importance of level of analysis, wording changes were made to shift the focus from the plant level to the work group level. For example, the original question "Processes in our plant are designed to be fool proof" was changed to "Processes in our work group are designed to be fool proof." Original wording that referred to charts being "posted on the shop floor" as an indication of the availability of information was changed to accommodate other modes of information dissemination. One question was added to the process control scale in an effort to improve content validity: "We make extensive use of written procedures and/or work instructions in our work group." Two items that were negatively worded were changed to positively worded items.

Process Outcomes

The Process Outcomes block of the conceptual model (Figure 4.3) contains two outcomes: continuous improvement achievement and employee fulfillment. The

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former outcome is measured at the group level, while the latter is measured as an individual-level phenomenon.

Continuous Improvement Achievement

Continuous improvement is conceptualized with respect to its *achievement* within the Process Outcomes block of the model (as opposed to *commitment* to continuous improvement in the Quality-Supportive Principles block of the model). A literature search found the scale used by Marler (1998) to be closest to the needs of the present research for a measure of continuous improvement achievement. In developing this scale, Marler studied the effect of training, flexible work and flexible technology on continuous improvement in an accounting division of a private university. Subjects ($N = 162$) were divided into treatment and control groups using a quasi-experimental design. Continuous improvement was measured on a seven-point Likert-like scale with 1 defined as *always* and 7 defined as *never*. The means obtained ranged from 4.97 to 5.24 (varying across subject groups) with standard deviations from .69 to 1.01. Marler reported a Cronbach's alpha for his scale of .78, indicating acceptable internal consistency reliability (Nunnally, 1978).

As hypothesized, Marler (1998) found that employee training in quality management techniques, use of flexible technology and job autonomy and variety were all positively associated with continuous improvement. Based on the way this measure related to the other variables within Marler's system of theoretical

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relationships one may reasonably conclude that the continuous improvement scale demonstrates construct validity.

Nevertheless, an inspection of the items in Marler's (1998) scale suggests some degree of ambiguity between *commitment to* and *achievement of* continuous improvement. Marler's original 3-item scale contains the following questions:

In your work, how often do you:

(1) Try out new ways to solve problems?

(2) Come up with new ideas and ways of doing things?

(3) Deal with non-routine or unique problems?

The question "How often do you try out new ways to solve problems" could be answered as "very often" even if such attempts are rarely successful. Consequently, Marler's scale was modified to make a stronger connection to the achievement aspect of continuous improvement. The modifications included changes to item wording and the addition of three new items to better focus the scale on achievement. In addition, because the hypotheses in the present research conceptualize continuous improvement achievement as an outcome achieved by a group, team or department, not by an individual organizational actor, the question stem was changed to shift the focus to the group level. The modified scale is as follows:

In your work group, how often do you and your coworkers:

(1) Implement successful new ways to solve problems?

(2) Find better ways to do the work?

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(3) Put new ways of accomplishing goals into practice?

(4) Successfully deal with non-routine or unique problems?

(5) Improve the quality of the work?

(6) Improve results by doing things in a new way?

Employee Fulfillment

The quality management model developed by Anderson et al. (1994) conceptualizes employee fulfillment as "job satisfaction, job commitment, and pride of workmanship" (1994, p. 480). Survey items from two different measurement scales were combined to achieve the content validity necessary to encompass Anderson et al.'s concept of employee fulfillment. Scales developed by Miller (1967) and Ganzach (1998) were used for this purpose.

Miller (1967) developed a 5-item measure of work alienation by combining two items from Morse's (1953) scale of intrinsic pride in work with three new items. The resulting 5-item scale was designed to measure the extent to which an organizational member lacks pride in his or her work, harbors feelings of estrangement from work, and works for extrinsic rather than intrinsic rewards (Bearden & Netemeyer, 1999). Michaels, Cron, Dubinsky and Joachimsthaler (1988) used Cronbach's alpha to assess the reliability of Miller's (1967) scale and obtained reliability estimates of .80 for their sample of 215 salespersons and .75 for their sample of 330 industrial buyers. These alpha figures indicate adequate internal consistency reliability (Nunnally, 1978).

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It is proposed that a reversal in the interpretation of this scale, when combined with one additional item from Ganzach (1998) yields a valid measure of employee fulfillment. Justification for claiming that work alienation and employee fulfillment are converse concepts may be made on both theoretical and empirical grounds. Michaels et al. (1988) cite Kanungo (1982) in defining work alienation as "a generalized cognitive state of psychological separation from work resulting from the perception that work itself is unable to satisfy salient personal needs and expectations" (p. 378). Conversely, one might define employee fulfillment using the opposite terms: the perception that one's work is able to satisfy salient personal needs and expectations. Empirically, one would expect employee fulfillment to be positively related to organizational commitment, and negatively related to role ambiguity and role conflict. Research has found work alienation to be negatively related to organizational commitment (Morrow, 1983; Rabinowitz & Hall, 1981; both cited by Michaels et al., 1988), and Michaels et al.'s study of sales people and industrial buyers found work alienation to be negatively related to role ambiguity and role conflict. These research findings lend support to the use of Miller's scale in the present research.

For this study, Miller's (1967) reverse-scored items were not reverse-scored. This was done because research has shown that inclusion of reverse-scored items in a scale may reduce validity and introduce systematic error (Hinkin, 1995; McLaughlin, 1999). With no reverse-scoring and only positive item wording, higher scores in this scale indicate higher levels of employee fulfillment.

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An aspect of employee fulfillment missing from (the converse of) Miller's (1967) scale is an item to tap job satisfaction. According to Ganzach (1998), job satisfaction can be adequately measured with a single item. Ganzach stated:

> Although reliance on a single-item measure is often questionable, in the case of job satisfaction, the construct validity of a single-item measure may be higher than that of a multiple-item measure (Scarpello & Campbell, 1983), and no serious loss in reliability is likely to occur (Wanous & Reichers, 1996; Wanous, Reichers, & Hudy, 1997).

The test item that Ganzach (1998) used in his study of intelligence and job satisfaction was simply "How much do you like your job?" For the present research, this single item was reworded to "I like my job very much" and combined with the five items and scoring convention used by Miller (1967). Coupled with Ganzach's single item, a 6-item scale is formed to measure employee fulfillment. The final form of the modified, combined scale is shown below, measured on a 7-point scale from *strongly disagree* to *strongly agree*.

(1) I really feel a sense of pride or accomplishment as a result of the type of work that I do.

(2) My work gives me a feeling of pride in having done the job well.

(3) I very much like the type of work that I am doing.

(4) My job gives me a chance to do the things that I do best.

(5) My work is my most rewarding experience.

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(6) I like my job very much.

Learning Organization Measures

The literature on organizational learning contains few empirical assessments (Easterby-Smith & Araujo, 1999). One reason may be the lack of reliable, validated instruments (Tetrick et al., 2000). To address this vacuum, Tetrick et al. developed a survey instrument to assess Peter Senge's (1990) five learning disciplines and performed a preliminary validation study. Tetrick et al.'s work makes it possible to pursue empirical investigations of organizational learning as conceptualized by Senge. It should be noted, however, that Senge has questioned the appropriateness of using a survey instrument to measure organizational learning. As Senge stated in a recent interview:

> You don't want to go out and develop survey instruments and measurement instruments and ask, Are we a learning organization? That's like asking, Am I a human being?...The learning organization, technically speaking, has always been simply a vision ... Its purpose is not to exist as an idea – its purpose is to be generative in the world. (Senge, quoted by Fulmer & Keys, 1998, p.35).

Perhaps part of Senge's worry about measuring organizational learning stems from a concern that it represents thinking about parts rather than thinking about wholes. As H. Thomas Johnson has written in Senge's newest book, *The Dance of*

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Change, "The practice of measurement leads, over time, to reductionist thinking and then to mechanistic activity ... measurement becomes a tool for fragmenting our understanding" (1999, pp. 295-297). While respecting Senge's concerns, Tetrick et al. (2000) suggest that it would nevertheless be useful for organizations and researchers to have a way to measure organizational learning phenomena so that one may assess how the disciplines of the learning organization affect organizational outcomes.

Scale Development

To assure adequate content validity of the instrument (the degree to which a measure covers the range of meanings included within the concept or a representative sample of the behavior being assessed), potential survey items were gleaned by Tetrick et al. (2000) from a review of the organizational learning literature. This yielded 108 possible items related to Senge's (1990) five learning disciplines. A pilot test of the instrument ($N = 97$ students) and exploratory factor analysis reduced the number of items to 75. Based on subsequent analysis, the final number of items recommended by Tetrick et al. was 48. Tetrick et al.'s items appear in Appendix A1.

A primary goal in developing Tetrick et al.'s (2000) instrument was to reflect the five dimensions (or learning disciplines as Senge calls them) of organizational learning. To this end, Tetrick et al. assessed the dimensionality of their instrument using a sample of 362 employees of a large government agency. A confirmatory factor analyses on the government employee data ($N = 343$ complete cases) was conducted to determine if the revised 75-item instrument reflected dimensions

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corresponding to Senge's five disciplines. A series of one-factor models (one for each of the five disciplines) was used to check for unidimensionality of each scale. One-factor structures adequately fit the covariance matrix of the items for three of the disciplines (systems thinking, shared vision, and team learning) but not for mental models and personal mastery. Exploratory factor analyses on the mental models and personal mastery scales lead the researchers to establish scales with sub-dimensions for these learning disciplines. Personal mastery emerged as a three-factor solution: personal mastery - general, personal mastery - in job, and personal mastery - through taking classes. Managing mental models was split into mental models-agency and mental models-individual. In mental models-agency, the referents are people in the government agency, while mental models-individual focuses on the attributes of the individual respondent. A confirmatory factor analysis on the full 8-factor measurement model (systems thinking, shared vision, team learning, mental models-agency, mental models-individual, personal mastery-general, personal mastery-job, personal mastery-classes) showed an acceptable fit with the data: $\chi 2$ (224) = 530.60; RMSEA = .06; NFI = .89; NNFI = .91; PNFI = .72, and all factor loadings were reported as significant (*t* values above 2.0).

Reliability of the scales was assessed by Tetrick et al. (2000) using Cronbach's alpha. The alphas for systems thinking, shared vision, team learning, personal mastery-general, and personal mastery-classes were all above .75, but those for managing mental models-agency, mental models-individual and personal mastery-job

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were low (α = .62 to .63). This issue is addressed below in proposed modifications to the original scales. The reliability coefficients for each scale, as well as their means and standard deviations, are reproduced in Table 6.4 below.

Table 6.4
Descriptive Statistics and Bivariate Correlations of Tetrick et al.'s (2000) Organizational Learning Instrument

	Scale	Items	Mean	*SD*	1	2	3	4	5	6	7	8
1	Systems Thinking	7	2.93	.60	**.88**							
2	Shared Vision	7	3.17	.71	.82	**.86**						
3	Team Learning	13	3.34	.94	.49	.47	**.94**					
	Mental Models											
4	Agency	5	2.75	.70	.61	.52	.38	**.63**				
5	Individual	3	3.83	.92	.31	.28	.37	.37	**.62**			
	Personal Mastery											
6	General	8	4.30	.55	.12	.16	.10	.05	.07	**.82**		
7	Job	5	4.07	.65	.24	.30	.32	.13	.07	.48	**.62**	
8	Classes	3	4.05	.88	.05	.13	.14	-.02	.11	.61	.44	**.75**

Note. a. Items were scored using a 5-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).
b. Coefficient alphas are presented in **bold** on the diagonal.
c. Correlations of .13 or above are significant at the $p < .01$ level.
d. Correlations of .10 or above are significant at the $p < .05$ level.
e. The Items column of the table reflects the number of survey questions associated with the Scale; Tetrick et al. recommend a reduced number of items and elimination of the Personal Mastery – classes sub-scale in future administrations of the survey.

Tetrick et al. (2000) also assessed their survey instrument for construct validity. Construct validity is based on the way a measure relates to other variables within a system of theoretical relationships. Both types of construct validity were

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assessed: convergent and divergent. Convergent validity exists when there is strong correlation (positive or negative) with what a measure should strongly correlate with, while divergent or discriminant validity exists when there is little or no correlation to what the measure should not relate to. To assess the validity of the survey, Tetrick et al. hypothesized numerous relationships between specific learning disciplines and other organizational phenomena, such as sense of community, intragroup conflict, problem solving styles, learning goal orientation and group innovation. Analysis of the pattern of relationships among the organizational learning scales and the other organizational measures lead Tetrick et al. to conclude that the data generally supported both the convergent and discriminant validity of the instrument, even though a few of the hypothesized relationships were in the opposite direction hypothesized and some constructs that were not hypothesized to have a relationship showed some statistically significant correlations, although the magnitudes were generally weak.

Item Reduction and Subscale Selection

Because of the large number of questions in Tetrick et al.'s (2000) instrument it was necessary to reduce the number of items for the present research for practical reasons. One way to reduce the number of items is to eliminate those which have the weakest connection with the construct in terms of content validity. The fidelity of this approach relies upon judgment and familiarity with the theoretical literature on which the measure is based. Another approach is to eliminate those items with the weakest

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factor loading coefficients. This second approach requires that one has a factor loading matrix to inspect (correlations between variables and factors after orthogonal rotation), which is not the case with respect to the Tetrick et al. manuscript. For the present research, the results of a pilot study of the organizational learning instrument guided the final selection of items.

To guide item reduction, a pilot administration of the organizational learning measures was conducted on a convenience sample of employed MBA and psychology students. Tetrick et al. (2000) used a sample size of 97 students in their own pilot test. The pilot test for the present research involved a sample of 161 individuals, although it is recognized that this is still a small sample with respect to the needs of factor analysis (Tabachnick & Fidell, 1996). Items from Tetrick et al.'s instrument were used in the pilot as well as some new items. Analysis of the pilot administration included a confirmatory factor analysis and computation of internal consistency reliability statistics (see Appendix A1). Rationale for selecting certain subscales from Tetrick et al.'s instrument is presented in the discussion that follows, along with a description of minor modifications to the wording of some items.

Personal mastery

According to Senge (1990), personal mastery involves personal growth and learning, the ability to create the results in one's life that are most important, generating and sustaining creative tension, intense commitment to improvement and a strong sense of responsibility. Tetrick et al. (2000) found three dimensions to personal

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mastery: general, job and classes. These researchers comment that the dimension they call personal mastery-general is most congruent with Senge's idea of personal mastery as growth and learning. The other two dimensions of personal mastery reflect personal competency in a single area of one's life (job) and a single vehicle for learning (classes). The general dimension is most germane to the present research and therefore the other two subdimensions were not used. The general dimension includes eight items and showed a reliability coefficient of .82 suggesting that some trimming of items may be made and still keep satisfactory reliability.

Managing Mental Models

In Tetrick et al.'s (2000) study, the survey items for managing mental models factor analyzed into two dimensions: mental models-agency (agency refers to the kind of organization they studied) and mental models-individual. Senge (1990, 1992) conceptualized the notion of managing mental models as an activity undertaken by individuals to surface, test and continuously improve one's picture of how the world works. Senge sees surfacing (recognizing and making explicit) mental models as especially important, since when models are tacit or unconscious they go unexamined and tend to become entrenched. This can lead to thinking that is out of alignment with current reality and may preclude effective systems thinking. Based on Senge's conceptualization of managing mental models as an individual level (as opposed to group level or organization level) phenomenon, the managing mental models-agency scale is viewed as less useful for the present research, while the mental models-

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individual scale is at the appropriate level of analysis and is therefore most applicable to the present research.

Team Learning

Senge (1990) says team learning is the group-based discovery of insights through dialogue and discussion. It involves thoughtful insight about complex issues, innovative and coordinated action, and cooperation with members of other teams. Tetrick et al.'s 13-item scale showed a reliability coefficient of .94, suggesting that substantial trimming of items may be made and still keep satisfactory reliability.

Shared Vision

Senge (1990) declares that shared vision arises from the combined personal visions of organizational members and represents the collective sense of the purpose of the organization and where it's headed, along with a concomitant commitment to that purpose and direction. With Senge's definition in mind, three items from Tetrick et al.'s (2000) 7-item scale seem essential for content validity. As was seen in the results of the pilot study (Appendix A1), the factor loading coefficients were highest for these three items.

Systems Thinking

Senge (1990) sees systems thinking as a mental discipline for observing totalities and wholes rather than isolated parts, and observing interrelationships, patterns and processes rather than individual things and isolated events. The original

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7-item scale for systems thinking from Tetrick et al. (2000) showed a reliability coefficient of .88, suggesting some items may be eliminated without sacrificing too much reliability. As with the other learning organization scales, the final selection of items for the systems thinking scale was guided by the findings from the pilot study.

Environmental Uncertainty Measures

Perceived Environmental Uncertainty (PEU) is defined in this study as a perceptual phenomenon in which an individual feels unable to assign probabilities to the likelihood of future events. A literature review found a number of possible scales for measuring perceived environmental uncertainty. Prominent in the literature were scales developed by Lawrence and Lorsch (1967), Duncan (1972), Miles and Snow (1978), and Dickson and Weaver (1997). These scales and others have been employed by various researchers with varying results with respect to how well each correlated with particular criterion variables, degrees of reliability, and so on. For the purpose of this research, selection of the "best" uncertainty scale was not done by choosing the one with the highest correlation with a particular study's criterion variables or the one with largest Cronbach's alpha. Rather, selection was focused on choosing a scale whose underlying definition of environmental uncertainty best matched the present study's conceptualization. That is, the key consideration in scale selection was that the nature of the measured construct should be congruent with this study's theoretical foundations. A literature review provided the basis for evaluating possible scales of

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perceived environmental uncertainty for applicability to the present research. A synopsis of that review follows.

The Lawrence and Lorsch (1967) scale conceptualizes perceived environmental uncertainty (PEU) in terms of the clarity of job requirements, difficulty in developing, manufacturing and selling products profitably, and the delay involved in obtaining feedback after research, manufacturing and marketing actions are taken. This collection of factors is not well aligned with the present study's definition of PEU as an inability to predict the likelihood of future events. Furthermore, Tosi, Aldag and Storey (1973) found the Lawrence and Lorsch scale to correlate poorly with alternative measures of uncertainty and to have marginal reliability; they judged the scale "methodologically inadequate."

The Duncan (1972) scale conceptualizes perceived environmental uncertainty in terms of a lack of relevant information for decision making, lack of knowledge of decision outcomes, and the inability to assess the likelihood of how the environment will affect success (Downey, Hellriegel & Slocum, 1975; Gerloff, Muir & Bodensteiner, 1991). Duncan also identifies two dimensions of the environment: a simple-complex dimension and a static-dynamic dimension. Duncan's definition of environmental uncertainty appears compatible with the needs of the present research. A study of 51 division managers of a large U. S. conglomerate conducted by Downey et al. found the Duncan subscales to have very poor reliability, with coefficient alphas from .26 to .66. A rearrangement of the grouping of the questions by Downey et al.

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improved the reliability of the subscales somewhat, but not to the point commonly accepted as adequate. In addition, criterion validity in this study was observed to be "disappointing." However, Gerloff et al. propose a rearrangement of how the questions are assigned to subscales, rewording of several items and a few additional items that they believe would improve the reliability and validity of the original Duncan instrument.

The Miles and Snow (1978) scale conceptualizes perceived environmental uncertainty as "the predictability of conditions in the organization's environment" (Buchko, 1994). This definition of uncertainty is compatible with the needs of the present research. Buchko evaluated the Miles and Snow scale for reliability and validity using a sample of CEOs in the automotive supplier industry. Reliability measured by Cronbach's alpha was above .70 for five of the instrument's six subscales and was above .85 for the overall instrument. Criterion validity was assessed by relating the Miles and Snow measure of PEU to two criterion measures (degree of innovation and frequency of change). Analysis of the data showed that the Miles and Snow scales did not correlate well with either of the criterion variables.

A more contemporary study by Dickson and Weaver (1997) assembled a scale of PEU from an eclectic blend of prior instruments. Their scale conceptualizes perceived environmental uncertainty as multidimensional in which each dimension relates to the source of the uncertainty. Dickson and Weaver identify five sources of uncertainty: general uncertainty, technological uncertainty, state uncertainty (e.g.,

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customer and competitor predictability), internationalization, and uncertainty regarding growth. This definition of uncertainty is generally compatible with the needs of the present research, although some of the dimensions may represent a better fit with the present study's definition of environmental uncertainty than others. The instrument's dimensionality may be advantageous to this study since the existence of subscales within this instrument affords an opportunity to test this study's hypotheses against more than one dimension of environmental uncertainty. Dickson and Weaver validated their hybrid instrument with a sample of 433 Norwegian manufacturing firms. Factor analysis was supportive of the theorized 5-factor solution, with all items but one demonstrating factor loadings above .50. Reliability coefficients for each of the five subscales were .69, .79, .74, .62, and .60. Although reliability coefficients above .70 are (in general) strongly desirable, these reliability levels may need to be tolerated given the alternatives available. Criterion validity in this study was also generally positive with respect to this scale.

Based on the foregoing, the Dickson and Weaver (1997) scale for perceived environmental uncertainty was used in this research. Unlike all of the other survey questions in this research, this set of questions was asked only of an executive or similar individual at the top of the hierarchy in each participating organization since, compared to workers and work group leaders, senior leaders are in a much better position to adequately assess the levels of the various forms of uncertainty faced by the organization as a whole. This approach will also tend to reduce the common

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method variance or percept-percept inflation often encountered with self-report methods (Crampton & Wagner, 1994; Kline, Sulsky & Rever-Moriyama, 2000; Podsakoff & Organ, 1986). Appendix G includes the items used to measure PEU.

Self-Efficacy Measure

Self-efficacy is the expectancy an individual has regarding their ability to complete certain tasks and achieve specific goals (Bandura, 1997). Individuals with high self-efficacy believe that their efforts will lead to success. Self-efficacy has long been the subject of research in industrial and institutional settings, but many of the measurement scales used in such research are crafted for the specific situation under examination (e.g., Flannery & May, 2000) and appear difficult to apply generically. Also, many self-efficacy scales tend to consist of a large number of items, while a highly parsimonious scale is desired for the present research. Nevertheless, one scale for self-efficacy was located that is both parsimonious and reliable. The 3-item scale from Truxillo, Bauer and Sanchez (2001), based on the scale from Bauer, Maertz, Dolen and Campion (1998) has an alpha of about .92 and was easily adapted to the present research. The focal activity for the original scale is test-taking ability. For the present use, this focal activity was replaced with ability in the workplace. The adapted items include: "I am confident in my ability to do well in my work"; "When it comes to my work, I generally do well"; "I tend to do better in my work than most people." These items are scored on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale.

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Chapter 7: Results

Overview

This chapter begins with a discussion of the composition of the sample, including a comparison of the organizations that participated in the study versus those that declined to participate. The results of the data screening procedures are presented next, including missing data pattern analysis, outlier screening, checks for parametric distributions and scale reliability measurement. The next sections describe the results of ordinary least squares (OLS) regression testing on the hypotheses. Each of the five major research questions in the study was supported by one to four hypotheses. The five major research questions were:

Research Question 1: How do leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management?

Research Question 2: How does the extent of adoption of quality management's underlying principles affect process management practices?

Research Question 3: How do the basic quality-supportive process management practices affect quality-related process outcomes?

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Research Question 4: How are the disciplines of the learning organization associated with quality-related process management practices and process outcomes?

Research Question 5: How do leadership behaviors affect the realization of various disciplines of the learning organization?

A subsection associated with each hypothesis describes the specific regression technique used to test the hypothesis, the results of missing value analysis, conformance of the data to the technique's underlying assumptions and the results of the analysis.

The next section of the chapter presents the results of multilevel regression testing. This analysis was performed as a precautionary step to assure that the significance levels observed under OLS analysis were not excessively biased. The data set consists of subordinates nested within work group managers, and mangers nested within organizations. Such nesting violates the independence of observations assumption of OLS regression. OLS analysis does not recognize the multilevel nature of nested data and may produce "spuriously significant effects" (Hox, 1998, p 148). Multilevel regression explicitly takes into account the hierarchical nature of data by analyzing multiple levels simultaneously (Heck & Thomas, 2000).

The last section of the chapter presents several structural equation models that illustrate the interrelationships among the study variables at both the work group and individual level. These models were not constructed for confirmatory purposes, but

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rather to more fully illustrate the multivariate relationships examined in the study and to graphically present significant unique relationships.

Unless otherwise noted, a Type I error rate of .01 was used as the basis for all claims of statistical significance. Because some of the dependent variables in this study are used in several hypothesis tests, this conservative *p* level was chosen to help control experiment-wise error. Exact *p* levels are reported for hypothesis testing if they were computed by the testing procedure. Software packages SPSS Version 10.0.7, HLM Version 5.04 and AMOS Version 4.01 were used to calculate all reported results.

Sample Composition

The sample consisted of randomly selected quality-focused organizations that voluntarily agreed to participate in the study. Quality-focused organizations were defined as those that had been recognized by a state-sponsored quality recognition program based on the Baldrige criteria or organizations that had a quality management program certified to ISO 9000 standards. Table 7.1 contrasts quality-focused organizations that agreed to participate in the study with those that declined in terms of a number of key characteristics. A series of chi-square tests of this contingency table found no statistically significant differences between participating and declining organizations. The chi-square tests establish only that the no statistically significant differences were detected between organizations that participated versus those that did not participate with respect to a limited selection of characteristics. Other issues

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related to the representative nature of the sample include the nearly even ratio of ISO 9000 certified organizations to organizations that were quality award winners and the organizations' geographical concentration. Table 7.2 reflects the diversity of organization types within the research sample.

Table 7.1
Comparison of Participating vs. Non-Participating Organizations

Characteristic or Attribute	Number of Organizations that Participated	Declined
ISO 9000 Certified Quality System	10	11
State Quality Award Recipient	9	7
	$\chi^2(1) = .271, p > .05$	
For-profit	17	15
Not-for-profit	2	3
	$\chi^2(1) = .298, p > .05$	
Publicly traded company	5	8
Privately held company	12	9
Government / Public	2	1
	$\chi^2(2) = 1.428, p > .05$	
Large site (> 500 employees)	5	8
Medium site (101 to 500 employees)	7	1
Small site (< 100 employees)	7	9
	$\chi^2(2) = 5.419, p > .05$	

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Table 7.2
Description of the Nineteen Participating Organizations

Manufacturers of	1. Electro-mechanical subassemblies
	2. Electronic medical instrumentation
	3. Battery packs
	4. Automotive subassemblies
	5. Hydraulic pumps
	6. Forrest products
	7. Plastic molded parts
	8. Formed metal parts
	9. Metal castings for aerospace
	10. Electrical connectors
	11. Printed circuit boards
	12. Scientific instruments
	13. Semiconductor wafers [a]
	14. Semiconductor wafers [a]
Providers of	15. Industrial calibration services
	16. Electrical energy
	17. Data services
Government / Public	18. Stage agency
	19. County branch library system

Note. [a] The two semiconductor fabrication facilities were owned by the same company but treated as separate organizations for this study on the basis of their substantially dissimilar manufacturing processes and the relative age of the facilities.

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Descriptive Statistics of the Sample

All respondents were asked to supply basic biographical information such as age, gender, organizational level, primary role, etc. Table 7.3 reflects this information.

Table 7.3
Descriptive Statistics of Individuals

Statistic	Group Leaders (N = 101 to 104)	Subordinates (N = 582 to 611)
Age (in years)		
Mean (SD)	45.3 (8.92)	41.2 (10.1)
Gender (Male % / Female %)	71.2 / 28.8	56.7 / 42.3
Employment Status (%):		
Regular full-time	100	92.4
Part-time	0	6.7
Temporary Agency	0	0.7
Other	0	0.2
Leader-Subordinate Relationship Duration (in years)		
Mean (SD)	--	2.63 (3.51)
Organizational tenure (in years)		
Mean (SD)	9.44 (7.93)	7.23 (7.13)

Note. N is expressed as a range because not all subjects responded to each demographic question.

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Table 7.3 (continued)
Descriptive Statistics of Individuals

Statistic	Group Leaders (N = 101 to 104)	Subordinates (N = 582 to 611)
Job Experience (years)		
Mean (SD)	16.2 (10.5)	10.93 (8.65)
Primary Role (%)		
Worker or Individual Contributor	0.0	76.4
Supervisor	39.4	10.7
Manager	42.3	7.6
Director of managers	9.6	1.2
General or division manager	5.8	0.5
Other	2.9	3.6
Job Function (%)		
Administrative or General Management	19.2	4.6
Manufacturing, Production or warehouse	33.7	35.4
Engineering or Research and Development	15.4	16.6
Customer Service	5.8	17.0
Finance or Accounting	7.7	7.4
Quality Assurance or Inspection	4.8	5.9
Sales, Marketing or Public Relations	5.8	3.3
Human Resources or Facilities	3.8	3.0
Professional staff	0.0	1.5
Other	3.8	5.4

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Variance Comparison of Measurement Scales

Approximately 44% of the sample's work groups were obtained from organizations that had received a state quality award. For all but one quality-related scale, variance measures were not different between the two organization types at the .05 level of significance (Table 7.4). This issue is discussed further on pages 276-7.

Table 7.4
Scale Variances: ISO 9000 Organizations vs. Quality Award Recipients

Measurement Scale and Measurement Perspective	ISO 9000 Registered Organizations (N = 56 to 59)	Quality Award Recipients (N = 44 to 46)	Levene's Statistic[1]	Sig.
Group Leader Perspective				
Customer focus	.328	.223	.824	.366
CI Commitment	.625	.462	.980	.324
Teamwork	.781	.411	3.854	.052
Process Control	.874	.571	3.540	.063
Process Feedback	.521	.464	.300	.585
CI Achievement	.718	.535	.361	.549
Subordinate Perspective				
Customer focus	.213	.142	2.038	.156
CI Commitment	.271	.178	2.722	.102
Teamwork	.466	.387	.592	.443
Process Control	.486	.179	12.415	.001
Process Feedback	.406	.269	3.346	.070
CI Achievement	.369	.218	2.852	.094

Note. N is number of work groups. N is expressed as a range due to not all work groups having complete data. [1]Levene's statistic assesses homogeneity of variance; significance implies unequal variance between groups. CI = continuous improvement.

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Data Screening

All data were screened prior to hypothesis testing. The screening process proceeded in four stages. Completed surveys were first examined by work group to determine if at least three-quarters of the members of each work group had responded. Groups with adequate participation levels were then subjected to missing data analysis. Missing data analysis included examination of responses from work group leaders, subordinates and executives. In the next phase of data screening variables were examined for conformance to certain parametric requirements (e.g., normal distribution of responses, presence of outliers, etc.). In the final phase of data screening scale reliability coefficients were examined for adequate internal consistency reliability.

Useable Work Groups

A total of 115 work groups were approached to participate in the study among the 19 organizations described above. A work group was composed of a leader who had at least three subordinates reporting directly to him or her. Useable response sets were obtained from 105 (91.3%) of the 115 work groups approached. A useable response set consisted of completed subordinate surveys from at least 75% of the work group members or 75% of those chosen by random selection. Only one work group leader out of the 105 groups failed to return a leader survey. Completed executive surveys (one per organization) were received from all participating organizations.

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Missing Data Analysis

Missing data analysis proceeded in three phases. The first phase involved an examination of all returned surveys for obvious problems and general usability in terms of overall completion of the form. The second phase focused on the individual questionnaire items and their associated measurement scales to identify any frequently skipped items. The third phase concerned statistical tests to evaluate whether or not data could be considered missing at random. The results from the first two phases are presented here; the results from the third phase are presented within each hypothesis testing section of this chapter in the subsections entitled Evaluation of Assumptions.

General Screening

Each of the three types of completed surveys (executive, work group leader, and subordinate) was screened for high proportions of missing data across measures. Of the 632 subordinate surveys returned from participating groups, five were blank and nine showed obvious end-bias or central tendency bias (i.e., answering all survey questions with the end response or middle response option); these surveys were excluded. Three additional subordinate surveys were excluded because they were less than two-thirds complete. The foregoing screening left 615 useable subordinate surveys. All of the executive and work group leader surveys were acceptable in the foregoing regards and none were excluded.

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Missing Value Analysis

Following general screening, missing value analysis (SPSS MVA) was used to examine the data for patterns of missing responses. This analysis was important since a frequently skipped item might imply that a question was confusing. If enough items comprising a measurement scale were skipped by an individual respondent, then a value for the items' associated scale would also be missing a value. This stems from the computational procedure used that required an individual to respond to at least three-quarters of the questionnaire items comprising a multi-item scale. For example, if a multi-item measure consisted of four items and a subject responded to only two of the items then that subject would not have a valid response associated with that particular scale.

Missing value analysis was conducted at both the individual item level and scale level for subordinate surveys and work group leader surveys for each of the variables that would be used in hypothesis testing at a given level of analysis. Missing value analysis was performed by inspecting statistics on the extent of missing values and analyzing tables of tabulated missing value patterns. Among the 104 completed work group leader surveys, 95 cases (91.3%) had no missing item values and 99 cases (95.2%) had no missing scale values for variables used in hypothesis testing at the work group level. The most frequently missing scale values were use of feedback (missing in two cases) and use of process control methods (also missing in two cases). The tabulated patterns table produced by the SPSS MVA procedure revealed that there

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were no instances in which a particular missing scale value was consistently associated with another missing measure (e.g., a tendency for cases missing a response on gender to also be missing a response on supervisor relationship quality). The five work group leader surveys with missing scale values showed no apparent commonality among biographical variables including organizational affiliation, age, gender, job tenure, years of experience, managerial level or department. Based on the foregoing it was concluded that there were no problematic items or scales in the work group leader survey.

Among the 615 useable subordinate surveys, 538 cases (87.5%) had no missing item values and 595 cases (96.7%) had no missing scale values for measures used in hypothesis testing at the individual level of analysis. The most frequently missing item was organizational tenure (missing in 21 cases) followed by one of the process feedback items (missing in 11 cases). All other items were missing in eight or fewer cases. The most frequently missing scale values were managing mental models (missing in 11 cases), use of process control methods (missing in 5 cases) and use of feedback (missing in 4 cases). All other scale values were missing in three or fewer cases. The tabulated patterns table revealed that there were no instances in which a particular missing scale value was consistently associated with another missing scale value. The subordinate surveys with missing scale values showed no apparent commonality among biographical variables including organizational affiliation, age,

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gender, job tenure, years of experience or department. Based on the foregoing it was concluded that there were no problematic items or scales in the subordinate survey.

Out of the nineteen organizations surveyed, only one executive survey was missing a scale value for general perceived environmental uncertainty. This organization included four work groups, resulting in four work groups without a measure for general perceived environmental uncertainty.

It should also be noted that in several of the hypothesis tests described below there are no missing data at the work group level. This follows from the fact that although some individuals within work groups did not answer all of the questionnaire items associated with each multi-item measure, individual responses were aggregated (averaged within groups) to form a group-level measure.

Handling Missing Data

For each hypothesis test that included cases with missing values, additional statistical analysis was performed to determine whether or not the missing values could be considered missing at random. The inferential technique used for this purpose was to test for the presence of reliable differences in the means of dependent variables. Dummy variables were constructed to form two groups. One group consisted of cases with missing values on the IV and another group with no missing values. Tests of mean differences in the DV were then conducted using *t* tests. If no statistically significant difference was detected, then analysis proceeded with listwise deletion of the cases with missing values.

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Parametric Screening

Each of the multi-item measurement scales were examined to assess the degree to which they could be considered normally distributed. Examination for normality consisted of inspection of skewness and kurtosis, Lilliefors' test of normality and examination of box plots, stem-and-leaf plots and histograms. Results of the scale normality assessments are discussed in the various hypothesis testing subsections where the scales are employed. In addition, data were screened for within-group outliers using Tukey box-plots; this was done prior to group-level aggregation of data and before screening of scales for normality. Outliers within groups were case-wise deleted from analysis.

Scale Reliability Analysis

The form of reliability analysis most applicable to the research design (a one-time administration of a survey instrument) is Cronbach's alpha, which assesses internal consistency reliability. A coefficient alpha of .70 or greater is a general indication of satisfactory reliability (Nunnally, 1978) although the number of items comprising the scale should also be considered in interpreting this statistic. All scales demonstrated acceptable reliability. The Cronbach's alpha for the perceptual measurement scales is reported in Appendix C and is also summarized in each results section where the scale is used.

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Confirmatory Factor Analysis

A confirmatory factor analysis (CFA) was performed prior to hypothesis testing to verify the measurement properties of the learning organization instrument. This is the same type of analysis that was done in the pilot study of the instrument. It was repeated to confirm the instrument's dimensionality on the larger population of individuals in the main study. CFA found that the organizational learning instrument demonstrated the anticipated 5-factor structure and produced satisfactory reliability across each of its scales. Refer to Appendix A2 for a complete discussion of the results.

Research Question 1: Leadership and Quality-Supportive Principles

The first research question addresses how leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management. Three hypotheses were tested to answer this question. The first two hypotheses were tested using canonical correlation, the third using linear regression.

Management by Exception (MBE) and the Basic Quality Principles

The first hypothesis, formulated at the work group level, involves the two forms of management by exception (active and passive) and two of the three basic principles of quality management. The hypothesized relationship was expressed as:

H1: Active and passive management by exception are negatively associated with continuous improvement commitment and teamwork.

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Both the IVs and DVs used to test this hypothesis were obtained from the aggregated responses given by the subordinates of work group leaders (as opposed to obtaining the IVs from subordinates and the DVs from group leaders). Although same-source bias (common method variance) from this measurement approach was a concern, avoiding it was problematic in testing H1 for several reasons. First, subordinate assessment of leadership behaviors is preferable to leader self-assessment which tends to be biased toward wished-for or socially desirable directions (Bass, 1990). Also, the commitment level of team members to continuous improvement is appropriately assessed by asking the team members themselves to report their degree of personal commitment as opposed to asking another individual (e.g., the work group leader) to estimate that magnitude. Consequently, some positive bias in estimating the effect size of this relationship is possible from common method variance.

Evaluation of Assumptions

There were no missing data at the work group level. The variables associated with the hypothesis were evaluated for conformance to the assumptions underlying canonical correlation. The MBE-passive scale demonstrated moderate skewness (.569, *SE* = .236), but not to the extent that data transformation was warranted. The teamwork scale also demonstrated some skewness (-.510, *SE* = .236). Each of the four scales passed Lilliefors' test of normality. Examination of box plots, stem-and-leaf plots and histograms supported parametric assumptions. With 105 cases and two IVs, a ratio of cases to IVs of at least ten to one (Tabachnick and Fidell, 1996) was met.

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No bivariate outliers were identified from scatterplots. Scale reliability measures (Cronbach's alpha) ranged from .70 to .91 at the individual level of analysis.

Results

Canonical correlation testing showed a statistically significant test of the multivariate relationship ($\Lambda = .585$, $F(4, 202) = 15.50$, $p < .001$). The Wilks' Lambda (Λ) statistic indicates that the first canonical correlation was significant; the R^2 for the first function was .398, indicating that 39.8% of the variance in the set of DVs is accounted for by variance in the set of IVs. The second canonical correlation was not significant, $F(1, 102) = 2.89$, $p = .092$.

The pattern of standardized canonical coefficients (Table 7.5) indicates that high scores on the first function are characterized by infrequent use of passive management by exception, strong commitment to continuous improvement and frequent use of teamwork. Unlike conventional linear regression, canonical correlation analysis does not yield tests of statistical significance for each variable. Consequently, the importance of each variable must be made based on an inspection of the relative magnitude of the canonical coefficients and on judgment. In the present case, the standardized canonical coefficient associated with passive MBE (-.997) is more than seven times the magnitude of the standardized coefficient associated with active MBE (.132) indicating that the passive form of MBE dominates the IV side of the canonical function. The results support the hypothesis that management by exception is negatively associated with continuous improvement commitment and

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Table 7.5
Standardized Canonical Coefficients for Transactional Leadership Behaviors and Quality-Supportive Principles

Variables	Function 1
IV Set: Leadership Behaviors	
Active Management by exception	.132
Passive Management by exception	-.997
DV Set: Quality-Supportive Principles	
Continuous Improvement Commitment	.708
Teamwork	.418

Note. N = 105 work groups.

teamwork, and it is observed that the passive form of MBE dominates the canonical relationship.

Transformational Leadership and the Basic Quality Principles

The second (two part) hypothesis involves the five factors of transformational leadership and their relationship with the three basic principles of quality management. Like H1, this hypothesis was formulated at the work group level. The hypothesized main effect (H2a) and moderated effect (H2b) were expressed as follows:

H2a: Transformational leadership behaviors are positively associated with teamwork, customer focus and continuous improvement commitment.

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H2b: There is a stronger positive relationship between transformational leadership behaviors and teamwork, customer focus and continuous improvement commitment in work groups with leaders at higher organizational levels than with leaders at lower levels.

As was the case with H1, both the IVs and DVs used to test H2a and H2b were obtained from the aggregated (within-group average) responses given by leaders' subordinates; work group leaders' responses were not used. Five interaction terms were formed by the product of each IV with the hierarchical level of the work group's leader. The hierarchical level of the work group leader was measured as an ordinal variable based on leaders' self-reported title. The categories used to measure hierarchical level, in ascending order, were as follows: supervisor, manager, director of managers, general or division manager, and vice president or executive.

Evaluation of Assumptions

There were no missing data at the work group level. The variables associated with Hypothesis 2a and 2b were evaluated for conformance to the assumptions underlying canonical correlation. Several of the transformational leadership scales showed moderate negative skewness but not enough to warrant transformation. All variables passed Lilliefors' test of normality at the .01 level. Examination of box plots, stem-and-leaf plots and histograms generally supported the assumption of the normality of measures. The ratio of cases to IVs was more than 20:1 for the main

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effects model. No bivariate outliers were identified. The reliability (Cronbach's alpha) of measurement scales ranged from .75 to .91 at the individual level of analysis.

Results

Two canonical correlation analyses were run, one to test the main effects hypothesis (H2a) and the second to test the interaction effects hypothesis (H2b). An F test comparing the two canonical correlations was used to test for significant interaction effects.

Canonical correlation testing of Hypothesis 2a showed a statistically significant main effect, $\Lambda = .457$, $F(15, 268) = 5.85$, $p < .001$. The Wilks' Lambda statistic indicates that the first canonical correlation in the main effects model was significant with an R^2 for the first function of .514, meaning that 51.4% of the variance in the set of DVs is accounted for by variance in the set of IVs. The second canonical function was not significant, $F(8,196) = .76$, $p = .642$, and consequently the third canonical function was automatically not significant.

The second canonical correlation model included interaction effects using the hierarchical level of the work group leader as a moderating variable. Five interaction variables (one associated with each predictor variable) entered on the IV side of the relationship. The canonical correlation was statistically significant, $\Lambda = .369$, $F(33, 266) = 3.24$, $p < .001$. The R^2 for the first function was .568. The second canonical function was not significant, $F(20, 182) = .74$, $p = .776$, and consequently the third canonical function was not significant.

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The two foregoing canonical analyses were then compared with respect to the total variance explained by each regression model. An *F* test was used to test for a statistically significant increase in explained variance between the main effects model and the interaction model. The *F* test offered no support for the notion that moderation was present, $F(6, 82) = 1.71, p = .129$. Consequently, H2b was not supported and only the results from the main effects model (H2a) are interpreted.

The pattern of standardized canonical coefficients from the main effects model (Table 7.6) indicates that high scores on the first canonical function are characterized by work group leaders' frequent display of intellectual stimulation behaviors, group members' strong commitment to continuous improvement and a high degree of teamwork. The large coefficient associated with intellectual stimulation (.679) relative to the coefficients of other predictor variables indicates that among the five subfactors of transformational leadership, intellectual stimulation demonstrates a significant unique positive association with two of the three quality-supportive principles. That only one of the transformational leadership subfactors showed a unique relationship with the set of dependent variables is understandable considering the high intercorrelations among the predictors ($r = .699$ to $.812$, $ps < .001$). Consequently it is informative to examine the zero-order correlations between each of the predictors and the set of dependent variables. As shown in Table 7.7, the zero-order correlations between the predictors and the dependent variables are all significant ($r = .369$ to $.665$, $ps < .001$) and collectively support Hypothesis 2a.

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Table 7.6
Standardized Canonical Coefficients for Transformational Leadership Behaviors and Quality-Supportive Principles

Variables	Function 1
IV Set: Transformational Leadership Behaviors	
Idealized Influence – attributed	.217
Idealized Influence – behavioral	.104
Inspirational Motivation	.123
Intellectual Stimulation	.679
Individualized Consideration	-.056
DV Set: Quality-Supportive Principles	
Continuous Improvement Commitment	.431
Teamwork	.733
Customer Focus	-.057

Note. $N = 105$ work groups.

Table 7.7
Zero-order Correlations: Transformational Leadership Behaviors and Quality-Supportive Principles

	Quality-Supportive Principles		
Transformational Leadership Behaviors	CI Commitment	Teamwork	Customer Focus
Idealized Influence – attributed	.502	.592	.370
Idealized Influence – behavioral	.547	.537	.371
Inspirational Motivation	.481	.543	.324
Intellectual Stimulation	.546	.665	.405
Individualized Consideration	.429	.527	.369

Note. $N = 105$ work groups. CI = continuous improvement. All correlations shown were significant at $p < .001$ (one-tailed).

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Laissez-faire Leadership and the Basic Quality Principles

The third hypothesis concerns laissez-faire leadership and its relationship with the three basic principles of quality management. Like the two prior hypotheses, this hypothesis was formulated at the work group level. The hypothesized relationship was expressed as follows:

> H3: Laissez-faire leadership is negatively associated with teamwork, customer focus and continuous improvement commitment.

Again, both the independent and dependent variables used to test Hypothesis 3 were obtained from the aggregated (within-group mean) responses given by work group members.

Evaluation of Assumptions

There were no missing data at the work group level. The variables associated with the third hypothesis were evaluated for conformance to the assumptions underlying linear regression. Except for laissez-faire leadership, assumptions of the normality of measures were met as judged by measures of skewness and kurtosis, Lilliefors' test of normality, and an examination of box plots, stem-and-leaf plots and histograms. The measure of laissez faire leadership behaviors exhibited positive skewness (.930, *SE* = .236) but not to such a degree as to warrant transformation. A series of scatterplots revealed no cases of bivariate outliers. The reliability of the measurement scales ranged from .77 to .91 at the individual level of analysis.

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Results

Hypothesis 3 was tested using linear regression. An R^2 of .281 (adjusted R^2 = .260) was obtained between the three predictor variables (teamwork, customer focus and commitment to continuous improvement) and the use of laissez-faire leadership, $F(3, 101) = 13.16$, $p < .001$. The regression coefficients (Table 7.8) indicate that frequent demonstration of laissez-faire leadership behaviors is negatively correlated with commitment to continuous improvement.

Table 7.8
Regression Analysis for Variables Predicting Laissez-faire Leadership

	Unstandardized Coefficients				Correlations		
Predictors	*B*	Std. Error	β	*p*	Zero	Partial	Part
Constant	3.418	.451		< .001			
Teamwork	-.119	.087	-.144	.172	-.392	-.136	-.116
Customer Focus	-.092	.143	-.071	.522	-.380	-.064	-.054
CI Commitment	-.445	.130	-.388	.001	-.510	-.322	-.288

Note. N = 105 work groups. R^2 = .281 (adj. R^2 = .260). CI = continuous improvement.

The weak and statistically non-significant betas associated with customer focus and teamwork would at first suggest that teams' degree of customer focus and extent of teamwork is not associated with laissez-faire leadership behaviors. However, an inspection of the zero-order correlations indicates intercorrelations among predictor variables (r = .531 to .615, $ps < .001$). Collectively the findings are supportive of H3

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in that teamwork, customer focus and commitment to continuous improvement are each negatively correlated with laissez- faire leadership behaviors, but only continuous improvement commitment accounts for unique variance beyond that explained by teamwork and customer focus.

Research Question 2: Quality-Supportive Principles and Process Management Practices

The second research question examines the relationship between the three basic principles of quality management and two kinds of process management practices (use of process control methods and use of process feedback to organizational members). The hypothesis associated with this research question was formulated at the work group level. The IVs were obtained from the aggregated responses (within group averages) given by subordinates. The DVs were obtained from the leaders of the work groups to avoid common method variance. The hypothesized relationship was expressed as follows:

H4: The more a work group is characterized by quality-supportive principles (teamwork, customer focus and continuous improvement commitment), the more process management practices are characterized by process control mechanisms and process feedback systems.

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Evaluation of Assumptions

There were five cases (4.8% of the sample) in which one or both of the DVs were missing; no IVs were missing. Missing values were therefore handled with listwise deletion.

The variables associated with the Hypothesis 4 were evaluated for conformance to the assumptions underlying canonical correlation. Assumptions of the normality of measures were met as judged by measures of skewness and kurtosis, Lilliefors' test of normality, and an examination of box plots, stem-and-leaf plots and histograms. The ratio of cases to IVs was 33:1. No multivariate outliers were identified from an inspection of scatterplots. The reliability (Cronbach's alpha) of the measurement scales ranged from .72 to .91 at the individual level of analysis.

Results

Canonical correlation testing failed to show a statistically significant effect at the .01 level of significance, $\Lambda = .867$, $F\,(6, 190) = 2.33$, $p = .034$.

Exploratory Analysis

Because Hypothesis 4 was not supported, a post hoc exploratory analysis was conducted to determine what variables might be useful predictors of process management practices. In keeping with the planned method used to test H4, the DVs were measured from the perspective of the work group leaders while the IVs were measured from the perspective of subordinates to remove common method variance.

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Of a total of 23 possible subordinate perspective IVs, seven were excluded from the exploratory analysis either because they were not appropriate for use as group measures (e.g., self-efficacy) or because they were duplicative with the leader perspective DVs (e.g., *subordinates'* assessment of process management practices). Zero-order correlations were inspected using the table of correlations in Appendix C.

Of the 16 IVs, only one (active management by exception) had a significant zero-order correlation with use of process feedback ($r = .299, p = .002$). In contrast, three of the IVs had low to moderate zero-order correlations with use of process

Table 7.9
Regression Analysis for Variables Predicting Process Management Practices

	Unstandardized Coefficients				Correlations		
Variables	*B*	Std. Error	β	*p*	Zero	Partial	Part
DV1: Use of Process Feedback ($R^2 = .090, F(1, 100) = 9.845, p = .002$)							
Constant	2.713	.218					
Active MBE	.363	.116	.299	.002	.299	.299	.299
DV2: Use of Process Control Methods ($R^2 = .193, F(3, 98) = 7.825, p < .001$)							
Constant	.388	.775		.618			
Active MBE	.543	.132	.379	< .001	.380	.384	.373
Customer Focus	.339	.232	.170	.147	.198	.146	.133
CI Commitment	.126	.207	.071	.544	.217	.061	.055

Note. $N = 104$ work groups. CI = continuous improvement. MBE = management by exception. Adj. R^2 (DV1) = .081. Adj. R^2 (DV2) = .169.

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control methods: active management by exception ($r = .380, p < .001$), customer focus ($r = .198, p = .023$), and commitment to continuous improvement ($r = .217, p = .014$). A multiple regression analysis was subsequently performed to determine if any of these three IVs played a unique part in predicting use of process control methods. Analysis showed that the only active management by exception explained unique variance in the use of process control methods beyond that explained by customer focus and commitment to continuous improvement (Table 7.9). It is interesting to note that this is the same predictor that had a significant relationship with process feedback.

Research Question 3:
Process Management Practices and Process Outcomes

The third research question addresses how quality-oriented process management practices affect quality-related process outcomes. Hypotheses 5a, 5b and 6 were tested to answer this question. The analytical techniques used were moderated multiple regression and hierarchical regression.

Process Management and Continuous Improvement Achievement

Hypothesis 5a and 5b, formulated at the work group level of analysis, involves two types of process management practices and the achievement of continuous improvement in work system outputs. The two IVs (use of process control methods and use of process feedback to work group members) were obtained from the within-

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groups aggregated responses of individuals working for each work group leader. To avoid common method variance, the DV (achievement of continuous improvement) was obtained from work group leaders. The hypothesized main effect (H5a) was:

> H5a: The more process management practices include process control methods and process feedback to organizational members the more frequently continuous improvement is achieved.

Likewise, a moderating variable measurement (perceived environmental uncertainty) was obtained from an executive in each work group's parent organization. The hypothesized moderator effect (H5b) was expressed as follows:

> H5b: There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty than under conditions of high perceived environmental uncertainty.

Evaluation of Assumptions

There were five cases with missing data (4.8% of the sample). Of these five cases, four stemmed from a missing value for the hypothesized moderator (perceived environmental uncertainty) from one organization that encompassed four work groups. The other missing value was related to the one leader in the study who failed to return a survey. Missing values were therefore handled with listwise deletion.

The variables associated with the two hypotheses were evaluated for conformance to the assumptions underlying linear regression. Assumptions of the

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normality of measures were met as judged by measures of skewness and kurtosis, Lilliefors' test of normality, and an examination of box plots, stem-and-leaf plots and histograms. No cases of multivariate outliers were identified from an inspection of scatterplots. The reliability (Cronbach's alpha) of the IV and DV scales ranged from .75 to .89. The reliability of the 5-item scale for general perceived environmental uncertainty (PEU-general) was .61. Analysis showed that the reliability of perceived environmental uncertainty (PEU-general) increased to .79 if the first item of the scale was eliminated. Inspection of the items comprising the scale revealed that the first item dealt with the rate of change in marketing practices, while the other four items dealt with more general factors. Analysis therefore proceeded using the shortened 4-item version of the scale.

Results

The moderated aspect of the hypothesized relationship was tested first. The interaction effects hypothesized in H5b were tested using moderated multiple regression (MMR). Five variables (process control, process feedback, perceived environmental uncertainty and two interaction terms) entered the equation simultaneously. The two interaction terms were PEU x process control and PEU x process feedback. Analysis indicated that all regression terms were non-significant as was the overall test, $F(5, 94) = 1.25, p = .292$. In addition, the zero-order correlations between the predictor variables and the dependent variable were all non-significant. Regression analysis offered no support for Hypothesis 5a or 5b.

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Exploratory Analysis

Because the foregoing results were not significant, a post hoc exploratory analysis was conducted to determine what variables might be useful predictors of continuous improvement achievement. As before, continuous improvement achievement was measured from the perspective of work group leaders and predictor variables from the perspective of their subordinates. Of 17 applicable scales measured from the subordinate perspective, three predictors had significant ($p < .01$) zero-order correlations with the DV and two others had p levels below .05. Two of these five predictors included teamwork and team learning. The other three variables were dimensions of transformational leadership. The foregoing five variables were entered simultaneously into a linear regression expression. The results (Table 7.10) showed that none of these variables had statistically significant betas. The zero-order and partial correlations indicate intercorrelation among the predictor variables such that none play a unique part in explaining the variance observed in continuous improvement achievement.

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Table 7.10
Regression Analysis for Variables Predicting Continuous Improvement Achievement: Exploratory Analysis

Variables	Unstandardized Coefficients		β	*p*	Correlations		
	B	Std. Error			Zero	Partial	Part
Constant	3.286	.614		< .001			
Teamwork	.089	.179	.075	.619	.237	.050	.048
Team Learning	.260	.254	.149	.309	.259	.103	.098
Inspirational Motivation	.208	.205	.151	.312	.263	.102	.097
Intellectual Stimulation	-.233	.243	-.163	.340	.201	-.096	-.092
Individualized Consideration	.220	.211	.155	.299	.260	.105	.100

Note. N = 104 work groups. $R^2 = .104$ (adj. $R^2 = .058$), $F(5, 98) = 2.264$, $p = .054$.
Zero-order correlations greater than .258 were significant at $p < .01$ (two-tailed).
Zero-order correlations greater than .197 were significant at $p < .05$ (two-tailed).

Process Management and Employee Fulfillment

The sixth hypothesis concerns the relationship between process management practices (use of process control methods and use of process feedback to team members) and degree of employee fulfillment. Because employee fulfillment is an individual-level phenomenon, this hypothesis was formulated at the individual level of analysis. The hypothesized relationship was expressed as follows:

H6: The more process management practices include process control methods and process feedback to organizational members, the greater employee fulfillment.

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For reasons explained in Chapter 4, leader-member exchange quality (LMX) and organizational tenure were used as control variables in testing the above relationship.

Evaluation of Assumptions

There were 31 cases (5.0% of the sample) with missing values. A dummy variable was created to identify cases with and without missing values for the independent or control variables. The two resulting groups were tested for equal means on the dependent variable and for homogeneity of variance. The means of the DV were 5.03 for the group with no missing predictors and 6.02 for the group with missing predictors. Levene's test indicated homogeneity of variance, $F(1, 613) = .022$, $p = .883$, and the t test indicated no significant difference in group means, $t(613) = .614$, $p = .540$. Missing values were therefore handled with listwise deletion.

The variables associated with the hypothesis were evaluated for conformance to the assumptions underlying linear regression. The perceptual variables demonstrated some skewness and did not pass Lilliefors' test of normality. Nevertheless, the distribution of the perceptual measures was deemed adequate as judged by visual inspection of box plots, stem-and-leaf plots and histograms. Organizational tenure demonstrated excessive skewness (1.454, $SE = .101$) and kurtosis (1.480, $SE = .202$). Tenure was $\log_{10}$ transformed; this improved its distribution considerably with regard to both skewness (-.570) and kurtosis (.131). No cases of multivariate outliers were identified from scatterplots. The reliability (Cronbach's alpha) of the IVs and DV ranged from .75 to .91.

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Results

Hypothesis 6 was tested using hierarchical linear regression (Table 7.11). LMX and the two biographical variables entered the regression equation in Step 1. An R^2 of .164 (adjusted R^2 of .161) was obtained on the first step, $F(2, 581) = 56.90$, $p < .001$. The inclusion of process control and in Step 2 yielded significant results: $R^2 = .174$ (adjusted $R^2 = .170$), $F(3, 580) = 40.83$, $p < .001$. The incremental variance in employee fulfillment accounted for by process control was small but statistically significant: $\Delta R^2 = .011$, $\Delta F(1, 580) = 7.42$, $p = .007$. In Step 3, process control was removed and process feedback was added in its place and this yielded significant results: $R^2 = .181$ (adjusted $R^2 = .177$), $F(3, 580) = 42.83$, $p < .001$. Process feedback explained significant incremental variance in employee fulfillment above that explained by the control variables in Step 1: $\Delta R^2 = .018$, $\Delta F(1, 580) = 12.44$, $p < .001$. The hypothesis was therefore supported in that both of the hypothesized variables predicted employee fulfillment after controlling for LMX and the log of organizational tenure. It should also be noted that there was significant correlation between the two predictors ($r = .607$, $p < .001$). Consequently either predictor alone may have difficulty explaining unique significant variance in the dependent variable (as will be seen later in the results from structural equation modeling).

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Table 7.11
Regression Analysis for Process Management Variables Predicting Employee Fulfillment

Variables	Unstandardized Coefficients				Correlations		
	B	Std. Error	β	p	Zero	Partial	Part
Step 1: Control Variables (R^2 = .164)							
Constant	2.748	.220		< .001			
Log of tenure	.301	.100	.114	.003	.133	.124	.114
LMX	.591	.059	.383	< .001	.388	.386	.382
Step 2: Incremental Effect of Process Control (ΔR^2 = .011 over Step 1)							
Constant	2.404	.253		< .001			
Log of tenure	.288	.100	.109	.004	.133	.119	.109
LMX	.544	.061	.352	< .001	.388	.348	.338
Process Control	.166	.061	.107	.007	.214	.112	.103
Step 3: Incremental Effect of Process Feedback (ΔR^2 = .018 over Step 1)							
Constant	2.462	.233		< .001			
Log of tenure	.290	.099	.110	.004	.133	.121	.110
LMX	.475	.067	.308	< .001	.388	.284	.268
Process Feedback	.224	.063	.152	< .001	.309	.145	.132

Note. N = 584 individuals.

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Research Question 4: The Learning Organization Disciplines and Quality Management

The fourth research question addresses how various disciplines of the learning organization are associated with quality-related process management practices and process outcomes. Four hypotheses were tested to offer answers to this question. Bivariate correlation analysis and various forms of linear regression analysis were used to test these hypotheses.

Personal Mastery and Employee Fulfillment

The seventh hypothesis of the study concerns the relationship between personal mastery and sense of work-related fulfillment. Because employee fulfillment is an individual-level phenomenon, this hypothesis was formulated at the individual level of analysis. The hypothesized relationship was expressed as follows:

> H7: The more individuals feel a sense of personal mastery, the greater their degree of employee fulfillment.

For reasons explained in Chapter 4, leader-member exchange quality (LMX) and organizational tenure were used as control variables in testing the above relationship. In addition, since process feedback was identified as a significant predictor of employee fulfillment in Hypothesis 6, this variable was also included as a control variable so that the unique contribution played by personal mastery could be determined.

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Evaluation of Assumptions

There were 29 cases (4.7% of the sample) with missing values. A dummy variable was created to identify cases with and without missing values for the independent or control variables. The two resulting groups were tested for equal means on the dependent variable and for homogeneity of variance. The means for employee fulfillment were 5.03 for the group with no missing predictors and 5.14 for the group with missing predictors. Levene's test indicated homogeneity of variance, $F(1, 611) = .592$, $p = .442$, and the t test indicated no significant difference in group means, $t(611) = 1.204$, $p = .229$. Missing values were therefore handled with listwise deletion.

The variables associated with the hypothesis were evaluated for conformance to the assumptions underlying linear regression. The distributions of the control variables were previously described above in Hypothesis 6. Personal mastery demonstrated some skewness (-.316, $SE = .101$) as did employee fulfillment (-.867, $SE = .101$) but not enough to warrant transformation. The normality of these measures was deemed adequate as judged by visual inspection of box plots, stem-and-leaf plots and histograms. No cases of multivariate outliers were identified from scatterplots. The reliability (Cronbach's alpha) of the perceptual measurement scales ranged from .79 to .87.

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Results

Hypothesis 7 was tested using hierarchical linear regression. LMX, organizational tenure and process feedback entered the regression equation first (Table 7.12). An R^2 of .181 (adjusted R^2 of .177) was obtained on the first step, $F(3, 582) = 42.82$, $p < .001$. The inclusion of personal mastery in the second step yielded significant results: $R^2 = .217$ (adjusted $R^2 = .212$), $F(4, 581) = 40.32$, $p < .001$.

Table 7.12
Regression Analysis for Learning Disciplines Predicting Employee Fulfillment

	Unstandardized Coefficients				Correlations		
Variables	*B*	Std. Error	β	*p*	Zero	Partial	Part
Step 1: Control Variables ($R^2 = .181$)							
Constant	2.456	.233		< .001			
LMX	.473	.067	.306	< .001	.387	.283	.267
Log of tenure	.288	.099	.109	.004	.131	.120	.109
Process Feedback	.226	.063	.154	< .001	.311	.146	.134
Step 2: Incremental Effect ($\Delta R^2 = .036$ over Step 1; total $R^2 = .217$)							
Constant	.691	.410		.092			
LMX	.441	.065	.286	< .001	.387	.270	.248
Log of tenure	.320	.097	.121	.001	.131	.136	.121
Process Feedback	.195	.062	.133	.002	.311	.129	.115
Personal Mastery	.491	.094	.195	< .001	.254	.211	.191

Note. $N = 586$ individuals.

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The incremental variance in employee fulfillment accounted for by personal mastery was significant: $\Delta R^2 = .036$, $\Delta F(1, 581) = 27.06$, $p < .001$. These findings supported the hypothesis.

Personal Mastery and Process Feedback

The next hypotheses of the study concern the relationship between the receipt of process feedback and one's sense of personal mastery. These hypotheses were formulated at the individual level of analysis because personal mastery is defined as an individual-level phenomenon. The hypothesized main effect was expressed as:

H8a: The more process feedback is made available to organizational members, the more individuals feel a sense of personal mastery.

For reasons explained in Chapter 4, the main effect was evaluated using self-efficacy as a control variable. In addition, the hypothesized moderating effect of self-efficacy was also tested. The moderated relationship was formulated as:

H8b: Individuals with high self-efficacy demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.

Evaluation of Assumptions

There were five cases (0.8% of the sample) with missing values for the predictor variable or control variable. A dummy variable was created to identify cases with and without missing values. The two resulting groups were tested for equal

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means on the dependent variable and for homogeneity of variance. The means for personal mastery were 4.00 for the group with no missing predictors and 3.85 for the group with missing predictors. Levene's test indicated homogeneity of variance, $F(1, 611) = .468$, $p = .494$, and the t test indicated no significant difference in group means, $t(611) = .545$, $p = .586$. Missing values were therefore handled with listwise deletion.

The variables associated with the hypotheses were evaluated for conformance to the assumptions underlying linear regression. The process feedback measure showed moderate skewness (-.286, $SE = .099$) and kurtosis (.406, $SE = .198$). Likewise, personal mastery showed moderate skewness (-.342, $SE = .099$) and kurtosis (.540, $SE = .198$). Inspection of box plots, stem-and-leaf plots and histograms for these variables led to the conclusion that no transformation of these variables was called for. The moderating variable, self-efficacy, exhibited very strong skewness (-1.582, $SE = .099$) and kurtosis (3.532, $SE = .198$). Following recommendations by Tabachnick and Fidell (1996, p. 83) self-efficacy was transformed using reflection followed by square root. This improved the appearance of self-efficacy's distribution dramatically, as well as its skewness (.827) and kurtosis (1.182). No cases of multivariate outliers were identified from scatterplots. The reliability (Cronbach's alpha) of the IV and DV were .87 and .79 respectively, and .80 for self-efficacy.

Results

The hypotheses were tested using moderated multiple regression. Three terms (feedback, transformed self-efficacy and the interaction term) entered the regression

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equation simultaneously in the interaction model (Table 7.13). An R^2 of .116 (adjusted R^2 of .112) was obtained on the first step, $F(3, 605) = 26.46, p < .001$. Analysis showed a non-significant interaction term. Lacking support for an interaction effect, the presence of main effects, controlling for self-efficacy, was tested in hierarchical fashion in Steps 1 and 2. Self-efficacy entered the regression equation as a control variable in Step 1, and an R^2 of .099 (adjusted R^2 of .097) was obtained, $F(1, 607) = 66.67, p < .001$. The model in Step 2 was significant, $R^2 = .116$ (adjusted $R^2 = .113$), $F(2, 606) = 39.67, p < .001$. The incremental variance in employee fulfillment accounted for by process feedback was significant: $\Delta R^2 = .017, \Delta F(1, 606) = 11.51, p = .001$. These findings supported the main effects hypothesis (H8a) although the incremental variance in personal mastery explained by process feedback was small. Note that the coefficients associated with the transformed self-efficacy scale show a negative sign. This is because the reflection involved in the transformation flips the scale (i.e., high numbers indicate low self-efficacy). Both self-efficacy and use of process feedback were significant predictors of personal mastery.

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Table 7.13
Regression Analysis for Variables Predicting Personal Mastery

Variables	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	β	*p*	Correlations Zero	Correlations Partial	Correlations Part
Interaction Model (R^2 = .116)							
Constant	4.607	.327		< .001			
Process Feedback	.039	.099	.067	.692	.171	.016	.015
Self-efficacy [a]	-.577	.218	-.345	.008	-.315	-.107	-.101
Self-efficacy [a]X Feedback	.025	.068	.075	.703	-.052	.016	.015
Step 1: Control Variable (R^2 = .099)							
Constant	4.775	.098		< .001			
Self-efficacy [a]	-.527	.065	-.315	< .001	-.315	-.315	-.315
Step 2: Incremental Effects Model (ΔR^2 = .017 over Step 1, total R^2 = .116)							
Constant	4.492	.128		< .001			
Self-efficacy [a]	-.497	.065	-.297	< .001	-.315	-.299	-.294
Process Feedback	.076	.023	.131	.001	.171	.137	.130

Note. *N* = 609 individuals. [a] Self-efficacy was transformed by reflection and square root.

Team Learning and Process Management Practices

The ninth hypothesis of the study concerns the relationship between the receipt of process feedback and the team learning discipline organizational learning. This hypothesis was formulated at the work group level of analysis because team learning is defined as a group-level phenomenon. The measurement perspective of both

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variables was the aggregated perceptions of work group members. The hypothesized relationship was expressed as follows:

H9: The more process management practices include quality-related process feedback to organizational members, the more team learning occurs.

Evaluation of Assumptions

There were no cases with missing data. There were no apparent multivariate outliers in a scatter plot of the data. The reliability (Cronbach's alpha) of the IV and DV were .87 and .80 respectively at the individual level of analysis. The variables associated with the hypothesis were evaluated for conformance to the assumptions underlying linear correlation testing. Both the independent and dependent variables passed Lilliefors' test of normality, although the team learning measure showed moderate skewness (-.561, SE = .236). Inspection of box plots, stem-and-leaf plots and histograms for these variables was generally supportive of the assumptions underlying the analysis.

Results

The hypothesis was tested using bivariate correlation analysis. Testing confirmed the hypothesis by finding the linear relationship statistically significant with $r(105) = .467, p < .001$.

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Systems Thinking and Continuous Improvement

The next two hypotheses concern the relationship between systems thinking and the achievement of continuous improvement. The level of analysis was at the work group level. Both the predictor and dependent variables were measured from the perspective of work group leaders while the moderating variable, general environmental uncertainty, was measured from the perspective of an executive. Although same-source bias is a general concern, it was appropriate to measure both the IV and DV from the perspective of the work group leaders. Each of the items comprising the systems thinking scale refers to the organization as a whole. For example, "We know how to make changes to improve the organization as a whole." This question calls for organization-wide knowledge that group leaders are in a better position to have compared to workers. The DV, continuous improvement achievement, is also best measured from the perspective of the work group leader as he or she is in the most appropriate position to judge goal achievement. The hypothesized main effect and moderated effect were expressed as follows:

H10a: The more systems thinking occurs the more frequently continuous improvement is achieved.

H10b: There is a stronger positive relationship between systems thinking and continuous improvement achievement under conditions of high perceived environmental uncertainty than under conditions of low perceived environmental uncertainty.

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Evaluation of Assumptions

There were six cases (5.7%) of the sample with missing values. One case was missing values for the IV and DV stemming from the one manager in the study who failed to return a survey. Another case was missing a value for the IV. Another four cases had missing values for the moderator variable; these cases were associated with one organization that encompassed four work groups. Missing values were handled with listwise deletion.

The variables associated with the hypothesis were evaluated for conformance to the assumptions underlying linear regression. Assumptions of the normality of measures were met as judged by measures of skewness and kurtosis, Lilliefors' test of normality, and an examination of box plots, stem-and-leaf plots and histograms. The reliability (Cronbach's alpha) of the perception-based measurement scales for work group leaders was .91 for systems thinking and .89 for continuous improvement achievement. Reliability of the 4-item general perceived environmental uncertainty measure was .79.

Results

Hypotheses 10a and 10b were tested using moderated multiple regression (Table 7.14). The interaction effects model was significant, $R^2 = .153$, $F(3, 95) = 5.71$, $p = .001$, but the interaction term was not significant. Lacking a significant interaction term, a test of main effects was conducted. Results were significant, $R^2 = .152$, (adjusted $R^2 = .134$), $F(2, 96) = 8.56$, $p < .001$. Systems thinking was a

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statistically significant predictor of continuous improvement achievement, which supported the hypothesized main effects of H10a.

Table 7.14
Regression Analysis for Variables Predicting Continuous Improvement Achievement: Systems Thinking and Environmental Uncertainty

	Unstandardized Coefficients				Correlations		
Variables	*B*	Std. Error	β	*p*	Zero	Partial	Part
Interaction Effects Model (R^2 = .153)							
Constant	3.456	1.392		.015			
Systems thinking	.489	.414	.558	.241	.389	.120	.112
Uncertainty (PEU)	.125	.407	.119	.759	.058	.032	.029
Systems thinking X PEU	-.043	.119	-.235	.721	.303	-.037	-.034
Main Effects Model (R^2 = .152)							
Constant	3.933	.412		< .001			
Uncertainty (PEU)	-.016	.101	-.015	.873	.058	-.016	-.015
Systems thinking	.344	.084	.392	< .001	.389	.386	.385

Note. N = 99 work groups. PEU = perceived environmental uncertainty.

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Research Question 5:
Transformational Leadership and the Learning Organization Disciplines

The fifth and final research question addresses the relationship between transformational leadership behaviors and specific disciplines of the learning organization. Two hypotheses were tested to explicate this question. The first deals with inspirational leadership and shared vision, and the second with the intellectual stimulation component of transformational leadership and mental models.

Inspirational Motivation and Shared Vision

The eleventh hypothesis of the study concerns the relationship between the inspirational motivation aspect of transformational leadership and the shared vision component of organizational learning. This hypothesis was formulated at the work group level of analysis because shared vision is a group-level phenomenon. The measurement perspective of both variables was the aggregated perceptions of work group members (i.e., the within-groups average of subordinates' responses). The hypothesized relationship was expressed as follows:

H11: The inspirational motivation component of transformational leadership is positively associated with shared vision.

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Evaluation of Assumptions

There were no cases with missing data. The variables associated with the hypothesis were evaluated for conformance to the assumptions underlying linear correlation testing. Both the independent and dependent variables passed Lilliefors' test of normality at the .01 level, although both variables showed moderate skewness. Inspection of box plots, stem-and-leaf plots and histograms for these variables was generally supportive of the assumptions underlying the analysis. There were no apparent multivariate outliers in a scatter plot of the data. The reliability (Cronbach's alpha) of the IV and DV were .85 and .87 respectively at the individual level of analysis.

Results

The hypothesis was tested using bivariate correlation analysis. Analysis confirmed the hypothesis by finding the linear relationship statistically significant with $r(105) = .338, p < .001$.

Intellectual Stimulation and Managing Mental Models

The twelfth and final hypothesis of the study concerns the relationship between the intellectual stimulation aspect of transformational leadership and the organizational learning discipline of managing mental models. This hypothesis was formulated at the individual level of analysis because of the individual-level nature of

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the managing mental models measurement scale. The hypothesized relationship was expressed as follows:

H12: The intellectual stimulation component of transformational leadership is positively associated with managing mental models.

Evaluation of Assumptions

There were 13 cases (2.1% of the sample) with missing data. Only two cases were missing predictor values and 11 cases were missing dependent variable values. Consequently, missing values were handled with listwise deletion.

The variables associated with the hypothesis were evaluated for conformance to the assumptions underlying linear correlation testing. Both the independent and dependent variables showed moderate skewness (-.326, *SE* = .100 and -.332, *SE* = .100, respectively), and the IV demonstrated some kurtosis (-.488, *SE* = .199) but neither were sufficiently distorted to warrant transformation. Inspection of box plots, stem-and-leaf plots and histograms for these variables was generally supportive of the assumptions underlying the analysis. There were no apparent multivariate outliers in a scatter plot of the data. The reliability (Cronbach's alpha) of the IV and DV were .79 and .71 respectively.

Results

Analysis confirmed the hypothesis by finding the linear relationship statistically significant, $r(602) = .255, p < .001$.

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Multilevel Modeling

The significance levels from the preceding ordinary least squares (OLS) regression testing were retested using multilevel modeling. This was important because the study's multi-staged sampling design resulted in data that were hierarchically structured. That is, the data consisted of individuals nested within work groups, and work groups nested within organizations. Hierarchically clustered data violate the independence of observations assumption of OLS regression. When data are hierarchically clustered, OLS regression may underestimate the standard errors associated with regression coefficient estimates and consequently produce inflated Type 1 error rates (Hox, 1998). As a result, the reliability of the OLS-based significance levels needed to be checked by explicitly taking into account the hierarchical nature of the data. This was accomplished by multilevel modeling. Multilevel modeling was not used in place of OLS regression in this study for practical reasons; the multilevel software package used (HLM Version 5.04) was not as flexible and versatile as the software used for OLS regression (SPSS Version 10.0.7).

Intraclass Correlation

One may ask: to what degree may the preceding significance tests from OLS regression testing be biased? To make this determination, Heck and Thomas (2000) suggest partitioning the variance of dependent variables into within-group and between-group components. If the variation between groups is small (i.e., there is homogeneity between groups) then there is no call for multilevel analysis. A statistic

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that describes the homogeneity of groups is the intraclass correlation coefficient (ICC or ρ). If ρ is low, then groups are similar to one another and a single-level analysis is sufficient. If ρ is high, then groups are dissimilar and a multilevel analysis will yield appropriately adjusted significance estimates and greater insight into higher-order factors that may help to better explain relationships. In the present context, ρ may be defined as "the proportion of the variance in the outcome variable that is between the second-level units" (Kreft & de Leeuw, 1998, p. 9). The greater the intraclass correlation, the greater the inflation of Type 1 error levels in OLS regression, and this effect increases as group size increases (Barcikowski, 1981).

Calculation of intraclass correlation coefficients for the dependent variables used in this research suggested that a multilevel approach may be highly useful for understanding some of the relationships explored in this study and less useful for others. Table 7.15 reflects the random intercept ANOVA models (i.e., empty models) that were prepared to calculate the intraclass correlation coefficients. Four of the hypotheses in this research were formulated and tested at the individual level of analysis (H6, H7, H8a and H12). The intraclass correlation coefficients for dependent variables used at the individual level were as follows: employee fulfillment (ρ = .051), personal mastery (ρ = .001) and managing mental models (ρ = .057). These intraclass correlation coefficients indicate that there are small differences between work groups with respect to these particular outcome variables. When interpreted in combination with the small average group size (5.86 workers per group) and the favorable

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significance levels observed during analysis (e.g., $p < .001$) the ρ coefficients do not strongly suggest the need for a multilevel analysis since the presence of this level of intra-class correlation is not expected to excessively inflate the Type 1 error level observed under single-level regression (Kreft & De Leeuw, 1998, p. 10).

In contrast, the intraclass correlation coefficients for several of the dependent variables used at the group level were considerably higher (Table 7.16 and Table 7.17). These variables include customer focus ($\rho = .302$), continuous improvement commitment ($\rho = .265$), teamwork ($\rho = .275$), shared vision ($\rho = .283$), process control ($\rho = .227$), process feedback ($\rho = .180$), team learning ($\rho = .090$) and continuous improvement achievement ($\rho = .002$). The largest coefficients indicate outcome variables in which there is considerable within-group clustering across organizations. Nevertheless, several factors mitigate the negative impact of the high intraclass correlations. First, the significance levels observed in the group-level hypothesis testing with ordinary least squares were often very favorable (e.g., $p < .001$). Second, the number of observations within groups was small (an average of 5.53 work groups per organization). These factors reduce the intraclass correlation's tendency to inflate OLS-based Type 1 error levels (Barcikowski, 1981). Nevertheless, the proper way to assess the affect of non-zero intraclass correlations is to perform multilevel testing.

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Table 7.15
Random Intercept Models, Individual-Level Variables, Subordinate Perspective

Model		Param.	t or (X^2)	df	p
Level 1: Employee Fulfillment = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	5.042	82.48	104	<.001
	τ_{00}	.091	(140.97)	104	.009
	σ^2	1.69	–	–	–
	ρ	.051	–	–	–
Level 1: Personal Mastery = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	4.000	179.02	104	<.001
	τ_{00}	.004	(121.87)	104	.001
	σ^2	.283	–	–	–
	ρ	.001	–	–	–
Level 1: Managing Mental Models = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	3.568	96.25	104	<.001
	τ_{00}	.037	(137.28)	104	.016
	σ^2	.610	–	–	–
	ρ	.057	–	–	–

Note. γ_{00} = unstandardized regression coefficient. τ_{00} = var(U_{0j}). σ^2 = var(R_{ij}). ρ is the interclass correlation coefficient. All variables measured from individual subordinate's perspective. N = 615 individuals nested within 105 work groups.

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Table 7.16
Random Intercept Models, Group-Level Variables, Subordinate Perspective

Model		Param.	t or (X^2)	df	p
Level 1: Customer Focus = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	3.817	59.39	18	<.001
	τ_{00}	.053	(65.56)	18	<.001
	σ^2	.124	–	–	–
	ρ	.302	–	–	–
Level 1: Teamwork = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	3.410	33.81	18	<.001
	τ_{00}	.126	(53.74)	18	<.001
	σ^2	.333	–	–	–
	ρ	.275	–	–	–
Level 1: Shared Vision = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	3.552	46.00	18	<.001
	τ_{00}	.075	(60.32)	18	<.001
	σ^2	.190	–	–	–
	ρ	.283	–	–	–
Level 1: CI Commitment = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	3.982	55.51	18	<.001
	τ_{00}	.063	(52.99)	18	<.001
	σ^2	.174	–	–	–
	ρ	.265	–	–	–
Level 1: Team Learning = $\beta_{0j} + R_{ij}$ Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{00}	3.565	65.70	18	<.001
	τ_{00}	.019	(28.47)	18	.055
	σ^2	.193	–	–	–
	ρ	.090	–	–	–

Note. γ_{00} = unstandardized regression coefficient. τ_{00} = var(U_{0j}). σ^2 = var(R_{ij}). ρ is the interclass correlation coefficient. CI = continuous improvement. All variables are aggregated within-group means measured from subordinates' perspective. N = 105 work groups nested within 19 organizations.

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Table 7.17
Random Intercept Models, Group Level Variables, Work Group Leader Perspective

Model		Param.	t or (X^2)	df	p
Level 1: Process Control = $\beta_{0j} + R_{ij}$	γ_{00}	3.173	26.19	18	<.001
Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{00}	.166	(47.29)	18	<.001
	σ^2	.566	–	–	–
	ρ	.227	–	–	–
Level 1: Process Feedback = $\beta_{0j} + R_{ij}$	γ_{00}	3.367	34.38	18	<.001
Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{00}	.106	(45.70)	18	.001
	σ^2	.484	–	–	–
	ρ	.180	–	–	–
Level 1: CI Achievement = $\beta_{0j} + R_{ij}$	γ_{00}	5.029	63.94	18	<.001
Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{00}	.002	(16.83)	18	>.500
	σ^2	.640	–	–	–
	ρ	.002	–	–	–

Note. γ_{00} = unstandardized regression coefficient. τ_{00} = var(U_{0j}). σ^2 = var(R_{ij}). ρ is the interclass correlation coefficient. CI = continuous improvement. All variables measured from each work group leader's perspective. N = 104 work group managers nested within 19 organizations.

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Multilevel Testing Procedure

Regression equations were prepared for multilevel testing by matching each dependent variable in the study with predictor variables that were previously determined to be statistically significant using OLS-based regression testing. Separate regression equations were formed for each DV rather than replicating the OLS-based canonical testing procedures performed previously (e.g., H1, H2a and H4). Testing multiple DVs simultaneously with multilevel techniques (i.e., multivariate multilevel modeling) is considerably more complicated although it does offer some advantages including the containment of experiment-wise Type 1 error (Snijders & Bosker, 1999). In recognition of the foregoing, a conservative alpha level of .01 was used.

Multilevel Results

This section reviews the results of multilevel regression modeling. Results are organized hypothesis by hypothesis. The specific results from each multilevel regression analysis are reported in various tables. Each table specifies the level-1 and level-2 regression equations. The gamma (γ) coefficients in the tables represent unstandardized regression coefficients and are accompanied by *t* tests of significance. The tau coefficients represent the variance of the level-2 random effects (e.g., τ_{00} = var(U_{0j}), τ_{10} = var(U_{1j}), etc.) and are accompanied by chi-square tests of significance. The parameter σ^2 represents the variance at level-1, i.e., the variance of R_{ij}.

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Hypothesis 1

Prior multivariate testing of Hypothesis 1 indicated that the canonical expression was dominated by a subset of the canonical variates (i.e., not all of the IVs played a unique part in the multivariate relationship). To avoid unnecessarily complicated multilevel models, only the dominant variables from the prior canonical results were analyzed. Multilevel analysis (Table 7.18) confirmed that the passive form of management by exception was a significant (negatively correlated) predictor of continuous improvement commitment (γ_{10} = -.417, $p < .001$) and teamwork (γ_{10} = -.481, $p < .001$). The intraclass correlation coefficients associated with continuous improvement commitment (ρ = .265) and teamwork (ρ = .275), although fairly large, did not affect the OLS-based standard error estimates to the point of making the predictors non-significant. The least squares regression findings were therefore validated.

Hypothesis 2a

Multilevel analysis (Table 7.18) showed that the intellectual stimulation component of transformational leadership was a significant predictor of continuous improvement commitment (γ_{10} = .402, $p < .001$) and a significant predictor of teamwork (γ_{10} = .722, $p < .001$). The OLS regression findings were therefore validated.

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Table 7.18
Multilevel Modeling for Hypothesis 1 and 2a

	Model		Param.	t or (X^2)	df	p
	H1: First DV	γ_{00}	3.985	72.03	18	<.001
Level 1:	CI Commitment =	γ_{10}	-.417	-5.24	18	<.001
	$\beta_{0j} + \beta_{1j}$ (MBE-p) $+ R_{ij}$	τ_{00}	.032	(45.39)	18	.001
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.037	(29.12)	18	.047
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.117	–	–	–
	H1: Second DV	γ_{00}	3.420	45.42	18	<.001
Level 1:	Teamwork =	γ_{10}	-.481	-4.59	18	<.001
	$\beta_{0j} + \beta_{1j}$ (MBE-p) $+ R_{ij}$	τ_{00}	.052	(35.36)	18	.009
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.027	(20.11)	18	.326
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.275	–	–	–
	H2a: First DV	γ_{00}	3.986	67.65	18	<.001
Level 1:	CI Commitment =	γ_{10}	.402	5.14	18	<.001
	$\beta_{0j} + \beta_{1j}$ (IS) $+ R_{ij}$	τ_{00}	.040	(48.49)	18	<.001
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.015	(22.53)	18	.209
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.128	–	–	–
	H2a: Second DV	γ_{00}	3.411	51.98	18	<.001
Level 1:	Teamwork =	γ_{10}	.722	7.66	18	<.001
	$\beta_{0j} + \beta_{1j}$ (IS) $+ R_{ij}$	τ_{00}	.039	(35.05)	18	.009
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.012	(18.28)	18	.438
	$\beta_{1i} = \gamma_{10} + U_{1i}$	σ^2	.215	–	–	–

Note. Predictors were grand-mean centered. CI = continuous improvement; MBE-p = management by exception - passive form, IS = intellectual stimulation component of transformational leadership. N = 105 work groups nested within 19 organizations.

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Hypothesis 3

Multilevel analysis validated the findings of OLS regression testing (Table 7.19). Degree of teamwork was a significant (negatively correlated) predictor of laissez-faire leadership (γ_{10} = -.325, $p < .001$) as was customer focus (γ_{10} = -.539, p = .001). Continuous improvement commitment again emerged as a significant (negatively correlated) unique predictor of laissez-faire leadership (γ_{30} = -.447, p = .010). The p values from multilevel analysis were larger than those obtained from OLS regression testing, but not so inflated as to contradict the OLS-based findings.

Hypothesis 4

Hypothesis 4 was not supported by OLS regression testing. However, exploratory OLS-based regression testing found that active management by exception was positively correlated with both the use of process control ($p < .001$) and process feedback ($p = .002$). Subjecting these exploratory findings to multilevel analysis showed that the least squares significance levels were optimistically biased (Table 7.20). Under multilevel analysis, the significance levels increased for both process control ($p = .008$) and process feedback ($p = .039$). This inflation in Type 1 error is understandable given the fairly large intraclass correlation coefficients associated with process control ($\rho = .227$) and process feedback ($\rho = .180$). Using our strict .01 level for significance, the OLS-based exploratory finding relating to process feedback was contradicted when level 2-effects were taken into account by multilevel modeling.

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Table 7.19

Multilevel Modeling for Hypothesis 3

	Model		Param.	t or (X^2)	df	p
	<u>Three Predictor Model</u>	γ_{00}	.885	18.51	18	<.001
Level 1:	Laissez-Faire Leadership =	γ_{10}	-.124	-1.36	18	.189
	$\beta_{0j} + \beta_{1j}$ (Team) + β_{2j} (C. Focus) +	γ_{20}	-.074	-.53	18	.606
	β_{3j} (CI Commitment) + R_{ij}	γ_{30}	-.447	-2.89	18	.010
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{00}	.004	(31.95)	14	.004
	$\beta_{1j} = \gamma_{10} + U_{1j}$	τ_{10}	.015	(23.81)	14	.048
	$\beta_{2j} = \gamma_{20} + U_{2j}$	τ_{20}	.007	(20.84)	14	.106
	$\beta_{3j} = \gamma_{30} + U_{3j}$	τ_{30}	.137	(25.67)	14	.028
		σ^2	.195	–	–	–
	<u>Single Predictor Model 1</u>	γ_{00}	.899	17.87	18	<.001
Level 1:	Laissez-Faire Leadership =	γ_{10}	-.325	-4.32	18	<.001
	$\beta_{0j} + \beta_{1j}$ (Team) + R_{ij}	τ_{00}	.001	(21.17)	18	.271
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.000	(11.71)	18	>.500
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.261	–	–	–
	<u>Single Predictor Model 2</u>	γ_{00}	.910	14.16	18	<.001
Level 1:	Laissez-Faire Leadership =	γ_{10}	-.539	-3.97	18	.001
	$\beta_{0j} + \beta_{1j}$ (C. Focus) + R_{ij}	τ_{00}	.030	(30.90)	18	.029
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.025	(15.04)	18	>.500
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.238	–	–	–
	<u>Single Predictor Model 3</u>	γ_{00}	.901	16.04	18	<.001
Level 1:	Laissez-Faire Leadership =	γ_{10}	-.599	-5.50	18	<.001
	$\beta_{0j} + \beta_{1j}$ (CI Commitment) + R_{ij}	τ_{00}	.018	(27.00)	18	.079
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.031	(21.07)	18	.276
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.206	–	–	–

Note. Predictors were grand-mean centered. CI = continuous improvement. Team = teamwork; C = customer. N = 105 work groups nested within 19 organizations.

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Table 7.20
Multilevel Modeling for Hypothesis 4

Model			Param.	t or (X^2)	df	p
	First DV	γ_{00}	3.176	30.92	18	<.001
Level 1:	Process Control =	γ_{10}	.505	3.00	18	.008
	$\beta_{0j} + \beta_{1j}$ (MBE-a) $+ R_{ij}$	τ_{00}	.090	(31.60)	18	.024
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.167	(29.29)	18	.045
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.473	–	–	–
	Second DV	γ_{00}	3.372	37.78	18	<.001
Level 1:	Process Feedback =	γ_{10}	.324	2.23	18	.039
	$\beta_{0j} + \beta_{1j}$ (MBE-a) $+ R_{ij}$	τ_{00}	.072	(37.64)	18	.005
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.130	(26.37)	18	.091
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.341	–	–	–

Note. Predictors were grand-mean centered. MBE-a = management by exception – active form. $N = 615$ individuals nested within 105 work groups.

Hypothesis 5a

Hypothesis 5a was not supported by OLS regression testing. However, exploratory OLS-based regression testing found three subordinate-perspective variables with significant zero-order correlations with work group leaders' assessment of continuous improvement achievement (although none were uniquely significant). The near zero intraclass correlation coefficient of the dependent variable ($\rho = .002$) indicated no need for multilevel testing of these exploratory findings.

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Hypothesis 6

Multilevel analysis validated the findings of OLS-based hierarchical regression testing (Table 7.21). Both process control (γ_{30} = .174, p = .009) and process feedback (γ_{30} = .438, p < .001) were significant predictors of employee fulfillment after

Table 7.21
Multilevel Modeling for Hypothesis 6

	Model		Param.	t or (X^2)	df	p
	Process Control Effect					
Level 1:	Employee fulfillment =	γ_{00}	4.858	54.17	104	<.001
	$\beta_{0j} + \beta_{1j}$ (log_tenure) + β_{2j} (LMX) +	γ_{10}	.296	3.03	611	.003
	+ β_{3j} (process control) + R_{ij}	γ_{20}	.514	6.98	611	<.001
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{30}	.174	2.64	104	.009
	$\beta_{1j} = \gamma_{10}$	τ_{00}	.115	(155.68)	104	.001
	$\beta_{2j} = \gamma_{20}$	τ_{30}	.003	(77.41)	104	>.500
	$\beta_{3j} = \gamma_{30} + U_{3j}$	σ^2	1.464	–	–	–
	Process Feedback Effect					
Level 1:	Employee fulfillment =	γ_{00}	4.858	55.98	104	<.001
	$\beta_{0j} + \beta_{1j}$ (log_tenure) + β_{2j} (LMX) +	γ_{10}	.296	2.97	611	.003
	+ β_{3j} (process feedback) + R_{ij}	γ_{20}	.340	4.57	611	<.001
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{30}	.438	5.41	104	<.001
	$\beta_{1j} = \gamma_{10}$	τ_{00}	.138	(169.42)	104	<.001
	$\beta_{2j} = \gamma_{20}$	τ_{30}	.067	(107.17)	104	.396
	$\beta_{3j} = \gamma_{30} + U_{3j}$	σ^2	1.345	–	–	–

Note. Predictors were group-mean centered. LMX = leader-member exchange quality. N = 615 individuals nested within 105 work groups.

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controlling for (the log of) tenure and LMX (leader-member exchange quality). The multilevel equations without random effects at level-2 reflect the predictors that were treated as control variables. That is, the control variables lack the $U_{\cdot j}$ disturbance terms in the level-2 equations. Consequently, the control variables also lack their corresponding tau parameters (the variance of the disturbance terms).

Hypothesis 7

Multilevel analysis validated the findings of OLS-based hierarchical regression testing (Table 7.22). Personal mastery was a significant predictor of employee fulfillment ($\gamma_{40} = .471, p < .001$) after controlling for LMX, use of process feedback and (the log of) tenure.

Hypothesis 8a

Multilevel analysis validated the findings of OLS-based hierarchical regression testing (Table 7.22). Process feedback ($\gamma_{10} = .116, p < .001$) was a significant predictor of personal mastery after controlling for self-efficacy.

Hypothesis 9

Multilevel analysis validated the findings of OLS-based correlation testing (Table 7.23). Process feedback ($\gamma_{10} = .400, p < .001$) was a significant predictor of team learning.

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Table 7.22
Multilevel Modeling for Hypothesis 7, 8a and 12

	Model		Param.	*t* or (X^2)	df	*p*
	Hypothesis 7					
Level 1:	Employee Fulfillment =	γ_{00}	4.829	55.79	104	<.001
	$\beta_{0j} + \beta_{1j}$ (LMX) + β_{2j} (Feedback) +	γ_{10}	.316	4.29	610	<.001
	β_{3j} (log_tenure) + β_{4j} (PM) + R_{ij}	γ_{20}	.384	5.17	610	<.001
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	γ_{30}	.345	3.48	610	.001
	$\beta_{1j} = \gamma_{10}$	γ_{40}	.471	4.55	104	<.001
	$\beta_{2j} = \gamma_{20}$	τ_{00}	.141	(222.32)	103	<.001
	$\beta_{3j} = \gamma_{30}$	τ_{40}	.037	(114.34)	103	>.500
	$\beta_{4j} = \gamma_{40} + U_{4j}$	σ^2	1.327	–	–	–
	Hypothesis 8a	γ_{00}	3.996	178.38	104	<.001
Level 1:	Personal Mastery =	γ_{10}	.116	4.67	104	<.001
	$\beta_{0j} + \beta_{1j}$ (Feedback) + β_{2j} (SE) + R_{ij}	γ_{20}	.110	3.49	612	.001
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{00}	.009	(133.57)	104	.027
	$\beta_{1j} = \gamma_{10} + U_{1j}$	τ_{10}	.001	(87.80)	104	>.500
	$\beta_{2j} = \gamma_{20}$	σ^2	.255	–	–	–
	Hypothesis 12	γ_{00}	3.566	95.83	104	<.001
Level 1:	Managing Mental Models =	γ_{10}	.197	4.55	104	<.001
	$\beta_{0j} + \beta_{1j}$ (IS) + R_{ij}	τ_{00}	.040	(143.32)	104	.007
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.005	(94.27)	104	>.500
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.584	–	–	–

Note. Predictors were group-mean centered. LMX = Leader-member exchange quality; Feedback = use of process feedback; SE = self-efficacy; PM = Personal mastery; IS = intellectual stimulation. $N = 615$ individuals nested within 105 groups.

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Table 7.23
Multilevel Modeling for Hypothesis 9, 10a and 11

Model			Param.	t or (X^2)	df	p
	Hypothesis 9	γ_{00}	3.544	67.12	18	<.001
Level 1:	Team Learning =	γ_{10}	.400	4.53	18	<.001
	$\beta_{0j} + \beta_{1j}$ (Feedback) + R_{ij}	τ_{00}	.018	(29.97)	18	.037
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.036	(27.57)	18	.069
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.143	–	–	–
	Hypothesis 10a	γ_{00}	4.99	61.60	18	<.001
Level 1:	CI Achievement =	γ_{10}	.410	3.92	18	.001
	$\beta_{0j} + \beta_{1j}$ (systems thinking) + R_{ij}	τ_{00}	.018	26.19	18	.095
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.042	26.56	18	.088
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.505	–	–	–
	Hypothesis 11	γ_{00}	3.571	48.38	18	<.001
Level 1:	Shared Vision =	γ_{10}	.313	2.97	18	.009
	$\beta_{0j} + \beta_{1j}$ (IM) + R_{ij}	τ_{00}	.071	(72.50)	18	<.001
Level 2:	$\beta_{0j} = \gamma_{00} + U_{0j}$	τ_{10}	.104	(43.90)	18	.001
	$\beta_{1j} = \gamma_{10} + U_{1j}$	σ^2	.130	–	–	–

Note. Predictors were grand-mean centered. Feedback = use of process feedback; CI = continuous improvement; IM = inspirational motivation. N = 105 work groups nested within 19 organizations.

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Hypothesis 10a

Multilevel analysis validated the findings of OLS-based regression testing (Table 7.23). Systems thinking ($\gamma_{10} = .410, p < .001$) was a significant predictor of continuous improvement achievement.

Hypothesis 11

Multilevel analysis validated the findings of OLS-based correlation testing (Table 7.23). Inspirational motivation ($\gamma_{10} = .313, p = .009$) was a significant predictor of shared vision.

Hypothesis 12

Multilevel analysis validated the findings of OLS-based correlation testing (Table 7.22). Intellectual stimulation ($\gamma_{10} = .197, p < .001$) was a significant predictor of managing mental models.

Structural Equation Models

The preceding regression-based hypothesis testing was augmented by constructing a series of structural equation models. Also known as covariance structure modeling, these models present a more comprehensive systems view of the multivariate relationships explored in this study. Structural equation modeling (SEM) provided an overall evaluation of the set of relationships confirmed from the previous statistical tests of individual hypotheses and was used to explore additional

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relationships suggested by SEM itself. Because two different levels of analysis were employed in this research (individual level and work group level), separate models for each level of analysis were required. In addition, wherever possible this study used dual measurement perspectives to remove same-source bias (i.e., measuring IVs based on subordinates' survey responses and DVs from work group leaders' responses). Continuing this strategy with SEM required the construction of multiple models.

Structural equation modeling is a comprehensive multivariate technique used to test hypotheses involving observable variables and latent variables (Hoyle, 1995). Combining linear regression and factor analysis, SEM provides estimates of coefficients in a set of linear structural equations. Input to SEM analysis includes a causal model of theorized relationships (i.e., the structure) and a data file. SEM outputs the strength (coefficients) of each of the various hypothesized relationships as well as numerous goodness-of-fit indices for the model as a whole. SEM was performed with AMOS Version 4.01 using full information maximum likelihood (FIML) estimation to minimize the difference between the observed and estimated population covariance matrices. FIML is the most commonly applied fitting function (Bollen, 1989, p. 107) and has been found to be robust against violations of distributional assumptions of normality (Chou & Bentler, 1995, pp. 38-39).

It should be emphasized that the proceeding structural equation models were not constructed for confirmatory purposes. Their purpose here is to provide graphical illustrations of a series of complicated multivariate relationships and to provide

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starting points for future follow-on research. Consequently, some models reflect a relaxed significance level. Also, the limited sample size did not afford the luxury of a hold-out sample for cross-validation of models that were subjected to various modifications or refinements. Additionally, in some models the measurement model was modified by reducing the number of questionnaire items comprising multi-item measurement scales. This was done to improve the ratio of cases to estimated parameters in the more complex models and was important due to the large number of latent variables and relationships combined with small sample size at the group level.

Diagram Conventions

A number of conventions are common to illustrating structural equation models. These conventions are described below.

Rectangles and Ellipses

Each structural equation model in this study is presented graphically as a path diagram. In the path diagrams the observed variables (questionnaire items) are indicated by rectangles. Latent variables are indicated by ellipses. Latent variables can be either independent latent variables (ILVs) (those with no straight arrows pointing into them) or dependent latent variables (DLVs) (those with one or more straight arrows pointing into them).

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Circles

Circles represent error terms. Circles associated with the observed variables (rectangles) model errors of measurement (e.g., e1, e2, etc.). Circles associated with latent variables (ellipses) model errors of prediction (e.g., z1, z2, etc.). With one exception in this study, observed variables are paired with error terms. The exception is when an observed variable is assumed to be measured without error. The questionnaire item measuring an individual's tenure with an organization was assumed to be measured without error.

Arrows

Single-headed straight arrows signify a theoretical causal relationship between variables (except for error terms). When drawn from latent variables (ellipses) to observed variables (rectangles), single-headed arrows imply that the latent construct is responsible for the observed measurement. Double-headed curved arrows indicate covariation between variables.

Parameter Estimates

The number (parameter estimate) adjacent to each single-headed straight arrow in the path diagram is the path's estimated loading coefficient; this number may be thought of as a regression parameter. In this study, all of the SEM diagrams present standardized regression parameter estimates (akin to beta coefficients in conventional regression analysis). The number adjacent to a curved double-headed arrow

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represents estimated correlation (standardized covariance) between two latent variables. The number adjacent to each observed variable (rectangle) is a squared multiple correlation (SMC). The SMCs reflect the reliability of the measured variables. SMCs may be interpreted as the proportion of variance in the observed variable accounted for by the associated latent variable. Finally, the number appearing adjacent to a dependent latent variable (DLV) is the variance accounted for in the DLV by the (one or more) independent latent variables pointing into it.

Model of Relationships at the Individual Level

Four of the hypotheses supported in this study (H6, H7, H8a and H12) were formulated at the individual level of analysis. An overall model of these relationships was constructed based on the results of the preceding hypothesis tests. All of the variables associated with these hypotheses including control variables were included in the model. Paralleling the preceding regression testing, variables relating to these four hypotheses were measured from the perspective of individual work group subordinates. Any relationships among variables found to be non-significant from prior testing were not included in the initial model. A maximum of five observed variables per latent construct were used to improve the ratio of cases to estimated parameters. As an example, the scale for process feedback consisted of seven items. The two items that showed the lowest average inter-item correlation within the scale were dropped to form a five-item measure.

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Data Screening

A total of 81 cases (13.2% of the 615 person sample) had some degree of missing data among the variables of interest. Missing data were explored for patterns of incompleteness using SPSS missing value analysis. Most of the perceptual variables were missing responses from just two or three subjects, but the compound effect of using multi-item measures was 62 cases with missing perceptual data. Another 19 cases were missing a response to the organizational tenure question (i.e., the number of years a subject worked for the organization). It was speculated that this might be due to some participants' concern that the tenure question might be used to uniquely identify them. It was further speculated that these subjects might differ on the variables of interest. A series of one-way ANOVA tests were performed to ascertain if subjects who responded to the tenure question differed from those who did not respond with respect to group means on the variables of interest (process control, process feedback, personal mastery, intellectual stimulation, employee fulfillment, LMX, managing mental models and self-efficacy). The results of these multiple comparisons of group means showed no significant differences at the .01 level. The structural equation modeling program, AMOS, is capable of handling missing data using full information maximum likelihood (FIML) estimates (Arbuckle & Wothke, 1999) to minimize bias in the estimates of variance and covariance. Nevertheless, AMOS is unable to compute several goodness-of-fit indices in the presence of missing data. Consequently, the 81cases with missing data were eliminated from the analysis.

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All variables were previously screened for normality and outliers. Multivariate tests showed lack of multivariate normality (*c.r.* = 41.0) but this appeared to be due to only moderate skewness (0.102 to -1.95) and kurtosis (-1.08 to 1.41) across the measures (except for self-efficacy, which showed kurtosis above 4.6 on two of its three items). No variables were transformed prior to use other than to reverse-score the three items associated with the managing mental models scale and to employ the log transform of organizational tenure. The ratio of cases to estimated parameters was an acceptable 7:1 (Schumacker & Lomax, 1996, p. 20).

Results

The independence model (H_o: variables are uncorrelated with one another) was rejected: $\chi 2$ (595, $N = 534$) = 9959.6, $p < .001$. The model of previously confirmed hypotheses was tested next (Figure 7.1; Model 1 in Table 7.24). A chi-square difference test indicated a significant improvement in fit between the independence model and Model 1: $\Delta\chi 2$ (41, $N = 534$) = 7984, $p < .001$. General support for Model 1 was poor: $\chi 2$ (554, $N = 534$) = 1976.0, $p < .001$; $\chi 2$ /df = 3.567. All paths were significant at the .05 level (t = 2.4 to 23.8) except the path from process feedback to employee fulfillment (t = 1.88, p = .06). Model 1 was subsequently modified to improve the model's fit with the data. Only changes that could be theoretically justified were made. Modifications included adding three paths with high modification indices (MIs). Exploratory modifications were made in a nested sequence of steps. A relaxed p value was used in considering paths for inclusion in

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the model (see below). The fit of each successive model is summarized in Table 7.24 and the final model appears in Figure 7.3.

The overall fit of the final model was fair as judged by the comparative fit index (CFI = .922) but poor by other fit measures. There were eight MIs remaining among latent variables but all had values below 10 and none were theoretically justifiable. The model's three dependent latent variables (employee fulfillment, personal mastery and managing mental models) exhibited squared multiple correlations of .44, .10 and .07 respectively (values above .50 are desirable). Each of the paths in the final model was significant at the .01 level except for the path from process feedback to personal mastery (p = .020), process feedback to fulfillment (p = .051), and personal mastery to employee fulfillment (p = .081).

Some explanation for the final model's mediocre fit may be found in the standardized residual covariances. Standardized residual covariances ranged from -2.76 to 8.00, indicating significant unexplained relationships. The largest residual covariances appeared between questionnaire items relating to the process feedback scale and the LMX (leader-member exchange quality) scale. Inspection of the items from these scales revealed the reason for the high residuals. The process feedback scale contains items such as "Information on quality performance is readily available to me" and "My manager often comments about the quality of my work." The LMX scale contains items such as "Do you know where you stand with your supervisor?" and "Do you usually know how satisfied your supervisor is with what you do?" The

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content of these items are very similar to one another. These questionnaire items are constrained to be unrelated in the model, so the model's fit indices reflect the corresponding lack of fit to the data. Although not done here, a possible modeling remedy would be to conduct a factor analysis to regroup the questionnaire items into new latent constructs and proceed to develop a new structural model using the revised latent variables.

Interpreting the model as it stands (Figure 7.2) we see paths reflecting each of the four individual level hypotheses we sought to model. The SEM diagram allows us to readily observe the direct and indirect effects that process feedback has on employee fulfillment. We see a direct effects path from process feedback to employee fulfillment, and an indirect path to employee fulfillment through personal mastery. The diagram also allows us to visualize the how the control variables used in regression testing (self-efficacy and LMX) fit into the overall set of relationships. Also, through the model modification process, SEM shows us the strong covariance between the two types of process management practices from our theoretical model: process control and process feedback. This covariance makes sense since the deployment of process control techniques within a work group may be expected to generate increased process feedback to work group members as a result of the process-related data generated. That is, process control methods (e.g., use of statistical quality control, data on the deviation of an output from the target value, etc.) feed information back to work group members on the state of work processes. Also, the model reflects

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a strong positive relationship between the intellectual stimulation component of transformational leadership and LMX. This covariation indicates that more frequent displays of this transformational leadership behavior are associated with higher quality leader-member relationships.

Table 7.24
Nested Sequence of Models for Individual-Level Effects: Model Fit Indices

	χ^2	df	χ^2/df	χ^2_{diff}	NFI	RMSEA	AGFI	CFI
Saturated	0	0	--	--	1	--	--	1
Independence	9959.6	595	16.74	--	0	.169	.270	0
Model 1	1976.0	554	3.567	7984*	.802	.069	.803	.848
Model 2	1691.1	553	3.058	285*	.830	.062	.829	.878
Model 3	1426.7	552	2.585	264*	.857	.055	.850	.907
Model 4	1279.9	551	2.323	147*	.871	.050	.860	.922

Note. See notes for Table A1.3 for an explanation of fit indices.
Model 1: Initial model of previously confirmed hypotheses (Figure 7.1).
Model 2: Added path with MI = 216 (Intellectual Stimulation ↔ LMX).
Model 3: Added path with MI = 207 (Process Feedback ↔ Process Control).
Model 4: Added path with MI = 107 (Self-efficacy → Fulfillment).
Model 4 is the final model illustrated in Figure 7.2.
* $p < .001$.

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Figure 7.1

Initial Path-Analytic Model for Individual-Level Effects (Standardized Estimates)

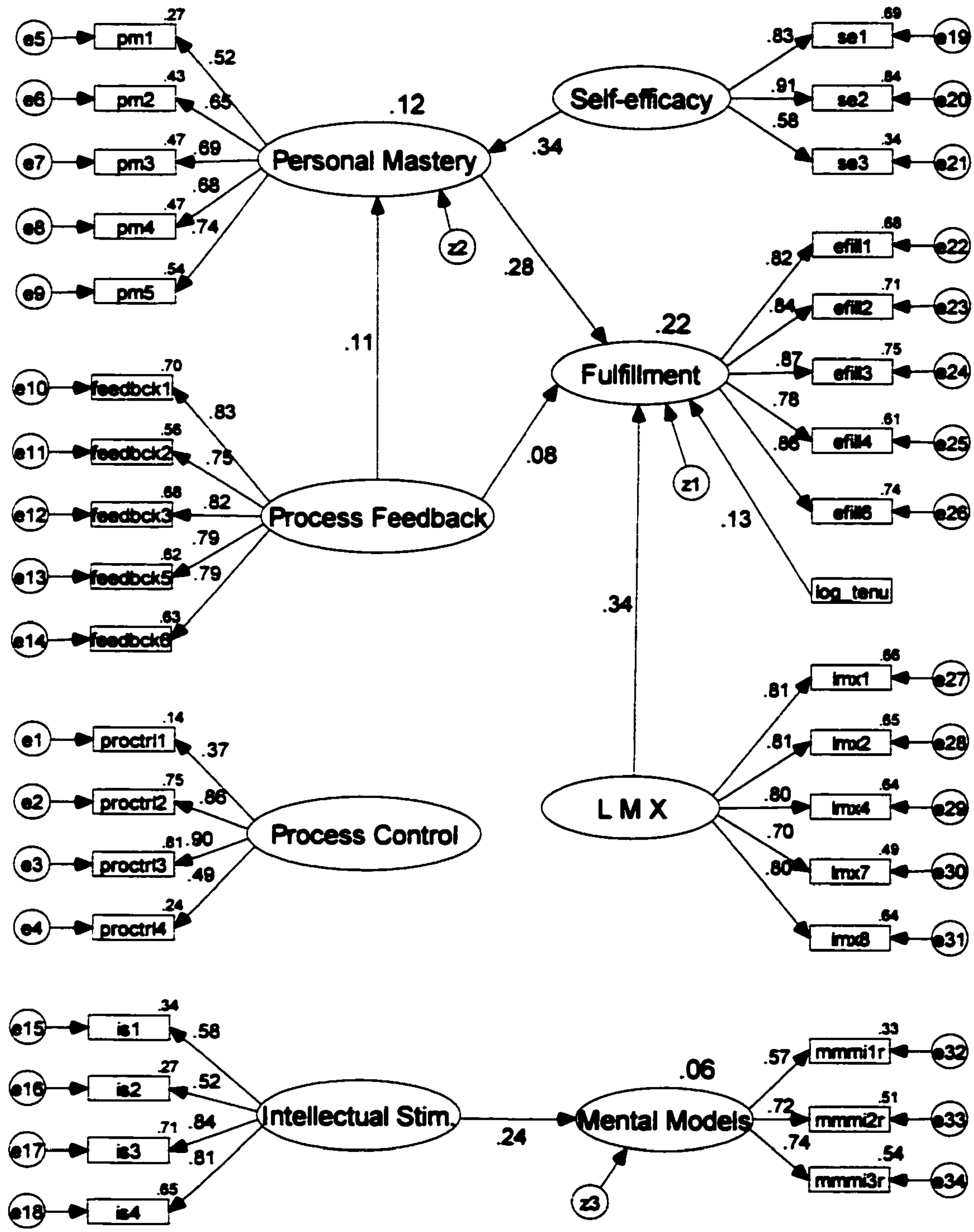

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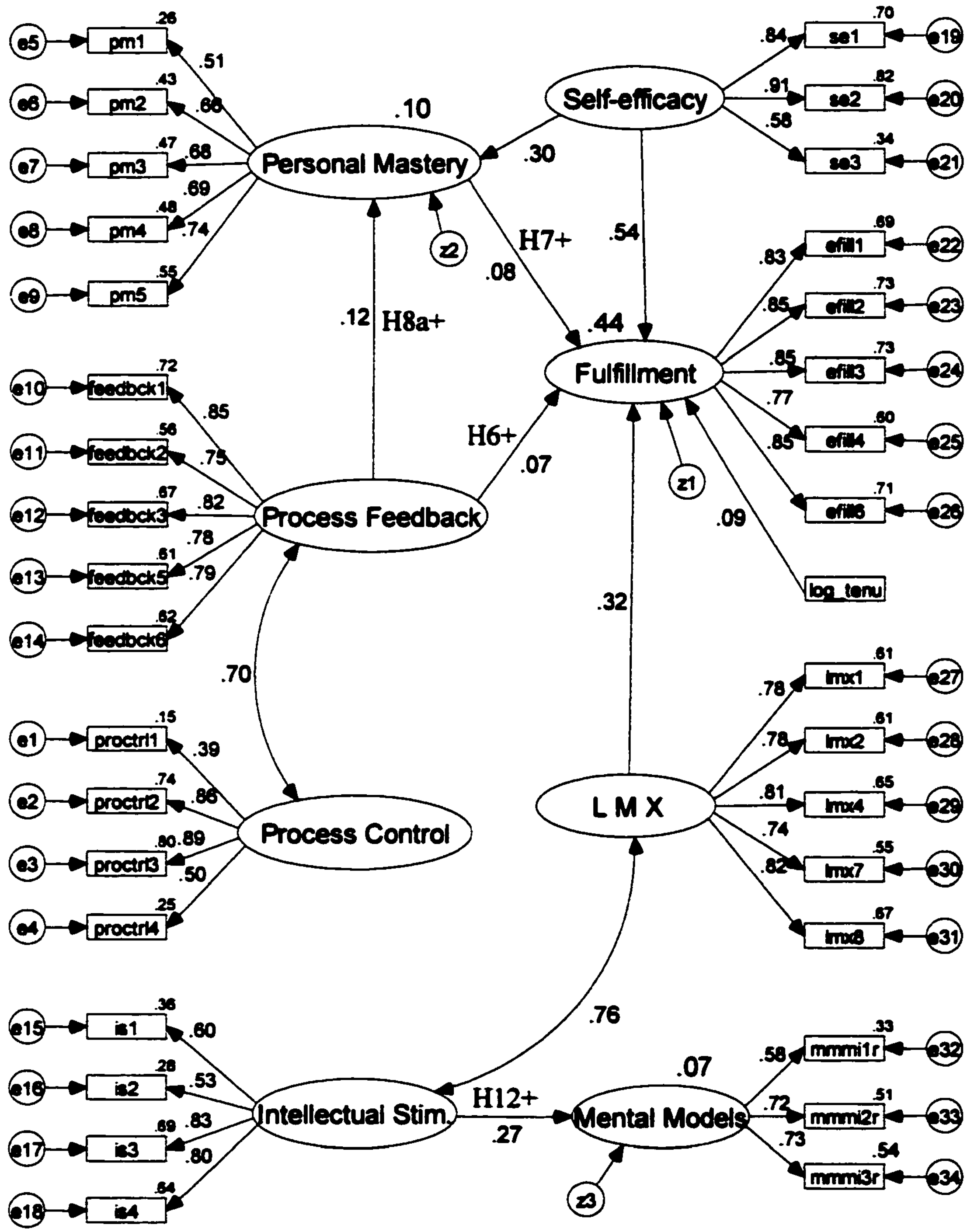
Figure 7.2
Final Path-Analytic Model for Individual-Level Effects (Standardized Estimates)



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Model of Relationships at the Work Group Level

Six of the hypotheses supported in this study by regression testing (H1, H2a, H3, H9, H10a and H11) were formulated at the work group level of analysis. Constructing a single structural equation model of these relationships was not possible for two reasons. First, the strategy to avoid common method variance (i.e., same-source bias) meant that for some hypothesis tests the DV was measured from the perspective of subordinates, and for other tests that same variable was measured from the perspective of work group leaders. A single SEM could not support this arrangement. Second, a single model's complexity coupled with the small sample size at the group level would make the ratio of cases to estimated parameters drop below unity. The situation of more free parameters than observations would make all results relating to such a model invalid. Consequently, several less complex models were constructed and tested.

Measurement Models

To simplify the measurement models, previously identified relationships pertaining to the five subfactors of transformational leadership were modeled using the higher order factor of transformational leadership as the independent latent variable. That is, each of the five subfactors of transformational leadership was represented as an observed endogenous variable. In addition, a maximum of five observed variables per latent construct were used to improve the ratio of cases to estimated parameters.

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Item reduction was important due to the large number of latent variables and relationships combined with small sample size at the group level.

Data Aggregation and Screening

Data were aggregated within work groups to provide group-level measures for analysis. Within-group aggregation was performed by computing medians for each questionnaire item. Medians were a practical choice in that the median is less sensitive to outliers than the mean and (unlike using the mean) did not require manually screening for outliers at the item level prior to aggregation. Of the 105 work groups in the study, only two groups were excluded listwise for missing values on aggregated response variables. All observed variables were previously screened for normality. Multivariate tests showed lack of multivariate normality (*c.r.* = 4.865); the next section explains how this issue was managed. No variables were transformed prior to use other than to reverse-score the six items associated with continuous improvement achievement.

Sample Size Issues

The sample afforded 103 work groups with complete data. This is a very small sample for analysis with SEM for several reasons. Parameter estimates and goodness-of-fit tests are sensitive to sample size and results may be unstable with small samples (Bollen, 1989). Statistical power is also adversely affected by small sample size. Compounding the problem of small sample size is model complexity. While a simple

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model with few observed variables may be adequately tested with a small sample, a more complex model may suffer from poor fit and unstable parameter estimates. Related to this issue is the ratio of cases to the number of parameters that must be estimated in the model. A variety of suggestions has been offered on the minimum sample size needed for accurate parameter estimates (Schumacker & Lomax, 1996, p. 20). Depending on the normality of variables, between 5 and 10 cases per estimated parameter has been recommended. Because each of the perceptual measures in the study involved scales with multiple indicators, the resulting ratio of cases to parameters was not favorable even after trimming indicators to a maximum of five per latent variable. The results sections below describe this problem in further detail as they relate to each model tested.

In addition, many common fit indices are biased under small sample conditions (Hu & Bentler, 1995). The normed fit index (NFI) in particular is downward biased with small samples and when degrees of freedom are large relative to sample size. Consequently, the present analysis focused on the comparative fit index (CFI) as a key indicator of model fit. CFI is recommended by West, Finch and Curran (1995) for small sample work since this index suffers only a small (3% to 4%) downward bias in small sample work and maintains this performance even under conditions of severe non-normality.

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Constructing Models at the Work Group Level of Analysis

Three models were constructed to cover the various relationships tested under regression analysis. The first model includes variables pertaining to leadership behaviors, quality-supportive principles and organizational learning. This model is referred to as the leadership effects model. The second model includes variables pertaining to process management practices, process outcomes and organizational learning and is referred to as the continuous improvement achievement model. The third model further investigates previous exploratory findings relating to the antecedents of process management practices.

Leadership Effects Model

A model of leadership effects was constructed around the variables relating to leadership behaviors, quality-supportive principles and organizational learning. This model covered four of the previously supported hypotheses: H1, H2a, H3 and H11. Consistent with the measurement perspectives used in regression testing, each of the variables in the model was measured from the perspective of subordinates. Direct effects paths were drawn based regression results. Covariance paths among the leadership constructs were drawn based on prior research showing intercorrelations among the leadership instrument's factor scores (Bass & Avolio, 1997). The initial model of relationships is diagramed in Figure 7.3.

Testing rejected the associated independence model: $\chi2$ (351, N = 103) = 2064.5, p < .001. The model in Figure 7.3 was tested next (Model 1 in Table 7.25). A

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chi-square difference test indicated a significant improvement in fit between the independence model and Model 1: $\Delta\chi2$ (38, N = 103) = 1633.9, $p < .001$. Nevertheless, four paths in Model 1 were not significant ($p > .05$). The reason stems from the strong intercorrelations among leadership constructs. Inclusion of these intercorrelations results in direct effects paths that do not explain unique variance in outcome variables. The four non-significant paths were eliminated in Model 2.

Inspection of the modification indices of Model 2 suggested a path from continuous improvement commitment to customer focus. A path between these two constructs could be theoretically justified, but the causal direction could be argued in either direction. That is, a greater increase in customer focus could lead to a greater commitment to improvement in order to satisfy those customers. Likewise, a greater commitment to improvement among work group members could lead to a stronger focus on the needs and desires of customers. Since both constructs are modeled as dependent latent variables, SEM requires any path between them to be directional; a non-directional covariance path could not be added. Consequently, an intuitive choice was made to represent the causal direction from commitment to customer focus. The addition of this path in Model 3 (the final model) represented a significant improvement over Model 2, $\Delta\chi2$ (1, N = 103) = 20.2, $p < .001$.

The final model is illustrated in Figure 7.4. A chi-square test of exact fit failed, but this test of model fit is extremely sensitive to even minor departures of fit, $\chi2$ (316, N = 103) = 413.9, $p < .001$. However, the model's chi-square per degree of

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freedom ratio was good, $\chi2$ /df = 1.310. All regression weights were significant in the measurement model (t = 4.66 to 12.81) and in the structural model (t = 2.78 to 5.23). The comparative fit index, an adjunct fit index particularly recommended for small sample studies (West, Finch & Curran, 1995) was .943 and indicated reasonable fit. While NFI and AGFI were both below .90, these indices are known to be downward biased by small sample sizes. Modification indices involving latent variables were small (below 6) and the paths they suggested could not be theoretically justified. Standardized residual covariances ranged from -2.22 to 2.53 indicating no significant unexplained relationships. The ratio of cases to estimated parameters was 1.7:1. The final leadership effects model explained a substantial portion of the variance in teamwork (54%), customer focus (45%), commitment to continuous improvement (29%) and shared vision (29%).

Table 7.25
Nested Sequence of Models for Leadership Effects: Model Fit Indices

	$\chi2$	df	$\chi2$ /df	$\chi2_{diff}$	NFI	RMSEA	AGFI	CFI
Saturated	0	0	--	--	1	--	--	1
Independence	2064.5	351	5.882	--	0	.219	.144	0
Model 1	430.6	313	1.376	1633.9*	.791	.061	.734	.831
Model 2	434.1	317	1.370	3.5	.790	.060	.735	.932
Model 3	413.9	316	1.310	20.2*	.800	.055	.743	.943

Note. See notes for Table A1.3 for explanation of fit indices.
Model 1: Model based on prior regression results (Figure 7.3).
Model 2: Dropped four non-significant paths.
Model 3: Added path with MI = 14.8 (CI Commitment → Customer focus). Model 3 is the final model diagrammed in Figure 7.4.
*$p < .001$.

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Figure 7.3

Initial Path-Analytic Model for Leadership Effects (Standardized Estimates)

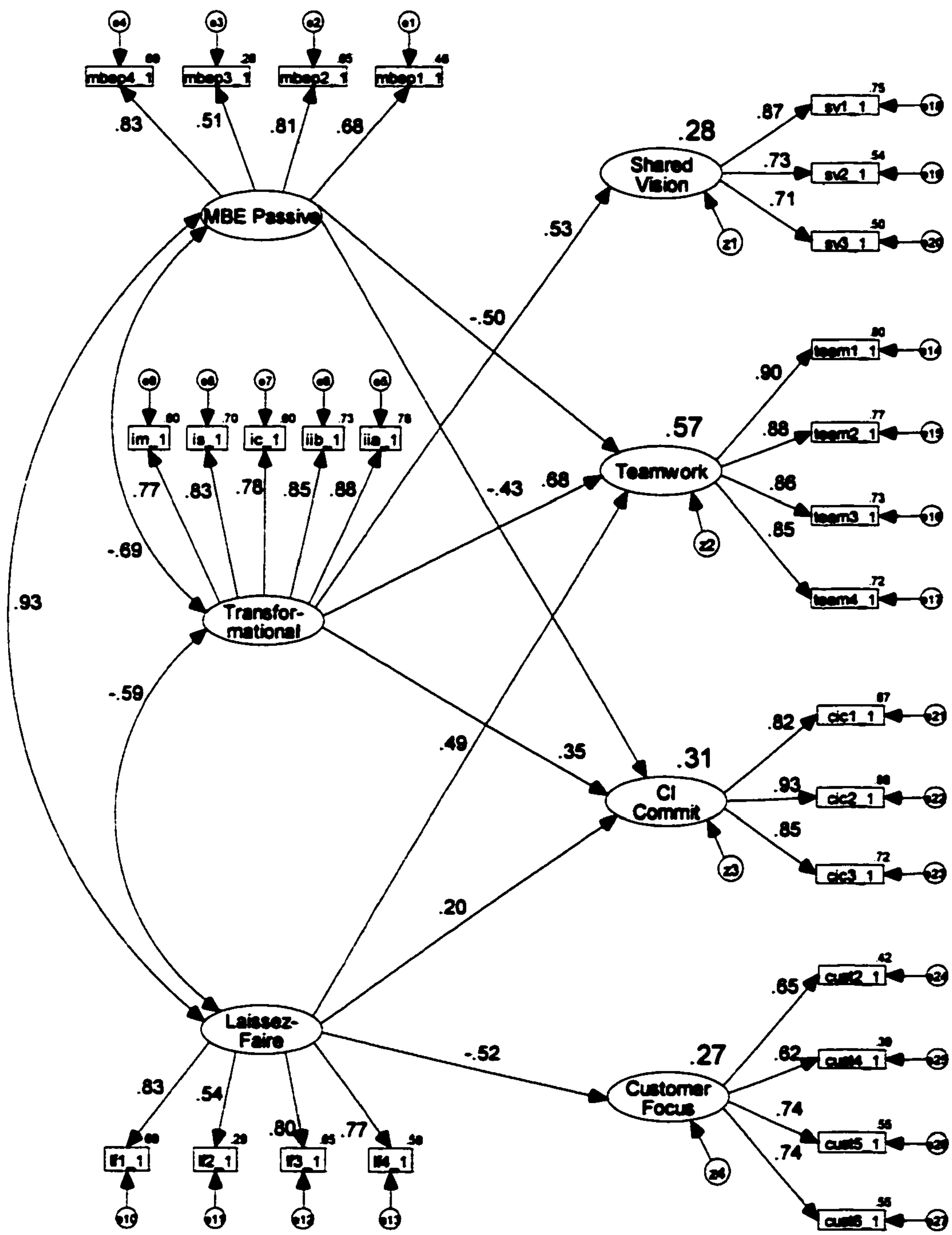

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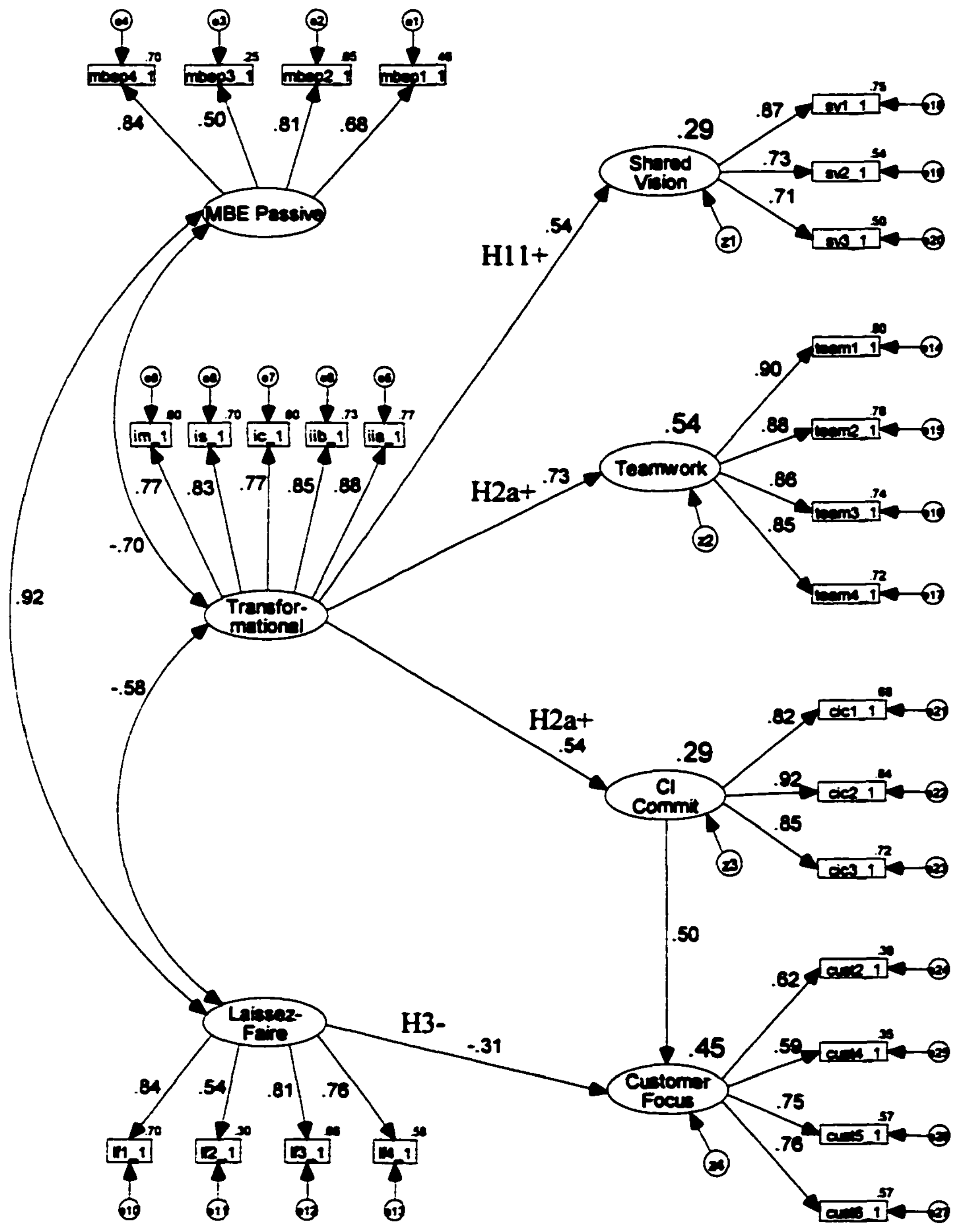
Figure 7.4
Final Path-Analytic Model for Leadership Effects (Standardized Estimates)



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Continuous Improvement Achievement Model

Continuous improvement achievement is a central point of focus for quality managers and a key goal of quality management systems. The following model reflects the antecedents of continuous improvement achievement and includes predictors relating to process management practices and organizational learning. This model encompasses two of the previously supported hypotheses (H9 and H10a) as well as one hypothesis that was not supported by regression testing (H5a). Hypothesis 5a was included on the chance that the results from SEM might yield different (or more interesting) results compared to regression testing. Consistent with the measurement perspectives used in regression testing, three of the variables (process control, process feedback and team learning) were measured from the perspective of subordinates, while systems thinking and continuous improvement achievement were measured from the perspective of work group leaders. A covariance path between the two process management practices (process control and process feedback) was included based on prior findings that showed a correlation between these two variables. The initial model of relationships is diagramed in Figure 7.5.

Testing rejected the associated independence model: $\chi 2$ (153, N = 103) = 1270.6, $p < .001$. The model in Figure 7.5 was tested next (Model 1 in Table 7.26). A chi-square difference test indicated a significant improvement in fit between the independence model and Model 1: $\Delta\chi 2$ (22, N = 103) = 1081, $p < .001$. The theoretical model's chi-square per degree of freedom ratio was good: $\chi 2$ (131, N =

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103) = 189.4, $p < .001$; $\chi2$ /df = 1.446. The comparative fit index was .948 and indicated reasonable fit. NFI and AGFI were both below .90 but these indices are downward biased by small sample sizes.

The model was subsequently modified to include a path suggested by modification indices. The fit of each successive model is summarized in Table 7.26. In Model 2, a path was added from team learning to continuous improvement achievement. The path was significant ($t = 3.55$) and could be theoretically justified; the more a work group engages in team learning (the team-based discovery of insights through dialogue and discussion) the more frequently one may expect group goals to be achieved. This path constitutes an exploratory finding. The final model appears in Figure 7.6.

The chi-square test of exact fit failed for the final model, but again this test is extremely sensitive to minor departures in fit, $\chi2$ (130, $N = 103$) = 182.5, $p = .002$. The model's chi-square per degree of freedom ratio was good, $\chi2$ /df = 1.404. Adjunct fit indices showed CFI = .953, RMSEA = .063 and AGFI = .798. All regression weights in the final model were significant in the measurement model ($t = 5.23$ to 13.10) and in the structural model ($t = 2.58$ to 4.96). Standardized residual covariances ranged from -1.82 to 2.46 indicating no significant unexplained relationships. The ratio of cases to estimated parameters was 2.5:1. The final model explained 44% of the variance in continuous improvement achievement.

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An especially interesting exploratory result is the significant ($t = -3.47$) path between process control and continuous improvement achievement. This is the path theorized by H5a, but in the opposite direction predicted. In SEM, occasionally the addition of a path will make a previously non-significant path significant. This generally indicates that a variable in the model is acting as a suppressor variable. A suppressor variable acts to remove error variance from the dependent variable and a corresponding predictor variable. In the model of continuous improvement achievement, two variables besides process control are predictors: team learning and systems thinking. It is unclear which of these variables may be acting as a suppressor; both may play a role in suppression. Clarification of this exploratory observation could be the topic of future research.

Table 7.26
Nested Sequence of Models for Continuous Improvement Achievement: Model Fit Indices

	χ^2	df	χ^2/df	χ^2_{diff}	NFI	RMSEA	AGFI	CFI
Saturated	0	0	--	--	1	--	--	1
Independence	1270.6	153	8.305	--	0	.268	.258	0
Model 1	189.4	131	1.446	1081**	.851	.066	.793	.948
Model 2	182.5	130	1.404	6.9*	.856	.063	.798	.953

Note. See notes for Table A1.3 for explanation of fit indices.
Model 1: Model based on prior regression results (Figure 7.5).
Model 2: Added path with MI = 11.5 (Team Learning → CI Achievement).
Model 2 is the final model diagrammed in Figure 7.6.
* $p < .01$. ** $p < .001$.

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Figure 7.5

Initial Path-Analytic Model of Continuous Improvement Achievement (Standardized Estimates)

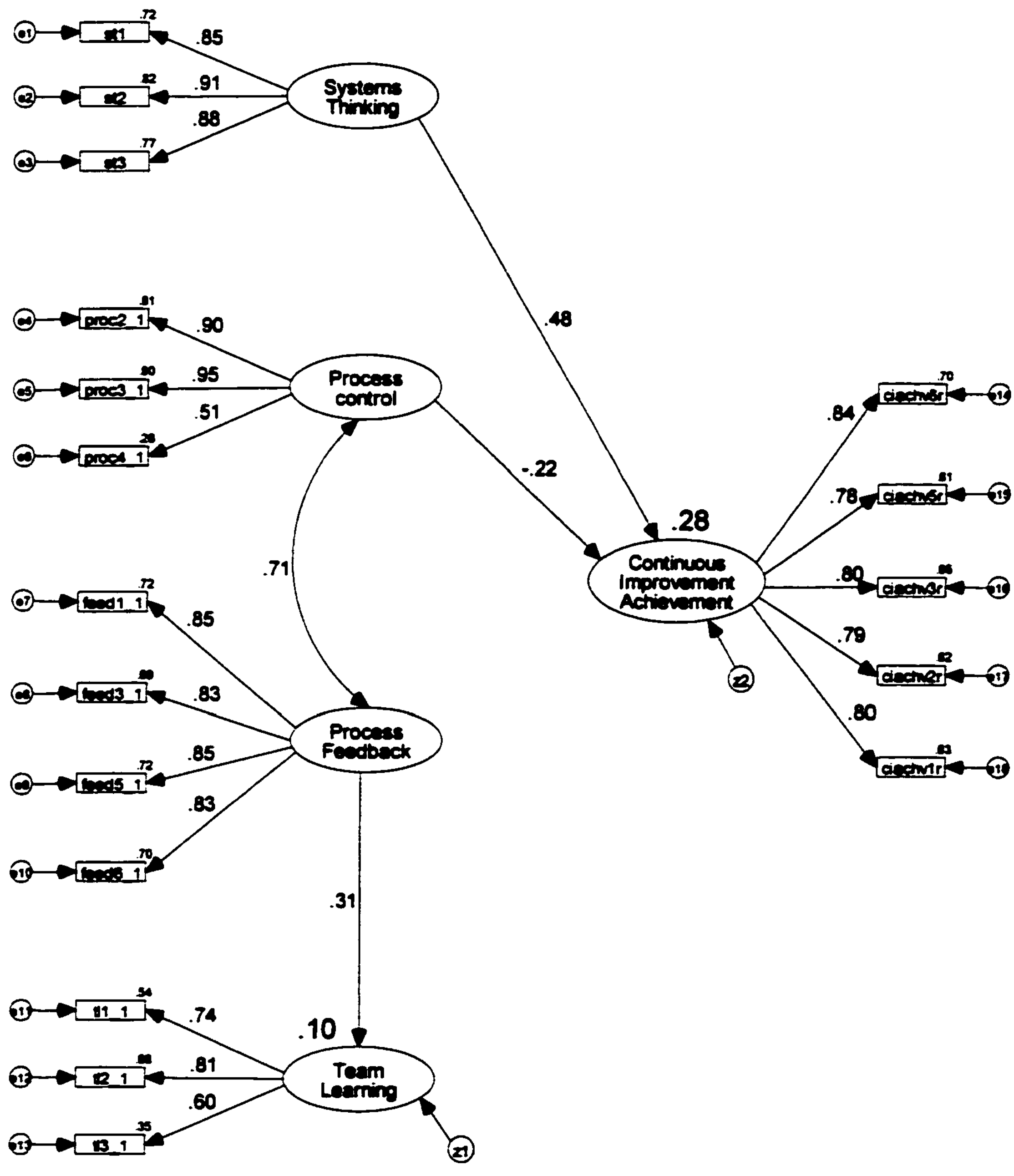

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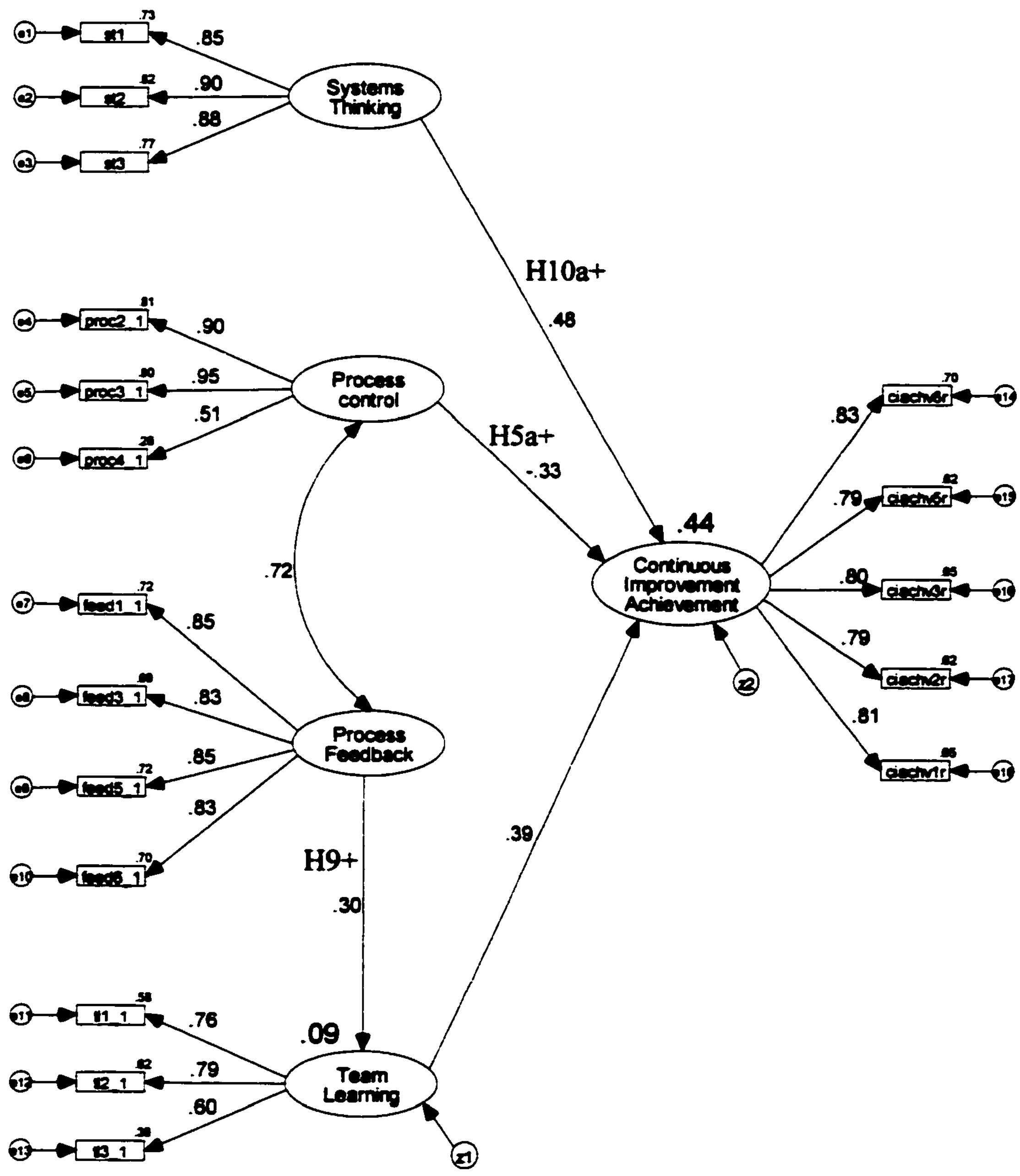
Figure 7.6
Final Path-Analytic Model of Continuous Improvement Achievement (Standardized Estimates)



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Process Management Practices Exploratory Model

Hypothesis 4 predicted that the antecedents of process management practices would include various quality-supportive principles. Process management practices include the use of process control methods and the use of process feedback. Canonical regression testing failed to support Hypothesis 4, but exploratory regression identified active management by exception (MBE-A) as a significant predictor of both outcome variables. A structural equation model was constructed to graphically illustrate this exploratory finding and to further investigate these relationships.

The initial model of the exploratory finding is illustrated in Figure 7.7. Consistent with the measurement perspectives used in the planned canonical regression testing, the predictor variable (MBE-A) was measured from the perspective of subordinates, while the two outcome variables were measured from the perspective of work group leaders. Of the 105 work groups in the study, nine cases were missing a work group leader's response to one or more of the items comprising the 4-item process control scale or the 7-item process feedback scale (both dependent variables). One additional case was excluded relating to the one work group leader who failed to return a survey. Missing data were handled with listwise deletion.

Testing rejected the associated independence model: $\chi 2$ (105, $N = 95$) = 639.0, $p < .001$. The model of exploratory findings was tested next (Figure 7.7 and Model 1 in Table 7.27). A chi-square difference test indicated a significant improvement in fit between the independence model and Model 1: $\Delta\chi 2$ (17, $N = 95$) = 441.2, $p < .001$.

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An exact test of fit for the theoretical model was rejected, $\chi2$ (88, $N = 95$) = 197.8, $p < .001$. The model's chi-square per degree of freedom ratio was marginal, $\chi2$ /df = 2.248. The adjunct fit indices for Model 1 were uniformly poor. Inspection of the measurement model for Model 1 revealed extremely low squared multiple correlations (SMCs) on two of the indictor variables for process feedback (.02 and .00) and two of the indicator variables for process control (.18 and .06). SMCs over .50 are desirable. Inspection of the associated questionnaire items revealed the reason for the low SMCs. Of the seven items comprising the process feedback scale, the two items with low SMCs differed in content from the other five items. The two discrepant items involved direct feedback from work group leaders to subordinates rather than feedback from charts and other data sources. For example, "I often comment on the quality of my subordinate's work" (SMC = .00) and "My subordinates are often told whether they are doing a good job" (SMC = .02) versus "Charts showing quality levels are readily available to my subordinates" (SMC = .69). Likewise, the two discrepant items in the process control scale involved non-statistical process control methods versus the other items that referred to statistically-based methods. For example, "We make extensive use of written procedures and/or work instructions in my work group" (SMC = .06) versus "We make extensive use of statistical techniques to reduce variance in processes" (SMC = .74).

Since this is an exploratory model, the measurement model was modified to eliminate each of the two pairs of discrepant items. The new 2-item scale for process

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control was renamed statistical process control. The new 5-item scale for process feedback was renamed passive process feedback. The term passive is meant to indicate that the feedback to work group members is communicated by charts and other data sources rather than by work group leaders themselves. The revised SEM with the modified measurement model was tested as Model 2. Because of the altered measurement model, Model 1 and Model 2 are not nested and consequently a chi-square difference test between the two models cannot be performed. Model 2 failed the chi-square test of exact fit, $\chi 2$ (42, $N = 95$) = 75.36, $p = .001$. Nevertheless, Model 2's adjunct fit indices improved considerably over those of Model 1 (Table 7.27).

Model 2 was modified to recognize the previously observed covariance between the two process management practices variables. Since these two variables are dependent latent variables, SEM does not allow a covariance path between them. Consequently, a direct effects path was included. The causal direction specified was from statistical process control to passive process feedback. This direction is based on the argument that SPC produces data, and the deployment of statistical process control methods within a work group will lead to an increase in the availability of process-related data to work group members. This seems more tenable that the opposite causal direction (i.e., an increase in data to workers would cause further deployment of statistical process control). The revised model was tested as Model 3.

There was a dramatic improvement in model-data fit under Model 3. The model passed the chi-square test of exact fit, $\chi 2$ (41, $N = 95$) = 45.48, $p = .291$. The

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comparative fit index (CFI) jumped to .990. All regression paths were significant ($p <$ .005) except for the path from active MBE to passive process feedback. The non-significant path was caused by the inclusion of the path between statistical process control and passive process feedback. The non-significant path was dropped and the final revised model was tested as Model 4.

Model 4 (Figure 7.8) also exhibited excellent fit with the data. The model passed the chi-square test of exact fit, $\chi 2$ (42, N = 95) = 47.28, p = .266. All regression weights were significant in the measurement model (t = 4.33 to 9.19) and in the structural model (t = 3.33 to 6.20). Standardized residuals ranged from -1.44 to 1.74 indicating no significant unexplained relationships. The overall fit of the final model was excellent as judged by the chi-square test, RMSEA and CFI fit indices (Table 7.27). The ratio of cases to estimated parameters was 4:1. The final model explained 17% of the variance in use of statistical process control methods and 48% of the variance in passive process feedback.

The final model clarifies the findings from prior exploratory analysis in that the active form of management by exception is significantly associated with use of SPC methods, and use of SPC methods is significantly associated with passive process feedback to work group members. The findings related to the measurement model suggest that future research should consider separating process control into statistical and non-statistical subfactors, and separating process feedback into passive (data-based) and active (leader-subordinate communication) subfactors.

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Table 7.27
Sequence of Exploratory Models for Process Management Practices: Model Fit Indices

	χ^2	df	χ^2 /df	χ^2_{diff}	NFI	RMSEA	AGFI	CFI
Saturated	0	0	--	--	1	--	--	1
Independence	639.0	105	6.086	--	0	.233	.349	0
Model 1	197.8	88	2.248	441*	.690	.115	.733	.794
Model 2	75.4	42	1.794	--	.847	.092	.814	.924
Model 3	45.5	41	1.109	29.9*	.908	.034	.878	.990
Model 4	47.3	42	1.126	1.8	.904	.037	.877	.988

Note. See notes for Table A1.3 for explanation of fit indices.
Model 1: Model based on prior regression results (Figure 7.7).
Model 2: Changed measurement model (dropped 4 observed indicator variables).
Model 3: Added path (Statistical Process Control → Passive Process Feedback).
Model 4: Dropped non-signifacant path (Active MBE → Passive Process Feedback). Model 4 is the final model diagrammed in Figure 7.8.
*$p < .001$.

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Figure 7.7
Initial Exploratory Path-Analytic Model of Process Management Practices (Standardized Estimates)

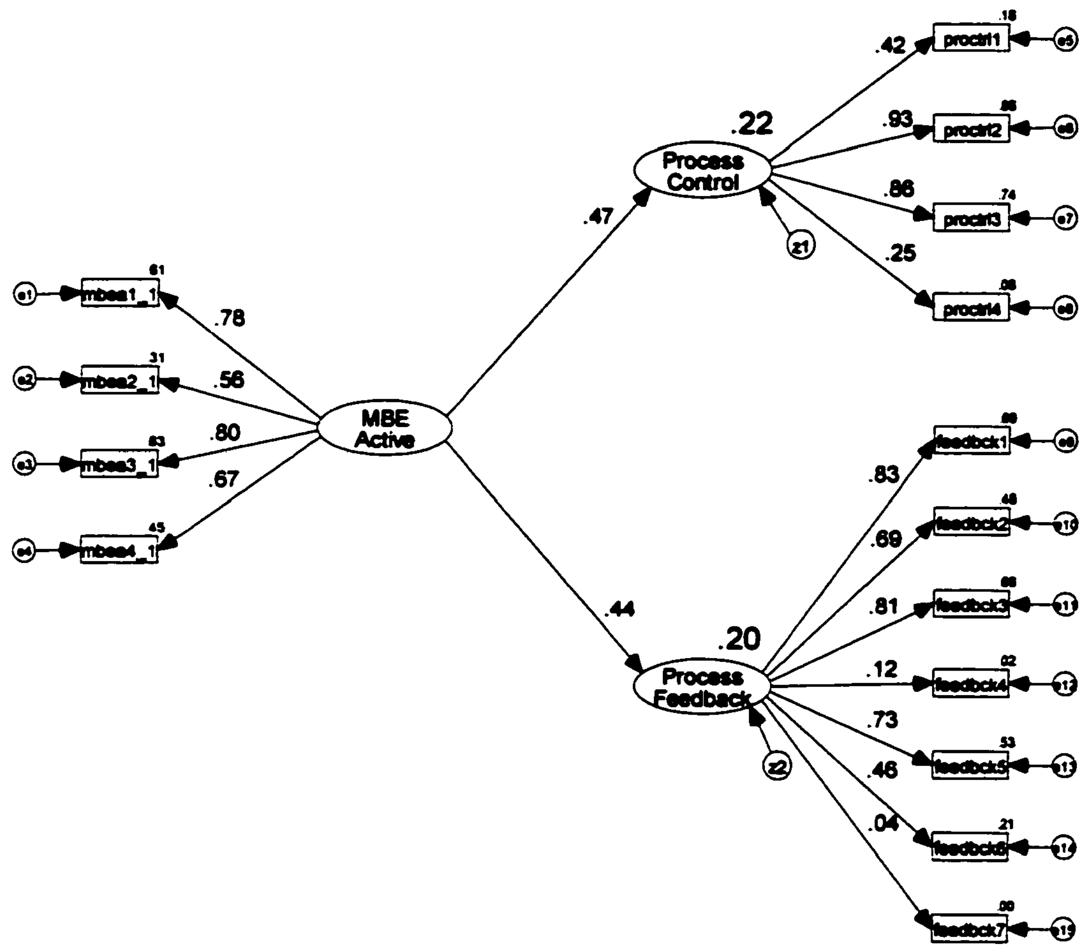

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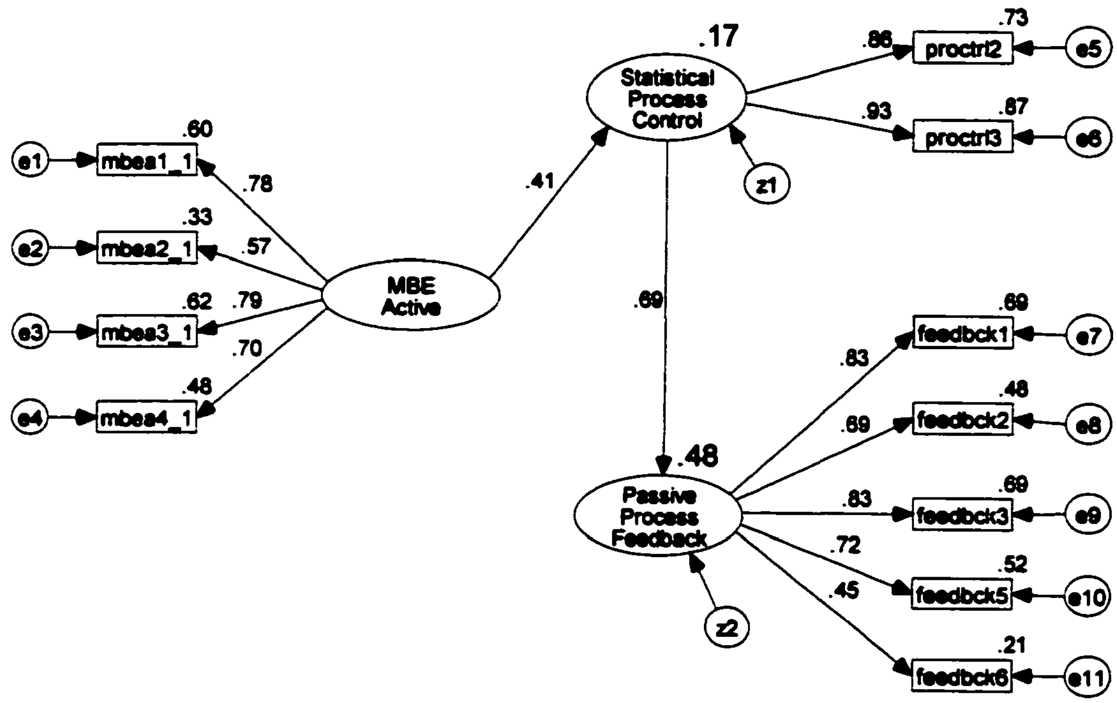
Figure 7.8
Final Exploratory Path-Analytic Model of Process Management Practices (Standardized Estimates)



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Chapter 8: Discussion

Overview

This research investigated the relationships among specific leadership behaviors, quality management principles, practices and outcomes, and the disciplines of the learning organization. These theoretical constructs were measured by quantifying the perceptions of work group leaders and their subordinates by means of self-administered surveys. This chapter discusses the findings from regression-based hypothesis testing and integrates those findings with the results of multivariate structural equation modeling and exploratory analysis. The study's important limitations are discussed, followed by the contribution of this research to knowledge. A number of practical implications to practicing managers and suggestions for further research are also presented.

Summary of Findings

Discussions of each finding are organized around the five major research questions addressed in this study. Table 8.1 summarizes hypotheses formulated at the group level of analysis; Table 8.2 does the same for hypotheses at the individual level of analysis. Each table states the hypotheses, the measurement perspectives for the variables, and whether or not regression analysis supported each hypothesis. Unsupported moderation effects (Table 8.3) and several exploratory findings (Table 8.4) are summarized and discussed together with supported hypotheses.

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Table 8.1

Summary of Findings: Group Level of Analysis (Hypothesized Relationships)

	Hypothesis (showing *IV* and DV)	*IV* - DV Perspectives	Finding
H1	*Active and passive management by exception* are negatively associated with continuous improvement commitment and teamwork.	*Members* Members	Supported
H2a	*Transformational leadership behaviors* are positively associated with teamwork, customer focus and continuous improvement commitment.	*Members* Members	Supported
H3	*Laissez-faire leadership* is negatively associated with teamwork, customer focus and continuous improvement commitment.	*Members* Members	Supported
H4	The more a work group is characterized by *teamwork, customer focus and continuous improvement commitment*, the more process management practices are characterized by process control and process feedback systems.	*Members* Leader	Not supported
H5a	The more process management practices include *process control* methods and *process feedback* to organizational members the more frequently continuous improvement is achieved.	*Members* Leader	Not supported
H9	The more process management practices include quality-related *process feedback* to organizational members, the more team learning occurs.	*Members* Members	Supported
H10a	The more *systems thinking* occurs the more frequently continuous improvement is achieved.	*Leader* Leader	Supported
H11	The *inspirational motivation* component of transformational leadership is positively associated with shared vision.	*Members* Members	Supported

Note. Members = within-group mean aggregated perceptions of work group members. Leader = work group leader.

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Table 8.2
Summary of Findings: Individual Level of Analysis (Hypothesized Relationships)

	Hypothesis (showing *IV* and DV)	*IV* - DV Perspectives	Finding
H6	The more process management practices include *process control* methods and *process feedback* to organizational members, the greater employee fulfillment.	*Individual* Individual	Supported
H7	The more individuals feel a sense of *personal mastery*, the greater their degree of employee fulfillment.	*Individual* Individual	Supported
H8a	The more *process feedback* is made available to organizational members, the more individuals feel a sense of personal mastery.	*Individual* Individual	Supported
H12	The *intellectual stimulation* component of transformational leadership is positively associated with managing mental models.	*Individual* Individual	Supported

Note. Individual = individual member of a work group.

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Table 8.3
Summary of Findings: Moderated Relationships (Hypothesized Interactions)

	Hypothesis	*IV*-DV-*Mod* Perspectives	Finding
H2b	There is a stronger positive relationship between transformational leadership behaviors and teamwork, customer focus and continuous improvement commitment in work groups with leaders at higher organizational levels than with leaders at lower levels.	*Individual* Individual *Leader*	Not supported
H5b	There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty than under conditions of high perceived environmental uncertainty.	*Members* Leader *Executive*	Not supported
H8b	Individuals with high self-efficacy will demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.	*Individual* Individual *Individual*	Not supported
H10b	There is a stronger positive relationship between systems thinking and continuous improvement achievement under conditions of high perceived environmental uncertainty than under conditions of low perceived environmental uncertainty.	*Leader* Leader *Executive*	Not supported

Note. Individual = individual member of a work group. Members = within-group mean aggregated perceptions of work group members. Leader = work group leader. Executive = a senior official of the organization.

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Table 8.4
Summary of Key Exploratory Findings: Group Level of Analysis

Observation	*IV*-DV Perspectives
Active MBE (management by exception) is positively related to use of process control methods.	*Members* Leader
Active MBE (management by exception) is positively related to use of process feedback.	*Members* Leader
Team learning is positively related to continuous improvement achievement.	*Members* Leader
The inspirational motivation and individualized consideration dimensions of transformational leadership are positively related to continuous improvement achievement.	*Members* Leader

Note. Members = within-group mean aggregated perceptions of individual work group members. Leader = work group leader.

Leadership and Quality-Supportive Principles

The first research question was: How do leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management? The underlying principles of quality management include teamwork, customer focus and commitment to continuous improvement (Dean & Bowen, 1994). Based partly on suggestions by Sosik and Dionne (1997), it was theorized in Hypothesis 1 that active and passive management by exception (MBE) are negatively associated with commitment to continuous improvement and teamwork. Regression analysis found that only passive MBE is negatively associated with these two quality-

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supportive principles (Table 7.5). However, structural equation modeling found that passive MBE does not play a unique role in predicting either continuous improvement commitment or teamwork beyond the role played by transformational leadership (Figure 7.4). This is explained by the strong negative correlation between passive MBE and transformational leadership; the overlapping variance is such that passive MBE explains no unique part. From a practical standpoint, this finding suggests that work group leaders in quality-focused organizations should avoid a passive MBE approach to work group management. Passive MBE behaviors include waiting until problems become serious before becoming involved and waiting for things to go wrong before taking corrective action. Although there may be a temptation to "lay back" and wait and see if problems go away or are resolved by other means, this hands-off strategy is associated with lower levels of commitment to continuous improvement among work group members and lower perceptions of teamwork.

Work group leaders' display of transformational leadership behaviors was theorized in Hypothesis 2a to be positively associated with the degree to which work groups are characterized by teamwork, customer focus and commitment to continuous improvement (Avolio, 1994; Conger, 1989; Sosik & Dionne, 1997). Analysis confirmed that each dimension of transformational leadership (idealized influence, individualized consideration, intellectual stimulation and inspirational motivation) is significantly correlated with the three quality-supportive principles (Table 7.7). In addition, the intellectual stimulation dimension of transformational leadership

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demonstrates a unique predictive relationship with continuous improvement commitment and teamwork (Table 7.6). These findings suggest that leaders who want to encourage teamwork, customer focus and commitment to continuous improvement should communicate an optimistic vision of the future, seek out differing perspectives among work group members, treat employees as individuals and engender a sense of purpose within the group that "goes beyond a simple exchange of rewards for effort provided" (Bass & Avolio, 1997). The results also found a significant positive relationship between leaders' display of individualized consideration behaviors and organizational members' commitment to continuous improvement. This finding supports Waldman's (1993) assertion that "individualized consideration (Bass, 1985) could be used to encourage people to continually improve job and quality skills."

It was further hypothesized in H2b that the hierarchical level of the work group leader moderates the relationship between the display of transformational leadership behaviors and the degree to which a work group is characterized by teamwork, customer focus and commitment to continuous improvement. This prediction was not supported. The reason for the null finding may stem from the use of job title to measure hierarchical level. Job title (e.g., supervisor, manager, director, vice president, etc.) may be a poor measure of a leader's standing within an organization's hierarchy in terms of their relative influence, power and prestige. For instance, the sales manager or engineering manager may rank considerably higher in an

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organization than the accounts payable manager. Job title may also be an uneven measure of hierarchical standing across organizations.

The third hypothesis theorized that laissez-faire leadership is negatively associated with teamwork, customer focus and continuous improvement commitment. Testing confirmed this association, and analysis found that a laissez-faire leadership style is particularly deleterious to workers' commitment to continuous improvement (Table 7.8). These findings imply that leaders must eschew a passive leadership style if they hope to encourage teamwork, customer focus and commitment to continuous improvement among the members of their work group.

Quality-Supportive Principles and Process Management Practices

The second research question was: <u>How does the adoption of quality management's underlying principles affect process management practices</u>? Hypothesis 4 theorized that the more a work group is characterized by quality-supportive principles (teamwork, customer focus and commitment to continuous improvement), the more process management practices are characterized by process control mechanisms and process feedback systems. This hypothesis was based in part on Deming's (1982) recommendation that effective process management should be predicated on cooperation and knowledge sharing among team members rather than on competition. Canonical regression analysis offered no support for the hypothesis. The degree to which management deploys process control methods and process feedback systems onto work processes is apparently independent from workers' sense of

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teamwork, degree of customer focus and their level of commitment to continuous improvement. This implies that leaders cannot assume that encouraging quality-supportive principles within a work group will lead to the further use of process management practices. Three possible explanations are offered for the null finding.

First, this study operationalized the construct of process control using a 4-item measure tapping several aspects of process control. These aspects included use of written procedures, use of error-proofing methods and use of statistical techniques. The broad nature of this measure may have affected its ability to test the hypothesis. Suggested refinements to this measure are discussed on page 285.

Second, the degree to which process management practices are used may be partly due to environmental forces such as the regulatory environment. For example, organizations whose production activities are regulated by the U. S. Food and Drug Administration are required to institute and maintain process control systems to assure that products conform to specifications (*Code of Federal Regulations, Title 21*, Part 820.100.b, 1993). Likewise, the ISO 9000 standards require "the implementation of monitoring and measurement" in the course of production and service delivery (*International Organization for Standardization. ISO 9001-2000, §7.5.1.e*).

Third, there may be barriers within some organizational cultures that inhibit the hypothesized relationship from manifesting. Organizational culture includes the basic assumptions, group norms, customs, traditions, espoused values and thinking habits held in common by the members of the organization (Schein, 1992). Bushe

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(1988) has theorized that in some organizations SPC is countercultural because it requires (a) a rethinking of how established processes work and what process variables are important, (b) more time to produce results than some organizations find acceptable, (c) makes problems excessively visible, and (d) gives rank-and-file members powerful factual information traditionally held only by high-status individuals. Bushe connects this line of thought with organizational learning, commenting that "learning must be as highly valued as performing for SPC to be used successfully" (1988, p. 25). Empirical evaluation of these ideas may be the subject of useful future research.

Exploratory analysis discovered that there is one particular leadership behavior that is associated with the use of process management practices. The active form of management by exception (MBE) was significantly related to the use of process control methods and process feedback (Table 7.9). Leaders who practice active management by exception actively monitor workers for mistakes or failures, and tend to search for problems and irregularities. The more work group members reported that their immediate supervisor exhibited these kinds of leadership behaviors, the more those leaders reported using process management practices in their work group. This observation may suggest that managers have found active MBE to be a useful approach in instituting process management. Or it may indicate that the deployment of process management practices leads to a leadership style that is focused on error detection and correction. In any case, the observed connection between active MBE and

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the use of process management practices may be considered robust in that the correlations were of moderate size (above .30), the observed significance levels were high ($p < .001$) and common method variance was removed by obtaining the IV measurement from work group members and the DV measurement from work group leaders.

Process Management Practices and Process Outcomes

The third research question was: How do the basic quality-supportive process management practices affect quality-related process outcomes? It was hypothesized that the more process control methods and process feedback are used the more frequently continuous improvement is achieved (Deming, 1982; Feigenbaum, 1991) and that the degree of environmental uncertainty faced by the organization will moderate the strength of the connection (Sitkin et al., 1994). These theorized relationships (H5a and H5b) were not supported by regression testing. Two possible explanations are offered for these null findings. First, as explained above, the broad nature of the process control scale may have affected its ability to test these hypotheses. Second, the null findings may make sense if one considers that a key objective of process control is maintenance of the status quo. Processes that stray outside of control limits are detected and corrective action is taken to remove the cause of the disturbance and return the process to a state of control, but not to a superior state. One may speculate that there is a tendency for work groups to use process control techniques only to maintain the status quo and not exploit it as a means for gaining deeper insight into work processes that could lead to permanent process

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improvements. The distinction here is between adaptive or single-loop learning and generative or double-loop learning. Single-loop learning involves the detection and correction of error or mismatch between current process output performance and targeted levels – much like simple cybernetic control. In contrast, double-loop learning involves examining the "governing variables" of the system and questioning implicit or explicit assumptions (Argyris, 1999).

In addition, exploratory analysis revealed that the degree of team learning reported by work group members is positively related to leaders' assessment of continuous improvement achievement (Table 7.10). Team learning is the group-based discovery of insights through dialogue and discussion (Senge, 1990). According to Senge, team learning involves thoughtful discussion of complex issues and cooperation with fellow team members (and those on other teams). Team learning also involves attaining collective understanding by suspending defensive routines, which are face-saving behaviors that "distort valid information" or make some information undiscussable (Argyris, 1999, p. 336). Leaders who want to encourage team learning may wish to engage in supportive communication (Whetton & Cameron, 1991) in which the members of a group, including its leader, concentrate on describing and understanding problems rather than focusing on the individuals and personalities involved. The exploratory finding connecting team learning with continuous improvement achievement may be considered a robust finding in that the effect size was substantial (a path coefficient of .39 from structural equation modeling,

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Figure 7.6), the observed significance level was high ($p < .001$) and common method variance was removed by obtaining the IV measurement from work group members and the DV measurement from work group leaders.

It was also theorized (Hypothesis 6) that the more process management practices include process control methods and process feedback to work group members, the greater employee fulfillment. This theory was built on foundations laid by the job characteristics model (Hackman & Oldham, 1976) and a related body of prior empirical work (Muchinsky, 1996; Nelson & Quick, 1995). Regression testing confirmed that both process control methods and process feedback are positively related to employee fulfillment (Table 7.11), even after partialling out the strong positive effect on employee fulfillment from leader-member exchange quality (Gerstner & Day, 1997). The value of this finding is that work group leaders making decisions on introducing or expanding the use of process management practices need not be concerned that additional "controls" in the work place will be deleterious to workers' sense of pride in their work or their general job satisfaction.

Organizational Learning and Quality Management

The fourth research question was: <u>How are the disciplines of the learning organization associated with quality-related process management practices and process outcomes</u>? Hypothesis 7 theorized that the more individuals feel a sense of personal mastery, the greater their degree of employee fulfillment. Personal mastery is Senge's (1990) "discipline of personal growth and learning" and refers to the

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"creative tension" one must maintain between one's current reality and a desired future state. Senge states that this tension is necessary for individual learning and personal growth and implies that higher levels of personal mastery should be associated with greater levels of personal fulfillment. The foregoing hypothesis put this theory to the test. Analysis confirmed the hypothesis; the greater one's perception of personal mastery, the higher the degree of employee fulfillment (Table 7.12). This relationship held true even after controlling for various other factors that influence employee fulfillment (e.g., organizational tenure, job feedback and the quality of the relationship with one's supervisor). The value of this finding is to add empirical weight to Senge's thesis.

Hypothesis 8a theorized that the more process feedback is afforded to organizational members, the more individuals feel a sense of personal mastery, and Hypothesis 8b theorized that this relationship is moderated by self-efficacy. Self-efficacy is the belief in one's ability to accomplish tasks and attain goals (Bandura, 1997). The underlying theory for the main effect was that process feedback affords the information needed by workers to assess their level of work-related success and degree of goal attainment, and that this information is necessary for building personal mastery. Testing confirmed the hypothesized main effect: the more process feedback one receives, the greater one's perception of personal mastery (Table 7.13). This relationship was significant even after partialling out the positive effect self-efficacy has on perceptions of personal mastery. The moderator effect (H8b) was not

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supported. The theory underlying the moderator effect held that individuals with high self-efficacy would have a stronger belief in their ability to effectively utilize process feedback to enhance personal mastery. If the moderator effect is present it was too small to be detectable under the present research design. The value of the foregoing findings is in identifying factors subject to direct management control that enhance personal mastery. The value of personal mastery itself is expressed by Senge:

> People with high levels of personal mastery are more committed. They take more initiative. They have a broader and deeper sense of responsibility in their work. They learn faster. For all these reasons, a great many organizations espouse a commitment to fostering personal growth among their employees because they believe it will make the organization stronger (1990, p. 143).

Hypothesis 9 predicted a positive relationship between receipt of process feedback and the degree of team learning. This theory was based on the idea that the information afforded to team members from process feedback allows members to better understand the web of interrelationships governing process outputs and thereby enhances a team's understanding of the production process. Testing confirmed this hypothesis; the more that team members report receipt of process feedback, the higher the reported degree of team learning (pg. 202). The practical value of this finding is that it establishes a path of positive connections from a variable under direct management control (use of process feedback) to a less tangible one (team learning) to

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a specific desired end (achievement of continuous improvement). The linkage between team learning and continuous improvement achievement was discussed above as an important exploratory finding.

Hypothesis 10a theorized that the more that work groups engage in systems thinking the more frequently continuous improvement is achieved. At the team level, systems thinking involves considering how the team's work processes fit into those of the larger organization. More generally, systems thinking is a mental discipline for observing totalities and wholes rather than isolated parts, and seeing interrelationships, patterns and processes rather than discrete events (Senge, 1990). Testing confirmed the hypothesized main effect: the greater the reported level of systems thinking, the greater the reported degree of continuous improvement achievement (Table 7.14). According to Senge, systems thinking is valuable because it allows one to identify "leverage points" in a system, the points in a production or process delivery system that are most amenable to effective intervention.

It was further theorized in H10b that the relationship between systems thinking and continuous improvement achievement is moderated by perceived environmental uncertainty (PEU). PEU is the degree to which one feels unable to assign probabilities to the likelihood of future events. The moderated effect was based on the idea that when uncertainty is low, conventional quality assurance methods will lead to effective outcomes, but when uncertainty is high a more advanced systems perspective will be necessary to achieve the desired ends (Sitkin et al., 1994). Testing offered no support

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for PEU moderating the relationship. A possible reason for this null finding is that PEU was measured from the perspective of an executive or other senior official in the parent organization of each work group. The idea was that such an individual would have a broad and reliable perspective on the degree of uncertainty faced by the organization as a whole (Koberg, 1987). However, it may be that many of the work groups sampled were sufficiently isolated or buffered from the larger outside environment such that the degree of uncertainty facing the work group was not approximated by the degree of uncertainty facing the organization as a whole. An additional possible reason for the null finding is statistical power loss from data disaggregation. That is, an organization's PEU measure was applied to each of the several work groups belonging to that specific parent organization. This made the effective sample size much smaller.

Leadership and Organizational Learning

The fifth and final research question was: <u>How do leadership behaviors affect the realization of various disciplines of the learning organization</u>? Hypothesis 11 theorized that the inspirational motivation component of transformational leadership is positively associated with shared vision. Inspirational motivation involves communicating an optimistic vision of the future, setting high expectations and expressing confidence that goals will be achieved (Bass, 1985; Bass & Avolio, 1997). Shared vision is the collective comprehension of the organization's purpose, where it's headed and a commitment to that direction (Senge, 1990). Inspirational motivation

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was theorized to move work group members toward common frames of reference leading to shared beliefs about the future. Testing supported the hypothesis: the more leaders exhibited inspirational motivation behaviors, the greater the degree of shared vision among their subordinates (pg. 207). The value of this finding is that it provides practical, behavior-based advice to leaders who wish to engender a commonality of purpose among their subordinates. According to Senge (1990), shared vision is important because it encourages risk taking and experimentation, and builds a common identity. It is especially important because:

> In a corporation, a shared vision changes people's relationship with the company. It is no longer "their company;" it becomes "our company." A shared vision is the first step in allowing people who mistrusted each other to begin to work together" (Senge, 1990, p. 208).

Hypothesis 12 theorized that the intellectual stimulation component of transformational leadership is positively associated with managing mental models. Intellectual stimulation is the rational component of leadership. Leaders who exhibit intellectual stimulation behaviors encourage their subordinates to approach problems in novel ways and to reexamine past assumptions (Bass & Avolio, 1997). Mental models represent the assumptions underlying people's thinking and positions on important issues (Senge, 1990). Managing mental models involves exposing assumptions so they may be shared, discussed and tested. Managing mental models requires individuals to explicitly consider their thought processes that affect work-

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related decisions (Tetrick et al., 2000). Testing supported the hypothesis: the more work group members reported frequent demonstration of intellectual stimulation behaviors by their supervisor, the more they reported actively managing their own mental models (pg. 208). The practical significance of this finding is to afford specific behavioral advice to leaders who wish to enhance their subordinates' management of mental models. Managing mental models is important because they form perceptual filters (Lendaris, 1986) that govern what we see and they determine our (often tacit) theories in use (Senge, 1990). Furthermore, mental models are integral to effective systems thinking "because one focuses on exposing hidden assumptions and the other focuses on how to restructure assumptions to reveal causes of significant problems" (Senge, 1990, p. 203).

Integration of Findings

A path-based illustration of hypothesized relationships was presented at the outset of this research (Figure 4.2). Figure 8.1 replicates that graphical framework to illustrate the findings supported by regression-based hypothesis testing. Figure 8.2 illustrates the hypothesized relationships that were <u>not</u> supported by regression testing. A comparison of these two figures reveals a gap (i.e., a lack of paths) between quality-supportive principles and process management practices. The theoretical bridge across this gap was set forth in Hypothesis 4, but that hypothesis was not supported. Possible explanations are discussed above. It is also possible that the theorized

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linkages do exist for certain kinds of organizations or for particular types of work groups. Further investigation into this topic could be the subject of future research.

Figure 8.3 illustrates several key exploratory findings. First is the positive connection between two process management practices and transactional leadership behaviors. This observation may be a useful starting point for future research on the connection between leadership behaviors and process management practices. Second, both transformational leadership behaviors and team learning were seen to have significant positive relationships with the achievement of continuous improvement achievement (Table 7.10). These exploratory observations may be considered robust since they were highly significant ($p < .01$) and were based on a dual perspectives measurement (i.e., IV = work group subordinates, DV = work group leader).

The dual perspectives measurement approach was used to test two main effects hypotheses (H4 and H5a); neither was confirmed. In contrast, the dual perspectives approach yielded four potentially useful exploratory findings (Table 8.4). This measurement technique has the advantage of removing common method variance and may be a useful approach to dealing with this issue. The fact that two hypotheses in this study were not supported under this technique should not discourage researchers from utilizing it. On the contrary, when findings are supported under a dual perspectives measurement approach the results may be considered especially robust.

An additional exploratory finding relates to the tighter variances observed within the quality award winners' scores on quality-related measures (Table 7.4). This

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may suggest that organizations that pursue Baldrige-based organizational evaluations (e.g., comprehensive self-assessments, third-party audits, etc.) reap benefits from the process. Such benefits may take the form of less variation within organizations from work group to work group with regard to use of teamwork, process management, etc.

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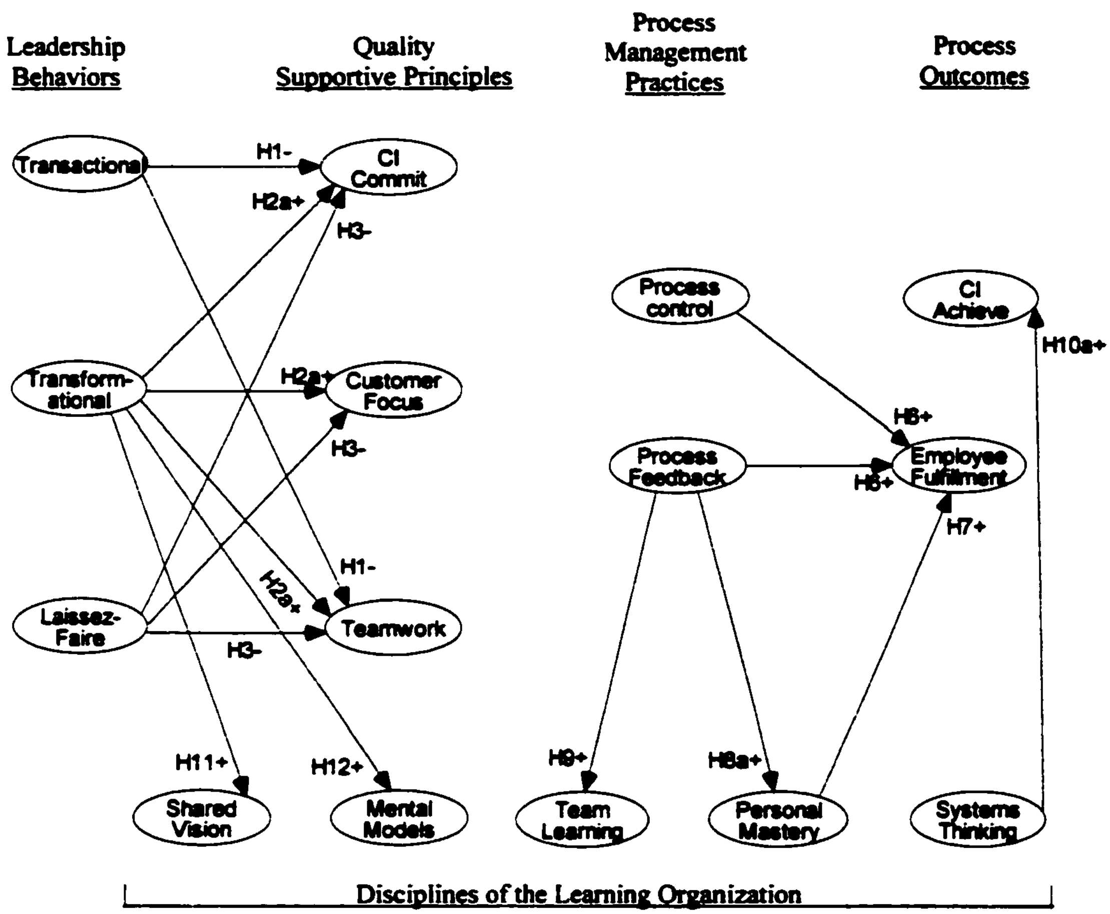
Figure 8.1

Theorized Main Effects Supported by Regression Testing



Note. For clarity, the component factors of transformational and transactional leadership are not shown. Control variables are also not shown. CI = continuous improvement. H = hypothesized relationship. +/- indicates direction of the hypothesized relationship.

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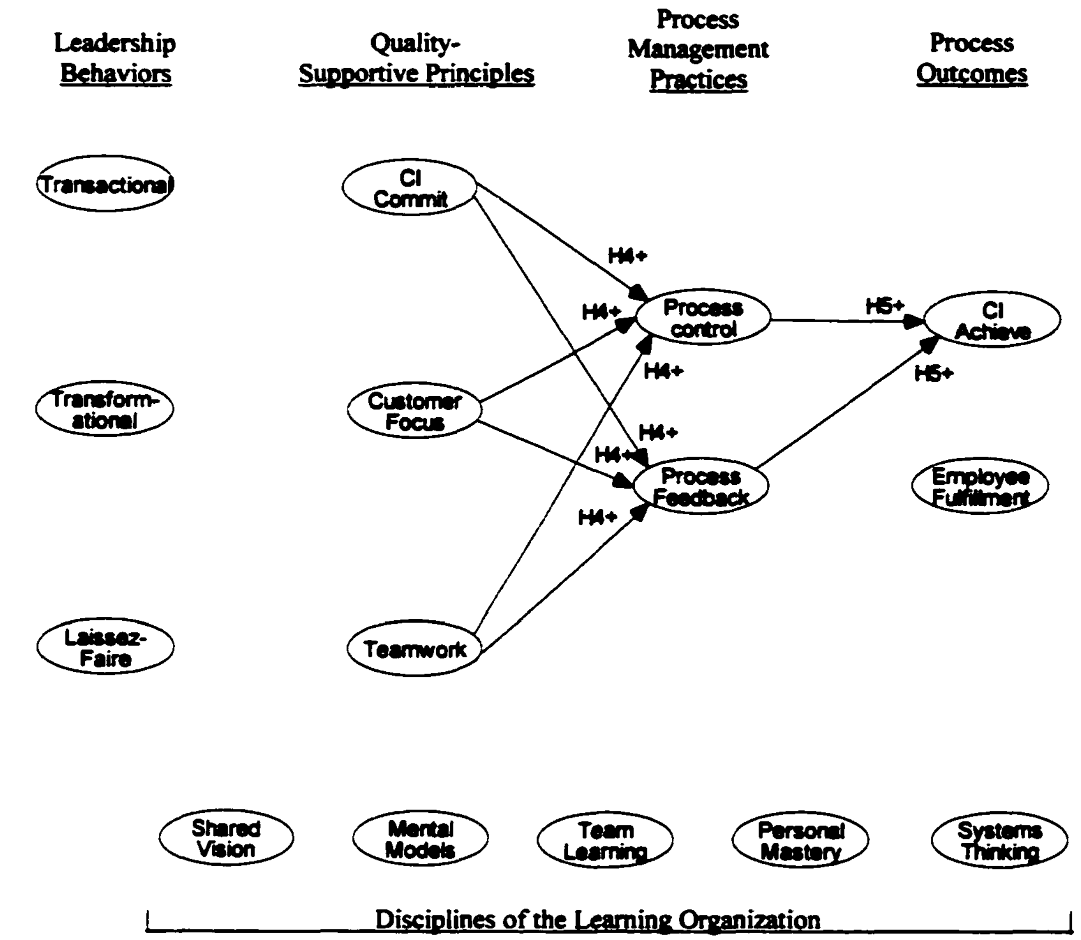
Figure 8.2
Theorized Main Effects Not Supported by Regression Testing



Note. CI = continuous improvement. H = hypothesized relationship. +/- indicates direction of the hypothesized relationship.

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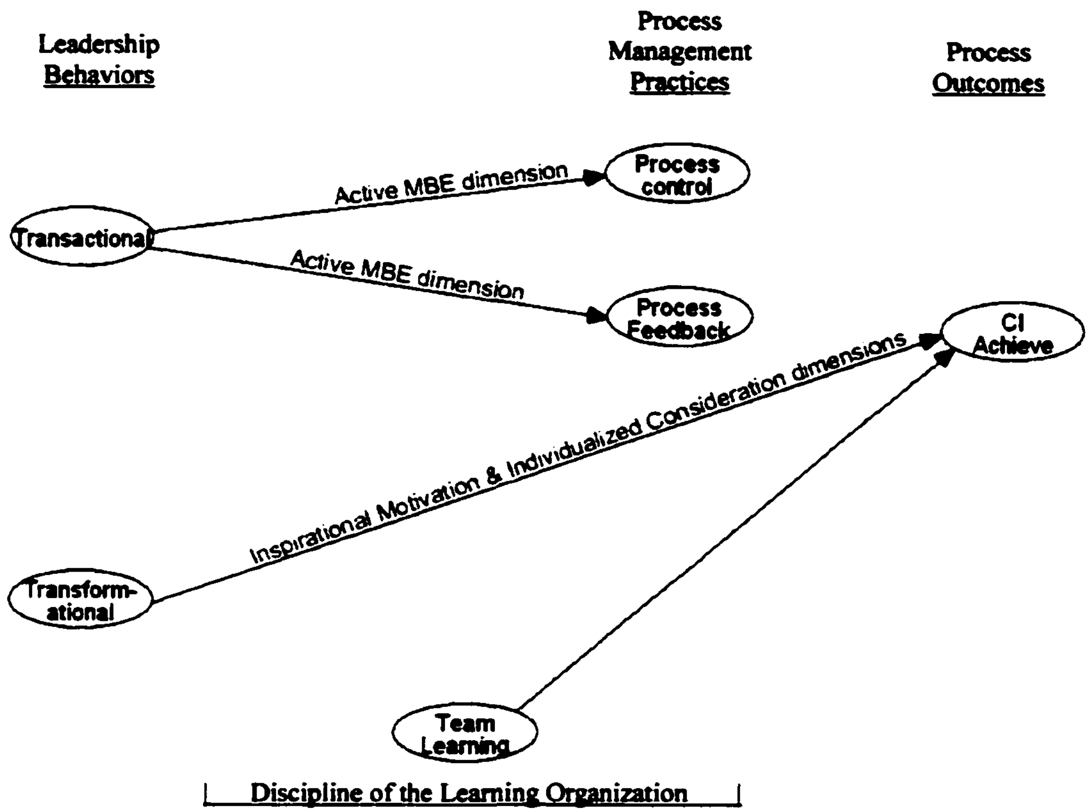
Figure 8.3
Key Exploratory Findings



Note. CI = continuous improvement. MBE = management by exception.

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Important Limitations

This section discusses the important limitations inherent in this research. Issues include the nature of the research design, response bias, adequacy of the measurement instruments used, omitted variables, attributing causal direction and common method variance. Various threats to external validity are also discussed including sample diversity.

Research Design

This research was performed as a cross-sectional correlational field study of naturally occurring work groups. This design did not permit the random assignment of individuals to treatment groups (e.g., work groups led by predominantly transformational versus transactional leaders). In addition, there was no intervention involved, no manipulation of variables and no observations over a period of time. In designs such as this it is not possible to manipulate the independent variables, eliminate all possible confounding variables and firmly establish causal relationships. This situation puts limitations on the conclusiveness of the findings that can be stated. Nevertheless, the study's main goal of identifying the relationships among independent and dependent variables was still achieved. In this research, the case for causality (including the selection of variables with hypothesized cause and effect relationships and the direction of those effects) was made on theoretical grounds rather then resting on the research design.

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Response Bias

There are several potential sources of response bias inherent in this research. The first is related to the cooperation rate from the organizations within the sample universe. The proportion of organizations agreeing to participate in this research (as a percentage of the total approached) was 51.4%. This creates the risk that the 48.6% of organizations that did not participate differed in ways from the cooperating organizations that would adversely affect the findings in the study. A series of statistical tests were conducted to investigate the likelihood of bias from a less than universal cooperation rate. The tests were aimed at detecting statistically significant differences between cooperating and non-cooperating organizations along a number of macro factors (e.g., organization size, type of ownership, etc.). The results (Table 7.1) found no significant differences. Nevertheless, the factors compared in this table are not exhaustive, and the potential for systematic differences remain.

Additional potential sources of response bias stem from the cooperation rates within organizations. For example, responses among those who complete surveys can be more liberal or more conservative compared to those who don't respond. Fortunately the response rates of individuals were very high in this study. Of the 115 work groups approached, 105 (91.3%) agreed to participate. Work group leaders from 104 of the 105 participating groups returned a useable survey (99%), and 615 of the 632 individuals (97.3%) within these work groups returned useable surveys. Consequently the likelihood of bias from poor response rates within organizations is low.

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A further potential source of response bias stems from the ratio of quality-award winning organizations to ISO 9000 certified organizations in the sample. Of the 19 participating organizations, nine were winners of a quality award. The roughly even split between the two types of organizations was intended but this ratio is also largely arbitrary. Both types of organizations were included to add diversity to the sample. One might theorize that organizations honored with a quality award are substantially different from those that have only ISO 9000 certification, especially in regard to their adoption of quality principles and quality-supportive practices. To investigate this, a series of ANOVA tests were performed on the various study variables to compare means at the work group level with respect to the two kinds of organizations. The means compared included the 23 scales measured from the perspective of work group members and the 11 scales measured from the perspective of work group leaders. Since multiple comparisons were made, a conservative *p* value of .005 was appropriate to guard against inflated Type 1 error. Of the 34 scales, only one scale mean (active management by exception) was significantly different between the two organization types, $F(1, 103) = 15.84, p < .001$. It therefore seems reasonable to conclude that wide-ranging substantive differences between the two types of organizations do not exist with respect to the means of the variables included in this study – an interesting finding in itself.

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Adequacy of Measurement Instruments

The adequacy of the measurements made in this research is a function of the validity and reliability of the selected survey instruments and consistency in the data gathering process. A valid comparison between subjects and between groups requires that each organizational informant be asked questions in the same way. Standardization of the interview was accomplished through the use of printed survey forms; consequently the questions were worded and presented identically to all informants. Nevertheless, different individuals may interpret questions differently or questions may not be clearly understood (Blalock, 1970). This risk was mitigated by employing survey scales used in prior research. To minimize risk, no entirely new scales were used. Scales developed and validated by other researchers were drawn from the peer-reviewed literature (Table 4.1) and modifications to these scales were made sparingly.

The most thoroughly investigated scale used in this research was the Multifactor Leadership Questionnaire (MLQ), which has been used in hundreds of studies and has been carefully refined by its authors over the years. No changes were made to the MLQ. On the opposite end of the field experience spectrum are the scales from Tetrick et al. (2000) for assessing Senge's learning disciplines. These scales have been used in only one (unpublished) study and were used in abbreviated form in this research. A pilot study was conducted to guide selection of the items that were used in the main study and to validate its factor structure (Appendix A1). The factor structure was revalidated in the main study as well (Appendix A2).

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Nevertheless, some indicators used in this research were not as reliable as desired. This can be seen in the loading coefficients and squared multiple correlations associated with the observed endogenous variables in the path diagrams presented in the results section. The strength of some relationships found in this research may be attenuated due to measurement unreliability.

The non-significance of some hypothesized relationships may in part be a result of measurement problems. The scale for process control in particular may be problematic in that the construct may be multidimensional. It is suggested that at least three dimensions may exist within the "use of process control methods" construct:

1. Use of written procedures, work instructions, policies and guidelines.
2. Use of statistical process control methods (e.g., X-bar charts, R-charts).
3. Use of error-proofing methods (e.g., the Japanese *poka-yoka* method).

Each of these possible subdimensions would best be measured with multiple items. It is suggested that new items either avoid or be very clear in their use of technical terms such as "variance" and "statistical techniques." Such words and phrases may be open to broad interpretation by individuals with little or no exposure to quality control methods.

Omitted Variables

Another limitation of the study is that hypothesized relationships may have omitted important variables. For instance, failure to recognize an important predictor variable could limit the degree to which various dependent variables can be explained.

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Such important predictor variables might include organizational structure, market structure, organizational culture, degree of bureaucracy and types of reward systems, to name a few. Such omissions, if consequential, would limit the usefulness of this research. This risk was mitigated by a thorough review of the relevant theoretical literature and prior empirical work in the field and incorporating that knowledge into the models that were tested. The effectiveness of this approach can be seen in the degree of explained variance in the study's dependent variables.

A related limitation that was avoided is choosing to focus only on leadership behaviors particular to a certain organizational setting or task environment. Some prior research has focused on leadership behaviors theorized to be quality-supportive (Coulthard, 1998). Limitations from this factor were mitigated by focusing on generic or universal leadership behaviors tapped by the multifactor leadership model and its associated measurement instrument (the MLQ).

Causal Direction

Analysis of the data gathered in this study revealed various correlations among study variables but it cannot unequivocally establish causality. There was no manipulation of the independent variables or study of changes over time. This makes it impossible to empirically designate one phenomenon as cause and another as effect. Alternatives to the direction of causation attributed to the results include reverse causation, reciprocal causation, or third variable causation. For example, exploratory analysis in this study found a strong positive correlation between the use of process

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control methods and the use of process feedback. Process control methods include statistical techniques involving the generation of data on process functioning. Adopting such techniques allows process feedback to be given to work group members. Consequently, the most logical direction of causation is from process control to process feedback, rather than the other way around (reverse causation). This study rests upon theory and reason to make the case for causal direction. However, another exploratory observation was a strong positive correlation between commitment to continuous improvement and customer focus. The causal direction of this relationship could be argued either way, but a case could also be made for reciprocal causation. That is, the stronger the work group's customer focus, the more committed the work group becomes to continuous improvement; the stronger the work group is committed to continuous improvement, the more they focus on the customer. This is an example of reciprocal causation or a positive reinforcement feedback process. The case for third variable causation is related to the omitted variables problem (discussed above).

Common Method Variance

Common method variance is the artificial inflation of measures of covariation between two (or more) variables assessed through the same data collection technique. In the case of data collected through self-report methods (i.e., surveys) which probe subject's attitudes, opinions, assessments or beliefs, this form of bias is also termed percept-percept inflation or same-source bias. Common method variance may source

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from a variety of factors, including subjects actively attempting to offer consistent responses, cues within questions that suggest that items should covary, cognitive consistency within subject's theories about reality, and task consistency in completing survey forms (Crampton & Wagner, 1994) as well as respondent's mood and the social desirability within response options (Podsakoff & Organ, 1986). A meta analysis of 581 studies using self-report methods concluded that common method variance can produce small but statistically significant degrees of covariation in both a positive and negative direction (*Ibid.*). This study also found that certain types of variables are more susceptible to common method inflation/deflation than others, and that self-reports are more likely than not to be *un*affected by common method variance. Least likely to be affected by common method variance are demographic variables and questions regarding matters of fact (as opposed to subject's attitudes or beliefs).

Several of the kinds of constructs identified by Crampton and Wagner (1994) as susceptible to inflationary bias appear in the present research. Susceptible variables identified by Crampton and Wagner included intrinsic satisfaction (similar to this study's employee fulfillment), and the traits, initiation and consideration behaviors of leaders (these bear some similarity to behaviors tapped by the MLQ). Consequently, the possible adverse effect of common method variance on the present research cannot be dismissed. Podsakoff and Organ (1986) offer a number of post hoc detection methods and remedies, but these are less preferred to avoiding or minimizing the

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problem by virtue of the study's design. This was the strategy undertaken in the present research.

The potential of correlation inflation from common method variance was ameliorated where possible by separating the source of the IV measures from that of the DV measures. Three information sources (organizational informants) were used in the research: work group leaders, their subordinates, and executives. This methodology follows that used by Smith, Organ and Near (1983) in their study of leader supportiveness, employee satisfaction and organizational citizenship behaviors. In the Smith et al. study, subordinates rated leader behaviors and their own satisfaction while leaders assessed organizational citizenship behaviors.

For most of the hypotheses in this study, however, it was not possible to use separate information sources for the independent and dependent variables. In these hypotheses the constructs were such that the most appropriate informant for both variables was the work group member. For example, Hypothesis 2a deals with the frequency of specific leadership behaviors and the level of commitment to continuous improvement. Research has shown that subordinate's assessments of leader behavior are more suitable measures of actual behavior than leader self-assessments (Bass, 1990), and clearly individual work group members are in the best position to report their own personal level of commitment. Tables 8.1 to 8.4 (above) show the combination of measurement perspectives that was used to test each hypothesis. Only two of the main effects hypotheses in this study (H4 and H5a) employed varied or dual

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measurement perspective and neither was supported. However, four significant exploratory findings (Table 8.4 and Figure 8.3) were reached under the varied measurement perspectives approach.

External Validity

External validity is the extent to which research findings generalize to a population of interest. The population this study aims to generalize to is organizations that have made an explicit, organization-wide commitment to a quality-focused agenda. The risks to external validity include the sample's diversity and geographic concentration, inclusion of award-winning organizations, the criteria used for defining quality-focused organizations, and different interpretations of the meaning of quality within organizations.

Sample Diversity and Geographic Concentration

The work groups studied in this research represent a variety of industries and organization types (for-profit and non-for-profit, publicly traded and privately held, large and small, etc.) to enhance generalizability. All of the work groups were from organizations classified as quality-focused. The strength of this design is that the study's findings may be applicable to a wide range of quality-focused organizations. However, these differences could confound results by introducing variation in the study's dependent variables due to technology differences, use of automation, levels of worker discretion and the strategic objectives of the organization, to name a few.

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Nevertheless, one of the principle research goals of this research is to provide practical guidance on effective leadership behaviors to managers working in organizations that emphasize the achievement of quality-focused goals. Consequently, it was the aim of the sampling strategy to be broadly inclusive of quality-focused organizations rather than to generalize to any one particular type or size of organization. A potential limiting factor on this goal is the geographic concentration of study participants. All of the study participants were drawn from organizations operating in the state of Oregon. Consequently some kind of geographical bias of an unknown nature is possible.

Inclusion of Award-Winning Organizations

Approximately half of the subject organizations in the study are recipients of a state-level, Baldrige-based quality award. One may expect that this set of organizations excludes those whose success with change initiatives, like quality improvement efforts, suffers from wavering organizational commitment (Waldman et al., 1998). That is, the sampled organizations may be more capable than others in maintaining organizational commitment to major initiatives.

A risk to external validity from including award winners is that a restriction in range is imposed on the study. This risk is mitigated by the fact that the Oregon Quality Award process recognizes quality management achievement at four different levels, from a basic recognition of the importance of quality (the Certificate of Quality Commitment) up to purportedly world-class quality (the Governor's Trophy). The

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sample included organizations representing all four levels of award recognition. A comparison between the two types of organizations found little reliable evidence of differences in the variances of the six scales related to quality management (Table 7.4). Although the difference in scale variances between the two organization types was generally not statistically significant, the overall pattern was interesting. Analysis showed that award-winning organizations had smaller variance figures for each of the measures relating to quality management compared to the organizations that had only ISO 9000 certification; this was true whether the measures were provided by work team leaders or by their subordinates. The effect of range restriction is to attenuate correlations. Consequently, the observation of plausible range restriction in some variables does not weaken the study's findings with respect to effect sizes. If anything, the effect sizes found in this study may be underestimated due to range restriction.

Criteria for Classification as a Quality-Focused Organization

Two criteria were used to define organizations as quality-focused. Either the organization had a quality system certified to ISO 9000 standards by an independent examining body (ISO registrar), or it was a recipient of a Baldrige-based quality award. This classification scheme excludes organizations that may have a strong commitment to quality but have elected not apply for such an award or undertake the expense of certification. Mitigating this risk to external validity is the very large and ever-increasing number of organizations that are opting for ISO certification. At the

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end of 1999 over 33,000 sites in the U.S. were certified to ISO 9000 (Figure 1.2). Also, the differences between organizations with ISO certification and those with quality awards may be unimportant in terms of the variables analyzed in this study (refer to the above discussion of response bias).

Defining Quality

The organizations in this study's sample may define key concepts like "quality" differently. This could be a risk to external validity if the study attempted to quantify such criterion variables or classify organizations into high quality achieving, low quality achieving, etc. However, this research avoided this potential problem by focusing on the frequency of quality *improvement* occurring within work groups (i.e., by measuring continuous quality improvement achievement).

Strengths of the Study

This section discusses a number of strengths of this research. These strengths stem from the nature of the research design and include the hierarchical structure of the data, levels of analysis, the breadth of the research and the varied measurement perspectives used to test hypotheses. These strengths form the foundation for the study's unique contributions.

Hierarchical Nature of the Data

The data gathered in this study are hierarchically structured. That is, individuals are nested within work groups, and work groups are nested within

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organizations. If not analyzed properly, nested data can yield misleading results (Snijders & Bosker, 1999). This risk was addressed by using multilevel modeling (also known as hierarchical linear modeling or HLM) to recheck the findings from ordinary least squares regression testing. HLM showed that the Type 1 error levels reported by conventional regression analysis were indeed inflated, but not to the degree that would overturn the conclusions of statistically significant findings.

Levels of Analysis

An additional strength of this study was to hypothesize and test relationships at more than one level of analysis. Four hypotheses were formulated at the individual level of analysis, while the rest were formulated at the level of the work group. Data were aggregated within work groups to form appropriate measures of variables at the work group level, and the resulting data were carefully inspected to assure within-group agreement. Using more than one level of analysis allowed for a more complete picture of the relationships within the topics of interest.

Breadth of Study

A unique aspect of this study is to jointly analyze a range of interrelated topics. Prior research has studied the relationship between leadership and quality management (e.g., Avolio, 1994; Darling, 1992; Waldman et al., 1998) and the relationship between quality management and performance outcomes (e.g., Hendricks & Singhal, 1997; Morrow, 1997). This study spans all three of the forgoing topics (leadership, quality

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management and performance outcomes) and adds the disciplines of Senge's (1990) learning organization as well. The breadth of this study also extends to the research sample used. Rather than focus on one very large organization or a few similar organizations, this study encompasses a wide range of organization types and work groups for the broadest possible generalizeability.

Varied Measurement Perspectives

A further strength of this study was to employ varied measurement perspectives. A pervasive problem of cross-sectional correlational studies is same-source bias or common method variance. The prevalence and magnitude of this problem has been well documented (Crampton & Wagner, 1994; Kline, Sulsky & Rever-Moriyama, 2000) and various remedies have been suggested (Avolio, Yammarino & Bass, 1991; Lindell & Whitney, 2001; McLaughlin, 1999; Podsakoff & Organ, 1986). This study attempted to avoid common method variance by measuring predictor variables from the perspective of work group members, and dependent variables from the perspective of work group leaders. This was not always possible due to the nature of the constructs under study, but when feasible the resulting findings are robust to this unwanted correlation inflation.

Contributions to Knowledge

This study develops a model of the interrelationships among leadership behaviors, characteristics of organizational learning and key aspects of quality

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management. The research makes a theoretical contribution to knowledge and provides empirical evidence of the theory's validity. The research fills a gap in the literature on leadership, quality management, and organizational learning by developing an integrative conceptual model. The illustration of supported hypotheses (Figure 8.1) identifies a series of tested relationships to explain how leadership, quality management and organizational learning are interrelated in a causal framework. The logic underlying the causality of the model is drawn from a variety of sources in the peer-reviewed literature. The development of the model satisfies the criteria for a legitimate theoretical contribution (Whetten, 1989) by focusing on interrelationships among multiple elements. The model is constructed in a manner that facilitates empirical validation by employing variables for which established measurement scales exist.

Leadership & Quality Management

Prior research has examined the effect of specific leadership behaviors on organizational outcomes such as leader effectiveness and overall business unit performance (Howell & Avolio, 1993; Seltzer & Bass, 1990). In addition, a variety of theoretically-based answers has been offered to the question of what kinds of leadership behaviors are likely to be most effective in achieving quality-oriented objectives (e.g., Bass, 1985; Puffer & McCarthy, 1996; Shea & Howell, 1998; Sosik & Dionne, 1997; Waldman, 1994). However, there was a considerable lack of empirical research to support the foregoing theoretical work. Leadership theory and

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research rarely explores the link between leadership and attainment of the goals of quality management programs (Avolio, 1994; Sosik & Dionne, 1997). Waldman (1994) noted that little research had been done to test the idea that subordinate behaviors associated with transformational leadership are important to achieving the ends of quality management. This research fills that void by illuminating the connections between work groups' degree of teamwork and commitment to continuous improvement and the dimensions of transformational leadership. This research on specific leadership behaviors associated with the achievement of quality-oriented organizational outcomes will be valuable to those wishing to evaluate quality management theories and have practical importance to those directly engaged in quality management activities.

Quality Management & Organizational Learning

The topics of quality management and organizational learning are focal points of interest for organizational scholars and practicing managers. For both topics, a key concern for managers and researchers alike is how to best take advantage of these ideas under varying circumstances. It may be inferred from Tata et al.'s (1999) research that organizational learning plays some role in determining the effectiveness of quality management programs. The present research reveals the nature and strength of the relationships between the learning disciplines (Senge, 1990) and quality management practices and outcomes. This study also extends the work by Flynn, et

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al. (1994) by illustrating how the use of process control methods and process feedback mechanisms fit into the framework of organizational learning constructs.

Contribution to Measurement Issues

The present research also extends what is known about measuring the foregoing organizational phenomena. Morrow (1997) recommended further research to verify the psychometric properties of the scales for quality-supportive principles developed in her research, and to determine to what extent these measures affect important, substantive measures of organizational performance. This research contributes to this goal. This research also suggests that the scales derived from Flynn et al. (1994) for measuring the use of process control methods and the use of process feedback may be improved by developing them into multidimensional measures. Furthermore, this research extends Tetrick et al.'s (2000) work in developing a valid and reliable instrument for assessing the disciplines of Senge's (1990) learning organization.

Practical Implications

The findings of this research may be useful to practicing quality managers and other leaders concerned with organizational goals relating to product and service quality. The underlying framework for this discussion is based on Senge's (1990) notion of leverage points, the points in a system that are most amenable to effective intervention. This study identified numerous statistically significant effects, but not all

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of these should be considered leverage points. Only relationships that are both statistically significant and practically meaningful (i.e., having moderate or large effect size) should be considered as having sufficient practical leverage for useful manipulation and intervention. The findings from the present study are coupled with practical implementation advice drawn from a variety of sources. Since managers are often focused on desired ends, this discussion begins with this end: achieving continuous improvement.

Question: What is "continuous improvement" and why should organizational leaders be concerned about it?

Continuous improvement is "an organization's ongoing quest for better work methods and organizational processes" (Morrow, 1997, p. 365). The Japanese word for it is *kaizen*. Its purpose is to "satisfy all customers through constant refinement of organizational processes" (Sosik & Dionne, 1997, p. 450). An organization's commitment to continuous improvement encourages members to continually learn about the work that they do (Hackman & Wageman, 1995).

The ISO 9000: 2000 standard requires registered organizations to "continually improve the effectiveness of the quality management system" (§ 8.5.1). But engaging in continuous improvement efforts only to satisfy registration requirements would miss important benefits. Continuous improvement often leads to lower costs (Cole, 2000; Garvin, 1988). Beyond cost, continuous improvement paves the way for large-scale change, innovation and technological progress (Cole, 2001). It may be argued

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that continuous change is necessary for the very survival of for-profit firms (Weston, 2001) and the effectiveness and continued relevance of not-for-profit organizations.

Question: As a leader, how does one encourage teamwork, customer focus and promote employee commitment to continuous improvement?

To foster a commitment to continuous improvement, teamwork and customer focus it is necessary to go beyond the traditional management functions of planning, directing and controlling. One must motivate and inspire subordinates to work together to achieve lasting, systemic improvements in organizational processes. Specifically, based on this research, leaders should:

- Communicate an optimistic vision of the future.
- Spend time teaching and coaching, and treat employees as individuals.
- Communicate values and important beliefs.
- Establish a collective sense of purpose and common mission.
- Encourage subordinates to question the established ways of doing things and to reexamine assumptions.
- Seek out different perspectives when solving problems, and encourage subordinates to do the same.
- Don't wait for things to go wrong before getting involved.

This research found that the foregoing recommendations are just as important for executives and department heads as they are for managers and supervisors.

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Department heads, training managers and HR professionals can aid line managers' continuous improvement efforts by fostering policies that promote employee development. It may be easier to achieve continuous improvements in business processes with concomitant improvements in the knowledge, skills and abilities of employees. Liberal training and educational support policies help to establish a foundation for individual growth and improvement. It is not sufficient, however, to merely have such policies. To make them effective, line managers and HR professionals should actively work with employees to establish personal development plans and encourage employees to take advantage of educational support programs such as tuition reimbursement. Supporting certification programs is another way to improve employee competencies. Senior managers should create an atmosphere that rewards personal improvement by publicly recognizing course completions and the attainment of professional certifications.

Question: What else can leaders do to see that continuous improvement objectives are achieved?

An especially useful approach is to view business processes not as long chains of events, but instead as a set of interdependent relationships. Rather than thinking in terms of cause and effect (i.e., A leads to B), look for circular processes (i.e., A leads to B, B leads to C, and C leads to back to A). Drawing diagrams of business processes may help visualize relationships and feedback loops. Once identified, look for ways to influence circular processes. This is part of systems thinking. Systems thinking

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enables one to observe the structures that lie beneath complex situations, to identify susceptible leverage points for effective process improvements and to avoid unintended negative consequences of change. Process modeling software may help one visualize, understand and modify business processes. Such tools are becoming increasing accessible to managers, planners and engineers. It may be advantageous to encourage organizational members to learn more about these kinds of tools.

Executives may be tempted to think of themselves as the captain of the corporate ship. It may be more helpful, Senge suggests, for the executive to think of him or herself as the *designer* of the ship. As the designer-in-chief, one is in a position to modify the processes that govern the ability of the corporate ship to meet new challenges and navigate change. Because senior leaders are responsible for the systems that determine the quality of the goods and services produced, "the quality-improvement process must begin with management's own commitment to total quality" (Hackman & Wageman, 1995). This research found a strong positive connection between the degree of process feedback afforded to members of a work group and the level of team learning within the group. Organizational leaders are in a position to determine the nature and amount of feedback given to workers and therefore have the power to significantly influence team learning. This research also found a strong connection between team learning and the degree to which the leaders of work groups report achieving continuous improvement goals. It is therefore clear that leaders who are in a position to influence or determine process management

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practices (e.g., use of feedback) within the organization can affect quality improvements and goal attainment.

The power of the rewards should not be overlooked as a tool to encourage continuous improvement. Work group managers should stay informed of continuous improvement efforts and provide recognition of successful efforts and for the achievement of key milestones along the way (Evans & Dean, 2000). Recognition can take many forms. Deming (1984) and others emphasize the importance of intrinsic rewards and caution against handing out trinkets and gold stars as a way to motivate performance. Specific suggestions by Kohn (1993) for rewarding individual and team performance include:

- Provide additional choice about how and when work is performed.
- Encourage employees to request assignment into jobs that they believe will be more interesting or challenging, or to suggest modifications to their present jobs to make their work more personally rewarding.
- Increase the amount of feedback to individuals and teams regarding work results.
- Increase the variety of work and offer work opportunities that lead to new skill development where employees desire this.

When modifying or designing reward systems, leaders should themselves engage in systems thinking to better assure that changes will not have unintended consequences or lead to dysfunctional behavior. This research found that whether the organization

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as a whole faced a large or small degree of uncertainty in the business environment, systems thinking led to improvements in problem-solving, goal accomplishment and quality improvement.

This research found that another effective practice to enhance the organization's ability to achieve continuous improvement is to foster team learning. "Continuous improvement requires a commitment to learning" (Garvin, 1993). Team learning is a group competency. It reflects how well and how quickly a team can improve existing process and master new tasks. Team learning and continuous improvement may be aided if managers help departments and work groups to better understand how the various processes within the organization fit together (Evans & Dean, 2000). Recent research has found that the team learning can be managed by leaders (Edmondson, Bohmer & Pisano, 2001); their investigation found three keys to effective team learning:

1) Select team members for their ability to work together, not just for their individual technical competence. Members' willingness to disagree with those of higher status is also a success factor.
2) Frame new challenges facing the team as difficult organizational challenges requiring new ways of working together, not just technical hurdles to overcome. Emphasize that each member must make an important contribution for the team to succeed.

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3) Create a climate free of fear. Team learning requires experimentation, often through trial and error. If mistakes are punished, experimentation will grind to a halt – and learning along with it. This research finding is completely aligned with what Deming (1982) advocated: "Drive out fear." If team members are accustomed to playing it safe for fear of being "dinged," it may be necessary for the team leader to repeatedly reinforce that experimentation is valued and mistakes along the way are a sign of progress.

In cases where even a minor mistake or misstep is too costly, consider using simulation methods to evaluate teams' ideas. Or it may be practical to experiment on a small scale, evaluate the results, refine the process, and then implement the change full-scale. These sorts of approaches are what Senge (1990) calls "microworlds" and what Deming (1982) refers to as the PDSA (plan, do, study, act) cycle.

<u>Question: What is "organizational learning" and why should a manager be concerned about it?</u>

Organizational learning "is the ability of an organization to gain insight and understanding from experience" (McGill et al., 1992) and involves "the process of improving actions through better knowledge and understanding" (Fiol & Lyles, 1985). The ability of an organization to learn faster than its competitors may be the only sustainable competitive advantage (Slater & Narver, 1995). Ray Stata, founder and Board Chairman of Analog Devices, Inc. sees organizational learning as fundamental

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to innovation (Stata, 1989). Learning organizations and quality management share the same goal – "to make continual learning a way of organizational life, especially improving the performance of the organization as a total system" (Senge, 1992a, p. 31). Senge argues that this goal can only be achieved by departing from the command and control form of management where thinking and decision-making occur at the top of the organizational hierarchy, to a participative style with thinking and decision-making at all organizational levels.

Question: How do leaders build learning organizations?

There are a number of tactics leaders can adopt to foster organizational learning. Specific suggestions offered by Garvin (1993) include:

- Adopt the tools of quality management and process improvement throughout the organization. These tools include:
  - Process flow diagrams
  - Control charts
  - Histograms
  - Pareto charts
  - Cause and effect Diagrams
- Make decisions based on data and fact rather than assumptions or "gut feel."
- Train employees in structured problem-solving methods, preferably in group or team settings so that common vocabularies are built.

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- Encourage use of the scientific method and formal experimentation using DOE (design of experiments) tools.
- Use statistical tools, and train employees in their appropriate use for process analysis and decision-making. Statistical methods help to identify leverage points in internal systems and aid in evaluating the effectiveness of change efforts (Hackman & Wageman, 1995).
- Make a deliberate effort to learn from the past. Form committees to explore the reasons for the successes and failures of the organization's past efforts, and share the results broadly so that all may learn.
- Learn from the experiences of others. Analog Devices, Inc. (ADI) sets an excellent example. As explained on their corporate website, ADI has integrated their total quality management (TQM) program with a boundary-spanning organizational learning strategy:

> An important characteristic of our TQM program is societal learning. Societal learning can be viewed as the network of learning within and between companies, customers, suppliers, and others who are trying to improve their quality practices. It is too limiting for each company to discover the organizational means of developing TQM by itself. A guest storyboard exchange program with other companies and all ADI sites has been incorporated, whereas several stories are exchanged to display the work of our

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partners at prominent locations within each facility. In addition, we regularly loan stories or provide presenting teams to those interested in learning about TQM.

- Transfer knowledge throughout the organization. In large organizations, site visits by one division to another are useful. Staff rotation programs can be used in organizations of any size.

Question: How may leaders encourage realization of the various disciplines of the learning organization?

- Build a collective sense of direction, purpose, and understanding among organizational members. This study showed that leaders may accomplish this by articulating an attractive vision of the future, clarifying "what we're all working toward" and expressing confidence that the team will get there.
- Encourage individuals to expose, share and discuss the assumptions underlying their thinking and positions on important issues. This research found the following leadership actions to be effective in this regard:
  - Encourage subordinates not to think about things in the same way as the boss.
  - Try ideas advanced by the team, even if they are unconventional and when there's no guarantee that they will work.
  - Reexamine one's own assumptions to test whether they are still valid and appropriate.

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- Solicit alternate points of view. Appoint one member of the team to be devil's advocate in decision-making meetings, or assign a special group to develop alternate proposals. This will help to avoid group-think, a phenomenon that occurs when the drive to consensus suppresses disagreement and leads to a reluctance to express contrary views (Janis, 1986).
- Provide structure for discussion and decision-making, but hold one's own opinion in abeyance so as not to unduly influence those of lower organizational status (Whetten & Cameron, 1991).

- This study also showed that leaders should design organizational processes that feedback information to the organizational members involved in the process. For instance, customer comments on the quality of service received should be regularly shared with the service providers, not just summarized and circulated to management. Defect reports, customer complaints (and complements) and product reliability information should be shared and discussed with all relevant personnel.

Suggestions for Further Research

This study employed multilevel modeling for the purpose of validating the findings obtained using ordinary least squares regression analysis. This was necessary and appropriate given the hierarchal nature of the data that were analyzed. However, the true value of multilevel modeling is to analyze how contextual factors (variables at

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the group level or higher) have a bearing on the nature and strength of relationships at the individual level. What is defined as the group level is up to the researcher; the group (also called level 2) could be companies, and the individual level (level 1) could be work groups or departments.

This study's multilevel analysis yielded estimates of intraclass correlation for a variety of variables. When intraclass correlation (ICC or ρ) is high a multilevel analysis may afford greater insight into higher-order factors that help explain relationships. The variables with the highest observed intraclass correlations in this study were customer focus (ρ = .302), shared vision (ρ = .283), teamwork (ρ = .275), commitment to continuous improvement (ρ = .265), use of process control methods (ρ = .227) and use of process feedback (ρ = .180). Identifying variables with high intraclass correlations does not explain what accounts for the level-2 variance associated with these variables, only that it exists. Multi-level modeling should be a useful analytical tool for further exploring these findings. Subsequent research may attempt to identify macro level variables responsible for between-group differences and integrate them into the structural framework established by the present research. Possible influential macro variables may include factors related to organizational culture, industry, use of automation, financial condition and organizational growth rates to name a few. Studies involving organizational culture in particular may be useful in understanding the relationship between work groups' adoption of quality-supportive principles and their use of process management practices such as statistical

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process control (SPC). Suggestions that organizational culture may play an important role in the use of SPC (Bushe, 1988) and that culture is key to effective organizational learning (Luthans, Rubach & Marsnik, 1995) may be useful theoretical bases for further work. In the language of multilevel modeling, organizational culture may be a level-2 variable that helps to better explain the relationship.

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Appendix A1: Organizational Learning Pilot Study

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Introduction

The purpose of the pilot study was to derive a shorter version of the 48-item organizational learning survey proposed by Tetrick et al. (2000). A shorter version was necessary since the survey for the main body of this research contains 84 items (in the subordinate's version) before adding items to measure the organizational learning disciplines. It was felt that approximately 100 items in total represented an upper limit for a reasonable number of questions to ask in the context of the present research. The goal was therefore to identify an instrument with approximately 16 items capable of adequately measuring Senge's (1990) five disciplines of organizational learning.

Senge's disciplines of organizational learning include personal mastery, mental models, team learning, shared vision and systems thinking. These terms may be elucidated by describing the meaning of a high score on each scale. A person who scores highly on the personal mastery scale works to achieve their goals, knows how to work toward the future they desire and is committed to personal growth. An individual who scores highly on managing mental models does not face criticism for doing things in a new way, has colleagues who view him/her as flexible and as one who understands their points of view. A high score on team learning indicates that an individual perceives that his or her work group contributes to their personal growth, helps to improve their work, and discusses opportunities for improvement. An individual with a high score on shared vision believes that the members of their organization are working together toward a common future and are committed to the

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organization's long-term goals. A person with a high score on systems thinking perceives that the members of their organization understand how to make the organization work properly and effect improvements to the whole of the organization.

Method

A convenience sample of employed MBA students and psychology students was used to evaluate a set of questionnaire items from the Tetrick et al. (2000) survey as well as several new items aimed at improving reliability and validity. From those results a subset of items was selected for inclusion in the shortened version of the survey on the basis of their ability to best capture the variance of the latent variables (i.e., the five constructs of organizational learning). Tetrick et al.'s work on the development of the five scales is reviewed in Chapter 6.

Pilot data were gathered during February 2001 by visiting several graduate business and psychology classes. The sample size for the pilot administration was 161 students who were either currently employed or had held a job within the last six months. The age of respondents ranged from 19 to 66 years old (mean 28.4; *SD* 7.2). Gender was split 46.8% male to 53.2% female. The members of the sample reported working for their current (or most recent) employer for an average of 2.97 years (*SD* 4.69). How respondents described their current (or most recent) employment status is shown below in Table A1.1. Surveys were handed out during class time and collected immediately upon completion of the survey. No students declined to participate. Responses were scored on a 5-point Likert scale (*strongly disagree* to *strongly agree*).

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Table A1.1

Descriptive Statistics of Pilot Survey Respondents

Work Status [1]	**Percent**
Regular full-time employee	54.1%
Part-time employee	29.3%
Temporary employee working for an agency	3.2%
Contract employee or independent contractor	1.3%
Consultant	.6%
Other or unanswered	12.6%

Note. [1] Response options to the question "Are you (or were you most recently) a …

Questionnaire Items

The pilot survey reflects a number of changes to the survey proposed by Tetrick et al. (2000). First, the pilot uses only scales from the Tetrick et al. survey that are theoretically connected to the present research. Second, Tetrick et al. worded all of their items to support deployment of their survey at a government agency. Their questions often included wording such as "People in this agency …" For the present research, the term *agency* was changed to *organization* throughout the survey for more general applicability (e.g., to companies, state agencies, volunteer organizations, etc.). Third, a number of new items were added to the pilot survey with the goal of finding items that might improve scale reliability and content validity. These changes and additions to Tetrick et al.'s survey are discussed below, scale by scale. The full questionnaire used in this pilot study appears at the end of the appendix.

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Personal mastery

As discussed in Chapter 6, Tetrick et al. (2000) found three dimensions to personal mastery: general, job and classes. These researchers comment that the dimension they call personal mastery-general is most congruent with Senge's (1990) idea of personal mastery as growth and learning. The other two dimensions of personal mastery reflect personal competency in a single area of one's life (job) and a single vehicle for learning (classes). The general dimension is most germane to the present research and therefore the other two subdimensions were not included in the pilot. The general dimension includes eight items with a reliability coefficient of .82 in Tetrick et al.'s fielding of the scale, suggesting some trimming of items may be made while retaining satisfactory reliability.

Managing Mental Models

In Tetrick et al.'s (2000) study, the items for managing mental models factored into mental models-agency (agency refers to the type of organization they studied) and mental models-individual. Senge (1990, 1992) conceptualized the notion of managing mental models as an activity undertaken by individuals to surface, test and continuously improve one's picture of how the world works. Senge sees surfacing (recognizing and making explicit) mental models as especially important, since when models are tacit or unconscious they go unexamined and tend to become entrenched. This can lead to thinking that is out of alignment with current reality and may preclude effective systems thinking.

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Based on Senge's (1990) conceptualization of managing mental models as an individual level (as opposed to group level or organization level) phenomenon, the managing mental models-agency scale is viewed as less useful for the present research. The mental models-individual scale is at the appropriate level of analysis. To improve reliability and validity, five new items were devised (based on a review of Senge's description of the concept) and were included in the pilot. The items from Tetrick et al's scale are shown below, along with the five new items.

Managing Mental Models – Individual (Tetrick et al.'s items)

1. I am criticized for doing things a new way. (R)
2. My coworkers think I am stubborn. (R)
3. People in this agency say I don't understand their point of view. (R)

Managing Mental Models (additional items)

4. I make an effort to test my assumptions about what I think is true.
5. When there are disagreements, I try to understand why my view isn't shared.
6. It's not unusual for me to change my views and theories.
7. When I don't understand why we do things a certain way, I ask questions until it becomes clear to me.
8. When others challenge my views I stand my ground no matter what. (R)

Note: (R) = reverse-scored item.

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Team Learning

Senge (1990) says team learning is the group-based discovery of insights through dialogue and discussion. It involves thoughtful insight about complex issues, innovative and coordinated action, and cooperation with members of other teams. Tetrick et al.'s (2000) team learning scale is shown below, along with two additional proposed items aimed at added content validity.

Team Learning (Tetrick et al.'s items)

1. We take the time as a group to consider how we may work better together.
2. In my work group, everyone is encouraged to speak freely, regardless of position or title.
3. Information is freely shared within this work group.
4. This work group contributes to my growth.
5. People in my work group help me do a better job.
6. My work group often discusses opportunities for improvement.
7. People in my work group learn from one another.
8. When I get stuck, I can count on my work group to help provide ideas.
9. In my work group, important issues are discussed, even when they are sensitive to some people.
10. People decide as a group what to do about problems within the unit.
11. In my work group, we celebrate our successes.

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12. People in my work group are open to expressing their feelings about work issues.

13. The contribution of every group member is valued.

Team Learning (additional items)

14. My group coordinates its actions with other groups when necessary.

15. In my group, we figure things out as a team by talking and working together.

<u>Shared Vision</u>

Senge (1990) says that shared vision arises from the combined personal visions of organizational members and represents the collective sense of the purpose of the organization and where it's headed, along with a concomitant commitment to that purpose and direction. With Senge's definition in mind, three key items from Tetrick et al.'s (2000) 7-item scale seem essential for content validity (items 1, 3 and 4 below) while it may be possible to drop the other items in the interests of economy. Items from Tetrick et al.'s scale are shown below, followed by minor rewording of some items.

Shared Vision (Tetrick et al.'s items)

1. PIA are working toward the same future.
2. PIA agree on what this organization should stand for.
3. PIA agree on what our mission means.
4. PIA are committed to the long term goals of this organization.

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5. PIA share the same basic values.
6. PIA talk about how what we are doing today will get us where we want to be tomorrow.
7. PIA believe in what this organization is all about.

   Note: PIA = People in this agency

Shared Vision (modifications to numbered items above)

1. In our organization we are all working together toward the same future.
3. In our organization we all agree on what our mission is.
4. We are all committed to the long-term goals of our organization.

<u>Systems Thinking</u>

Senge (1990) sees systems thinking as a mental discipline for observing totalities and wholes rather than isolated parts, and observing interrelationships, patterns and processes rather than individual things and isolated events. The original 7- item scale for systems thinking from Tetrick et al. (2000) showed a reliability coefficient of .88, suggesting some items may be eliminated without sacrificing too much reliability. An additional item for increased content validity is also proposed. Some slight rewording of the retained items is also proposed. Tetrick et al.'s seven items are shown below, followed by modifications to the wording of three items and one additional new item.

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Systems Thinking (Tetrick et al.'s items)

1. PIA understand how to improve the way this organization functions.
2. PIA know how to develop or change policies and procedures to improve this organization as a whole.
3. PIA know how to make things work properly.
4. PIA feel personally responsible for how well this organization is doing.
5. PIA look at patterns or relationships among different parts of a problem to figure what went wrong.
6. Decision making takes into account the effects on other parts of this organization.
7. When there aren't enough resources to go around, PIA set up some way of sharing.

Systems Thinking (modifications to numbered items above)

2. We know how to make changes to improve the organization as a whole.
4. In our organization we feel personally responsible for how well the organization is doing.
5. We look at patterns and relationships among different parts of a problem to figure what went wrong or what to do to best improve things.

Systems Thinking (additional item)

8. When something goes wrong, we try to implement a long-term solution, rather than concentrate on the symptoms of a problem or go for a short-term fix.

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Analytical Technique

Confirmatory factor analysis (CFA) was used to determine which survey questions to retain in the abbreviated form of the survey. This was accomplished by inspecting which items loaded most strongly on their respective latent constructs. CFA also permitted verification of the anticipated 5-factor structure. CFA may be thought of as a combination of multiple regression and factor analysis. It includes two types of variables: observed and latent. In this pilot study, the observed variables are the questionnaire items and the latent variables are the five organizational learning disciplines. CFA yields a number of model fit indices that allow one to assess the fidelity of the specified (hypothesized) relationships. The nature of several of these goodness-of-fit measures is described in the notes of Table A1.3.

Missing Data

A total of 19 cases (11.8% of the 161 student sample) had some degree of missing data (Table A1.2). Inspection of the pilot data using SPSS missing value analysis found no obvious patterns of incompleteness (e.g., a particular variable that was often missing a response). The software used for CFA, AMOS Version 4.01, is capable of handling missing data using full information maximum likelihood (FIML) estimates (Arbuckle & Wothke, 1999). Nevertheless, AMOS is unable to compute a number of goodness-of-fit indices in the presence of missing data, and it cannot compute modification indices without complete cases. Consequently, the 19 cases with missing data were eliminated from analysis.

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Table A1.2
Missing Data Summary

Missing Responses	Proportion Missing	Number of Cases	Proportion of Cases
0	0%	142	88.2
1	2%	10	6.2
2-4	4% - 9%	4	2.5
5-6	11% - 13%	3	1.9
14	30%	1	0.6
28	61%	1	0.6
Total		161	100.0

Data Screening

All variables were screened for conformance to the underlying statistical assumptions pertaining to covariance structural modeling. Measures of skewness and kurtosis were evaluated, and each variable's histogram was inspected visually with a superimposed normal curve. The variables appeared generally well-behaved with respect to univariate normality, with some variables showing moderate skewness. Tests for multivariate normality were not performed. No variables were transformed prior to use other than to reverse-score three items associated with the managing mental models scale.

Results

Three CFA models were tested in this pilot study. The purpose of the first model was to identify the survey items loading most heavily on the latent variables;

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these items would be retained for use in the shortened version of the survey. The items comprising the shortened form of the survey were then subjected to a second CFA to inspect the abbreviated measurement model's fit with the data and to obtain modification indices suggesting paths among the latent variables (i.e., a structural model). A third and final CFA was performed to evaluate the combined measurement and structural model. This multiple-models approach is in accordance with the recommendations of a variety of researchers who suggest assessing the measurement model independently from the structural model (Schumacker & Lomax, 1996, p. 72).

Confirmatory factor analysis was performed using AMOS Version 4.01. AMOS uses a maximum likelihood estimation technique in minimizing the difference between the observed and estimated population covariance matrices. This technique is regarded as a good choice for small sample work in which normality and independence assumptions hold (Tabachnick & Fidell, 1996). Reliability analysis was performed using SPSS Version 10.0.7 to compute Cronbach's alpha.

Model One

The first analysis tested a measurement model containing all 46 items in the pilot survey. The measurement model specified a path between each observed variable (survey item) and its respective latent variable (learning discipline). Since only a measurement model was specified there were no paths from one latent variable to another. The independence model (H_0: variables are uncorrelated with one another) was rejected: $\chi 2$ (1035, N = 142) = 4365, $p < .001$. Next, the hypothesized model

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(Model 1) was tested. A chi-square difference test indicated a significant improvement in fit between the independence model and Model 1: $\Delta\chi 2$ (46, N = 142) = 2534, $p < .001$. The chi-square per degree of freedom ratio for the model was satisfactory: $\chi 2$ (989, N = 142) = 1831, $p < .001$; $\chi 2$ /df = 1.852. To further judge model fit, a variety of goodness-of-fit indices was chosen (following the advice of Hoyle, 1995) to represent measures stemming form several theoretical bases, including sample discrepancy measures, measures based on population discrepancies, information-theoretic measures, comparisons to a baseline model and parsimony adjusted measures. Support for the first model was marginal as judged by the adjunct fit indices (Table A1.3), but Model 1 includes no paths (correlations) among the latent variables. Prior research from Tetrick et al. (2000) demonstrated that the latent variables (measurement scales) are correlated among one another, so poor fit measures are to be expected with a model that does not reflect those correlations.

The purpose of the first model was to select a smaller set of items for inclusion in an abbreviated form of the survey. Table A1.4 shows the standardized regression weights for each item on their respective latent variable. The items with strong regression weights (shown in **bold** in the table) indicate the items chosen for retention in the abbreviated form of the survey. Only two of the eight proposed additional items loaded strongly on their intended constructs. For consistency, only items from the Tetrick et al. (2000) instrument were used going forward; the minor rewording of those items was retained.

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Table A1.3
Model fit indices

	χ^2 /df	AGFI	RMR	AIC	NFI	RFI	CFI	PNFI
Model 1	1.852	.640	.255	2015	.580	.561	.747	.555
Model 2	2.739	.736	.241	394	.739	.701	.814	.646
Model 3	1.470	.853	.079	244	.863	.840	.951	.736

Note. **χ2/DF** is a discrepancy measure assessing the size of the difference function being minimized. A value of less than 2:1 indicates reasonable fit (Tabachnick & Fidell, 1996, p. 776).

AGFI (Adjusted goodness of fit) is a sample discrepancy measure that assesses the difference between predicted and observed covariances after adjusting for degrees of freedom. Values above .90 are sufficient.

RMR (root mean square residual) is another sample discrepancy measure. RMR is the square root of the average squared amount by which the sample variances and covariances differ from the model's estimates. Low RMRs are preferred.

AIC (Akaike information criterion) is a widely used information-theoretic measure of comparative model fit. Low AIC values indicate a simple, well-fitting model.

NFI, RFI and **CFI** are measure the model's fit compared to the independence model.

NFI (normed fit index) is based on the ratio (not difference) of the model compared to the independence model. Values above .90 are desirable.

RFI (relative fit index) adjusts NFI for degrees of freedom.

CFI (comparative fit index) takes normality-related concerns into consideration; used across studies.

PNFI (parsimony adjusted NFI) is NFI adjusted by degrees of freedom.

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Table A1.4

Standardized Regression Weight Estimates for Model 1 (46 Questionnaire Items)

	Personal Mastery	Mental Models	Team Learning	Shared Vision	Systems Thinking
Item 1	**.551**	**.335**	.671	**.892**	**.807**
Item 2	**.680**	**.907**	.601	.712	**.790**
Item 3	**.607**	**.654**	.702	**.865**	**.747**
Item 4	**.686**	*-.073*	**.825**	**.895**	.680
Item 5	**.594**	*.056*	**.726**	.692	.736
Item 6	.373	*.026*	**.736**	.735	.718
Item 7	.359	*-.198*	.691	.797	.605
Item 8	.365	*.236*	.678		*.754*
Item 9			.612		
Item 10			.718		
Item 11			.567		
Item 12			.563		
Item 13			.719		
Item 14			*.583*		
Item 15			*.779*		

Note. **Bold** indicates item selected for inclusion in abbreviated form of the instrument. *Italic* indicates proposed additional item.

Model 2

The second analysis tested a measurement model containing the 17 items suggested by the first model. As before, the measurement model specified a path between each observed variable (survey item) and its respective latent variable (learning discipline) and there were no paths from one latent variable to another. The

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independence model was rejected: $\chi 2$ (136, N = 142) = 1247, $p < .001$. The theoretical model (Model 2) was tested next. A chi-square difference test indicated a significant improvement in fit between the independence model and Model 2: $\Delta\chi 2$ (17, N = 142) = 921.1, $p < .001$. General support for the model was marginal: $\chi 2$ (119, N = 142) = 325.9, $p < .001$; $\chi 2$ /df = 2.739. The fit indices for Model 2 were uniformly superior to those of Model 1. Since Model 2 represents the survey items to carry over to the abbreviated instrument, a series of t tests were examined to verify that each path in the model was statistically significant. The t values ranged from 3.3 to 15.3; all were significant at the .001 level or better. The standardized regression weights for each item are shown in Table A1.5 along with scale reliabilities.

Modification indices

Modification indices (MIs) estimate how much the discrepancy function would improve (measured by a drop in the chi-square statistic) if the constraints on a given parameter were changed. The highest MI for covariance between latent variables was 58.4 for a covariance path between shared vision and systems thinking. This indicates that the chi-square statistic would decrease by 58.4 if shared vision and systems thinking were correlated in the model. Two other covariance paths were suggested by the MIs: team learning and shared vision (MI = 52.6) and team learning and systems thinking (MI = 42.9). The remaining MIs pertaining to latent variable covariances were all below 5.

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Table A1.5
Standardized Regression Weight Estimates for Model 2 and Scale Reliabilities

	Personal Mastery ($\alpha = .73$)	Mental Models ($\alpha = .63$)	Team Learning ($\alpha = .84$)	Shared Vision ($\alpha = .92$)	Systems Thinking ($\alpha = .86$)
Item 1	.52	.36	.77	.88	.92
Item 2	.70	.79	.83	.90	.75
Item 3	.60	.75	.79	.92	.79
Item 4	.71				
Item 5	.58				

Note. α is Cronbach's alpha.

Model 3

Model 3 (Figure A1.1) incorporates the three covariance paths suggested by the modification indices produced from Model 2. The addition of these three paths can be justified based on the findings from prior research by Tetrick et al. (2000). This is important, since simply adding paths suggested by MI's runs the risk of opportunistically capitalizing on chance covariances in the data. The three additional paths suggested by Model 2 correspond to the three strongest inter-scale correlations observed by Tetrick et al. The path diagram (Figure A1.1) indicates the standardized regression weight for each item on its latent construct. The path diagram also indicates the squared multiple correlations (SMCs) for each item. For the first indicator of shared vision (sv1), the item's SMC is .78, indicating that 78% of the variance of this item is accounted for by the variance in the shared vision scale. The remaining 22% cannot be explained by this model and is attributed to the error term.

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General support for Model 3 was good as judged by chi-square per degree of freedom: $\chi 2$ (116, N = 142) = 170.5, p < .001; $\chi 2$ /df = 1.470. The addition of the three covariance paths resulted in improvements to all of the goodness-of-fit indices (Table A1.3). Each of the three covariance paths in the model was statistically significant with t values from 5.3 to 6.2. Standardized residual covariances ranged from -2.80 to 2.73.

Because Model 2 and Model 3 are nested, it is possible to compare the two models using a chi-square difference test. Models are nested if they have the same parameters but one model's free parameters are a subset of the other model's free parameters (Hoyle, 1995, p. 8). A chi-square difference test indicated a significant improvement in fit from Model 2 to Model 3: $\Delta\chi 2$ (3, N = 142) = 155.4, p < .001. The means, standard deviations and correlations of the abbreviated measurement scales are shown in Table A1.6. The values in this table are roughly similar to those observed by Tetrick at al. (2000) in their fielding of the full-length instrument (Table 6.4).

Table A1.6

Descriptive Statistics and Bivariate Correlations of Pilot Data

	Variable	Mean	*SD*	1	2	3	4
1	Systems Thinking	3.11	.89				
2	Shared Vision	3.09	1.03	.679**			
3	Team Learning	3.50	.89	.584**	.624**		
4	Mental Models (Individual)	3.62	.76	.214**	.201*	.248**	
5	Personal Mastery (General)	4.22	.48	-.031	-.010	.064	-.097

Note. N = 161. * p < .05. ** p < .01.

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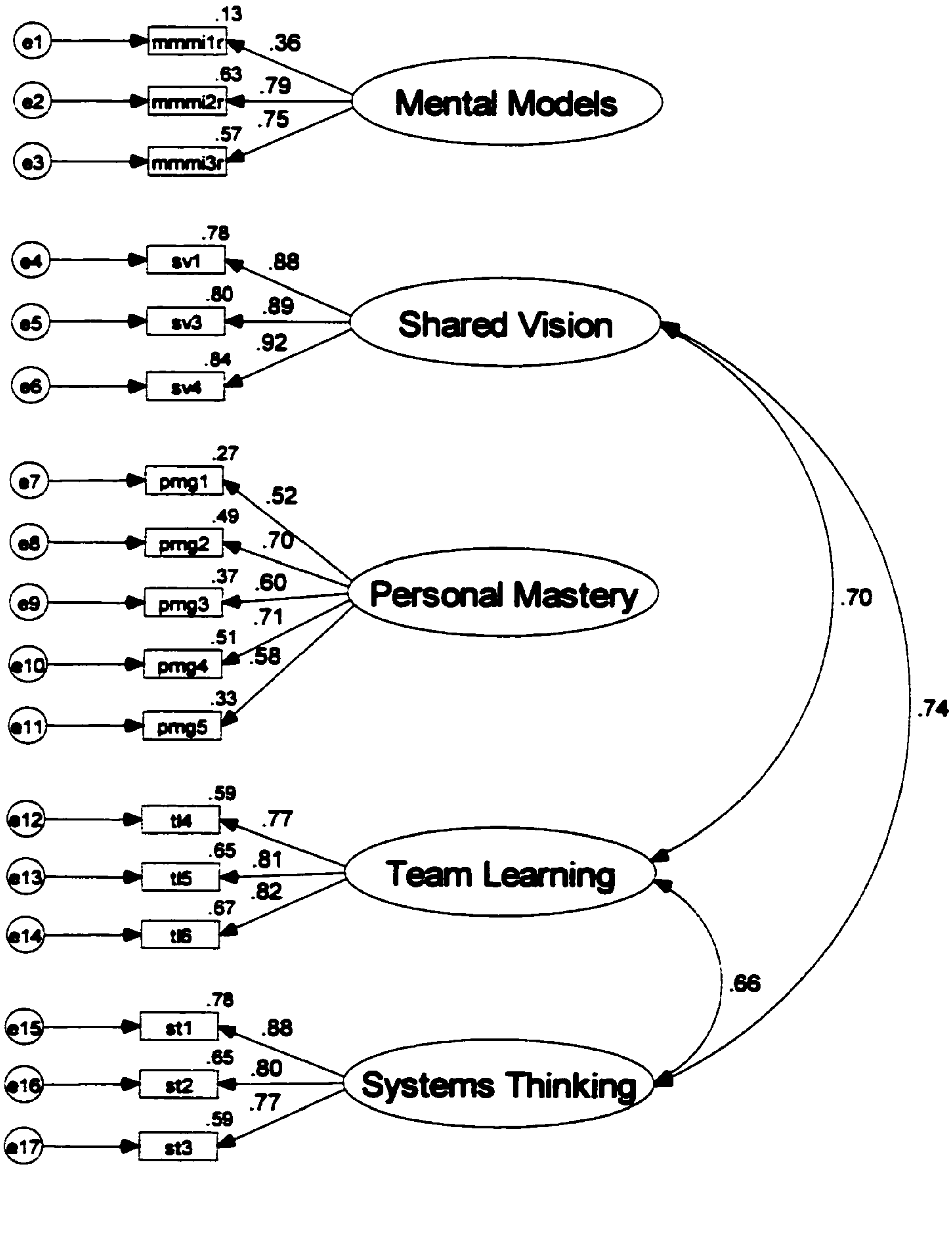
Figure A1.1
Path-Analytic Model for Organizational Learning Instrument Pilot Study (Standardized Estimates)



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Discussion

The pilot study validated the hypothesized 5-factor structure of the organizational learning instrument developed by Tetrick et al. (2000) in both its full-length and abbreviated test forms. The fit of the final model (Figure A1.1) with the data was adequate as judged by the comparative fit index (CFI = .951) but poor by the other adjunct fit indices (Table A1.3). However, many adjunct fit indices are biased under small sample conditions (Hu & Bentler, 1995). CFI is recommended by West, Finch and Curran (1995) for small sample studies since this index suffers only a small (3% to 4%) downward bias with small samples. Nevertheless, the chi-square test of exact fit failed. This likely stems from several low path coefficients. For example, the path diagram shows one path with a coefficient below .50 (associated with the managing mental models scale). There are a total of four questionnaire items in the model with path coefficients below .70. This indicates that future refinement of the survey instrument would be beneficial.

The study demonstrated that the abbreviated form of the survey produces measurement scales with satisfactory reliability. Reliabilities of the shortened instrument were above .70 for four of the five scales. Only the 3-item managing mental models scale, with a Cronbach's alpha of .63, fell short of the often-used .70 threshold. However, it is important in judging reliability estimates to consider not only the reliability coefficients obtained but also the number of items associated with a scale. Scale length is important since Cronbach's alpha is adjusted for the number of

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items. Increasing the number of items will, all other things being equal, increase reliability (Cronbach, 1951, p. 323). Further, the nature of the sample and the sample size also play a part in the fidelity of reliability estimates. The pilot study employed a convenience sample of 161 working adult students, many of whom were employed part-time. The reliability estimates obtained from the larger ($N > 600$) sample employed in the main study were all above .70 (refer to Appendix A2 and Figure A2.1).

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Pilot Questionnaire

Directions: The statements below describe various ways in which people may approach their work and how they work together. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. I am always trying to make my goals a reality. .... ① ② ③ ④ ⑤
2. If my life is not going the way I want, I change things. .... ① ② ③ ④ ⑤
3. I know how to work toward the future that I have chosen for myself. .... ① ② ③ ④ ⑤
4. I willingly change my strategies to better meet my personal goals. .... ① ② ③ ④ ⑤
5. I am committed to my personal growth. .... ① ② ③ ④ ⑤
6. I seek out information on how to improve my relationship with others. .... ① ② ③ ④ ⑤
7. I think about what I want for my future. .... ① ② ③ ④ ⑤
8. I know what really matters to me. .... ① ② ③ ④ ⑤
9. In my organization I am criticized for doing things a new way. .... ① ② ③ ④ ⑤
10. My coworkers think I am stubborn. .... ① ② ③ ④ ⑤
11. People in this organization say I don't understand their point of view. .... ① ② ③ ④ ⑤
12. I make an effort to test my assumptions about what I think is true. .... ① ② ③ ④ ⑤
13. When there are disagreements, I try to understand why my view isn't shared. .... ① ② ③ ④ ⑤

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14. It's not unusual for me to change my views and theories. ..... ① ② ③ ④ ⑤

15. When I don't understand why we do things a certain way, I ask questions until it becomes clear to me. .... ① ② ③ ④ ⑤

16. When others challenge my views I stand my ground no matter what. .... ① ② ③ ④ ⑤

17. We take the time as a group to consider how we may work better together. .... ① ② ③ ④ ⑤

18. In my work group, everyone is encouraged to speak freely, regardless of position or title. .... ① ② ③ ④ ⑤

19. Information is freely shared within this work group. .... ① ② ③ ④ ⑤

20. This work group contributes to my growth. .... ① ② ③ ④ ⑤

21. People in my work group help me do a better job. .... ① ② ③ ④ ⑤

22. My work group often discusses opportunities for improvement. .... ① ② ③ ④ ⑤

23. People in my work group learn from one another. .... ① ② ③ ④ ⑤

24. When I get stuck, I can count on my work group to help provide ideas. .... ① ② ③ ④ ⑤

25. In my work group, important issues are discussed, even when they are sensitive to some people. .... ① ② ③ ④ ⑤

26. People decide as a group what to do about problems within the unit. .... ① ② ③ ④ ⑤

27. In my work group, we celebrate our successes. .... ① ② ③ ④ ⑤

28. People in my work group are open to expressing their feelings about work issues. .... ① ② ③ ④ ⑤

29. The contribution of every group member is valued. .... ① ② ③ ④ ⑤

30. My group coordinates its actions with other groups when necessary. .... ① ② ③ ④ ⑤

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31. In my group, we figure things out as a team by talking and working together. .... ① ② ③ ④ ⑤

32. In our organization we agree on what this organization should stand for. .... ① ② ③ ④ ⑤

33. In our organization we share the same basic values. .... ① ② ③ ④ ⑤

34. In our organization we talk about how what we are doing today will get us where we want to be tomorrow. .... ① ② ③ ④ ⑤

35. We believe in what this organization is all about. .... ① ② ③ ④ ⑤

36. In our organization we are all working together toward the same future. .... ① ② ③ ④ ⑤

37. In our organization we all agree on what our mission is. ...... ① ② ③ ④ ⑤

38. We are all committed to the long term goals of our organization. .... ① ② ③ ④ ⑤

39. In our organization we understand how to improve the way the organization functions. .... ① ② ③ ④ ⑤

40. In our organization we know how to make things work properly. .... ① ② ③ ④ ⑤

41. In our organization we feel personally responsible for how well the organization is doing. .... ① ② ③ ④ ⑤

42. When there aren't enough resources to go around, we set up some way of sharing. .... ① ② ③ ④ ⑤

43. We know how to make changes to improve the organization as a whole. .... ① ② ③ ④ ⑤

44. We look at patterns and relationships among different parts of a problem to figure what went wrong or what to do to best improve things. .... ① ② ③ ④ ⑤

45. Our decision making takes into account possible side-effects on other parts of the organization. .... ① ② ③ ④ ⑤

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46. When something goes wrong, we try to implement a long-term solution, rather than concentrate on the symptoms of a problem or go for a short-term fix. .... ① ② ③ ④ ⑤

Demographic Information

The following information is needed to describe the general characteristics of those who answered this survey. Please darken the appropriate response or fill in the blank.

(1) How old were you on your last birthday?________ years

(2) Are you male or female? Ⓜ Male Ⓕ Female

(3) Are you (or were you most recently):
- Ⓐ a regular full-time employee?
- Ⓑ a part-time employee?
- Ⓒ a contract employee or independent contractor?
- Ⓓ a temporary employee working for an agency?
- Ⓔ a consultant?
- Ⓕ other

(4) How long have you (or had you) been employed by your most recent employer?

________ years OR ________ months

Please put your completed survey in the collection envelope. Thank you again for your help.

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Appendix A2: Organizational Learning CFA

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Confirmatory Factor Analysis

A confirmatory factor analyses was performed to verify the dimensionality of an abbreviated form of the learning organization measurement instrument developed by Tetrick et al. (2000). This validation was important for several reasons. First, the instrument is new and has not been vetted by other researchers. Hinkin (1995) suggests that a confirmatory factor analysis is useful and appropriate for verifying the dimensionality of even established scales and refining such measures. Second, the 161 subjects in the pilot study (Appendix A1) included nearly 30% part-time workers and had an average participant age of 28.4 years, while the main research sample of more than 600 individuals consisted of nearly all full-time workers and had an average age of 41.2 years (Table 7.3).

Confirmatory factor analysis (CFA) may be thought of as a combination of multiple regression and factor analysis. It includes two types of variables: observed and latent. In the present context, the observed variables are the questionnaire items and the latent variables are the five organizational learning disciplines. CFA is a special type of structural equation modeling in which a theorized or anticipated factor structure is specified a priori.

The final model identified in the pilot study (Appendix A1) was used as the basis for the CFA with the exception that all possible covariance paths among latent variables were included. In the pilot study only three covariance paths among the latent variables were significant due in part to pilot's small sample size. Including all

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covariance paths in the final confirmatory model was reasonable since prior research (Tetrick et al., 2000) has indicated that the latent variables (organizational learning constructs) are intercorrelated. The CFA model included all of the questionnaire items comprising the abbreviated 17-item organizational learning instrument. The ordering of the measured variables on the path diagram (the rectangles in Figure A2.1) from top to bottom follows the ordering of the questions on the survey form itself (Appendix E, Part 6 of the questionnaire).

Data Screening

A total of 22 cases (3.6 % of the 615 person sample) had some degree of missing data. Inspection of the data using SPSS missing value analysis found no obvious patterns of incompleteness (e.g., a particular variable that was often missing a response). The structural equation modeling program used for CFA, AMOS, is capable of handling missing data using full information maximum likelihood (FIML) estimates (Arbuckle & Wothke, 1999) to minimize bias in the estimates of variance and covariance. Nevertheless, AMOS is unable to compute several goodness-of-fit indices in the presence of missing data. Consequently the 22 cases with missing data were eliminated from the analysis.

All variables were screened for conformance to the underlying statistical assumptions pertaining to structural equation modeling. Measures of skewness and kurtosis were evaluated and each variable's histogram was visually inspected. Aside from moderate skewness, the distribution of the variables appeared generally well-

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behaved. Multivariate tests showed lack of multivariate normality (*c.r.* = 34.7) but this appeared to be due to only mild negative skewness (-.255 to -.876) and positive kurtosis (.619 to 1.001) across the measures. No variables were transformed prior to use other than to reverse-score the three items associated with the managing mental models scale. The ratio of cases to estimated parameters was 13.5:1 indicating a favorable ratio (Schumacker & Lomax, 1996, p. 20).

Results

The independence model (H_o: variables are uncorrelated with one another) was rejected: $\chi 2$ (136, N = 593) = 4479, $p < .001$. The hypothesized model (Model 1) was tested next. A chi-square difference test indicated a significant improvement in fit between the independence model and Model 1: $\Delta\chi 2$ (27, N = 593) = 4212, $p < .001$. The theoretical model's chi-square per degree of freedom ratio was fair: $\chi 2$ (109, N = 593) = 266, $p < .001$; $\chi 2$ /df = 2.443. Figure A1.1 shows the standardized regression weights for each item with respect to its specified latent variable and Cronbach's alpha reliabilities. Reliability coefficients were computed using SPSS Version 10.0.7. All regression weights in the measurement model were significant with t values from 10.39 to 24.58. All the covariance paths in the structural model were also significant (t values from 4.71 to 12.94) except for the path between personal mastery and managing mental models (t = 1.07, r = .06, p = .287).

To further judge model fit, a variety of goodness-of-fit indices was computed and standardized residual covariances were inspected. A range of goodness-of-fit

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indices were chosen to represent measures stemming form several theoretical bases (following the advice of Hoyle, 1995) including sample discrepancy measures, measures based on population discrepancies, information-theoretic measures, comparisons to a baseline model and parsimony adjusted measures. Support for the model was good as judged by the various adjunct fit indices (Table A2.1). The standardized residual covariances ranged from -2.321 and 2.596 except for the value between one particular pair of questionnaire items. The standardized covariance between questionnaire item sv2 (shared vision question 2) and mmmi1r (managing mental models individual, question 1, recoded) was 3.54. Item mmi1r had a squared multiple correlation with its associated latent variable of just .34, meaning that this item had 66% error variance. This suggests that the managing mental models scale could benefit from additional refinement that would reduce error variance and improve the scale's reliability. Overall, the abbreviated 17-item organizational learning instrument demonstrated the anticipated 5-factor structure and produced satisfactory reliability across each of its scales.

Table A2.1
Confirmatory Factor Analysis for Organizational Learning Instrument: Model Fit Indices

	χ^2 /df	AGFI	RMR	AIC	NFI	RFI	CFI	PNFI
Saturated	--	--	0	306	1	--	1	0
Independence	32.9	.296	.286	4513	0	0	0	0
Figure A2.1	2.44	.931	.038	354	.941	.926	.964	.754

Note. See notes for Table A1.3 for explanation of fit indices.

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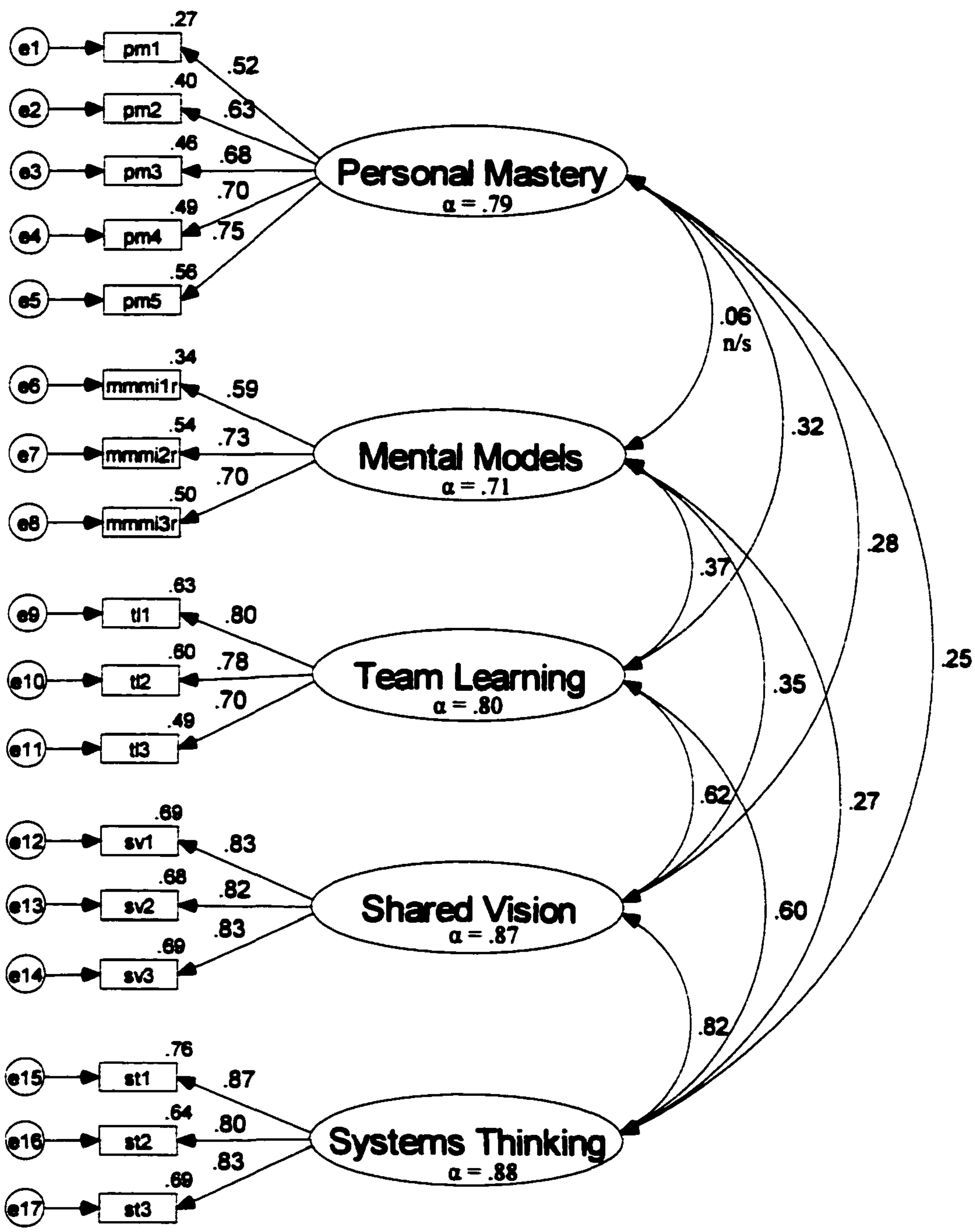
Figure A2.1
Confirmatory Factor Analysis for Organizational Learning Instrument: Standardized Estimates and Reliability Coefficients (Cronbach's alpha)



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Appendix B: Malcolm Baldrige National Quality Award Criteria

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The assessment criteria for the Malcolm Baldrige National Quality Award are reproduced below. Applicants are judged along seven criteria, as follows.

Leadership

Leadership addresses how the senior leaders guide the organization in setting directions and seeking future opportunities. Primary attention is given to how the senior leaders set and deploy clear values and high performance expectations that address the needs of all stakeholders. The category also includes the organization's responsibilities to the public and how the organization practices good citizenship.

Strategic Planning

Strategic planning addresses strategic and action planning and deployment of plans. The category stresses that customer-driven quality and operational performance excellence are key strategic issues that need to be integral parts of overall planning.

Customer and Market Focus

Customer and Market Focus addresses how the organization seeks to understand the voices of customers and of the marketplace. The category stresses relationships as an important part of an overall listening and learning strategy. Customer satisfaction results provide vital information for understanding customers and the marketplace.

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Information and Analysis

Information and Analysis is the main point with the Criteria for all key information to effectively measure performance and manage the organization, and to drive improvement of performance and competitiveness.

Human Resource Focus

Human Resource Focus addresses key human resource practices – those directed toward creating a high performance workplace and toward developing employees to enable them and the organization to adapt to change. The category covers human resource development and management requirements in an integrated way, aligned with the organization's strategic directions. Included in the focus on human resources is a focus on the work environment and the employee support climate.

Process Management

Process Management is the focal point with the Criteria for all key work processes. Built into the category are the central requirements for efficient and effective process management – effective design, a prevention orientation, linkage to suppliers and partners, operational performance, cycle time, and evaluation and continuous improvement.

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Business Results

The Business Results category provides a results focus that encompasses the customer's evaluation of the organization's products and services, overall financial and market performance, and the results of all key processes and process improvement activities.

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Appendix C: Correlations of Study Variables

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Table C.1

Means, Standard Deviations, Coefficient Alphas, and Correlations Among Study Variables for Group-Level Measures

Scale	Mean	SD	1	2
Subordinates' Perspective				
1. Idealized Influence (attributed)	2.55	.65	(.80)	
2. Idealized Influence (behavioral)	2.34	.61	.780	(.75)
3. Inspirational Motivation	2.65	.59	.758	.807
4. Intellectual Stimulation	2.36	.56	.782	.758
5. Individualized Consideration	2.32	.56	.812	.712
6. Contingent Reward	2.44	.57	.765	.748
7. Management by Exception (active)	1.78	.59	-.050	.085
8. Management by Exception (passive)	1.34	.59	-.541	-.402
9. Laissez Faire	.90	.55	-.554	-.396
10. Customer Focus	3.80	.43	.370	.371
11. Continuous Improvement Commitment	3.97	.48	.502	.547
12. Teamwork	3.39	.67	.592	.537
13. Process Control Methods	3.11	.60	.340	.336
14. Process Feedback	3.17	.59	.432	.545
15. Team Learning	3.56	.46	.510	.520
16. Shared Vision	3.53	.52	.332	.438
17. Systems Thinking	3.31	.47	.328	.320
Leaders' Perspective				
18. Process Control	3.14	.86	-.047	-.023
19. Process Feedback	3.36	.70	.009	.102
20. Continuous Improvement Achievement	5.03	.80	.178	.185

Note. Coefficient alphas appear in parentheses along the diagonal. Variables 1 to 9 were measured on a 0 to 4 scale; variables 10 to 19 on a 1 to 5 scale; variable 20 on a 1 to 7 scale. $N = 105$. Correlations greater than .258 are significant at $p < .01$, two-tailed. Correlations greater than .197 are significant at $p < .05$, two-tailed.

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Table C.1 (continued)
Means, Standard Deviations, Coefficient Alphas, and Correlations Among Study Variables for Group-Level Measures

	3	4	5	6	7	8	9	10	11
1.									
2.									
3.	(.85)								
4.	.715	(.79)							
5.	.699	.715	(.77)						
6.	.736	.749	.796	(.77)					
7.	-.181	.078	-.014	.121	(.70)				
8.	-.484	-.507	-.402	-.505	.045	(.72)			
9.	-.429	-.457	-.435	-.479	-.004	.766	(.77)		
10.	.324	.405	.369	.338	-.048	-.442	-.380	(.79)	
11.	.481	.546	.429	.500	.109	-.578	-.510	.608	(.90)
12.	.543	.665	.527	.577	-.053	-.517	-.392	.507	.549
13.	.184	.385	.285	.392	.447	-.300	-.276	.418	.567
14.	.372	.562	.459	.566	.390	-.444	-.397	.433	.611
15.	.522	.634	.508	.516	-.029	-.473	-.455	.576	.565
16.	.338	.445	.310	.381	.084	-.454	-.368	.515	.634
17.	.209	.396	.228	.298	.132	-.425	-.311	.538	.564
18.	-.101	.018	.036	-.036	.380	-.040	-.004	.198	.217
19.	-.030	.110	.098	.060	.299	.062	.068	.017	.167
20.	.263	.201	.260	.142	-.156	.001	.063	.157	-.047

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Table C.1 (continued)
Means, Standard Deviations, Coefficient Alphas, and Correlations Among Study Variables for Group-Level Measures

	12	13	14	15	16	17	18	19	20
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.	(.91)								
13.	.394	(.75)							
14.	.519	.732	(.87)						
15.	.717	.332	.467	(.80)					
16.	.470	.552	.651	.483	(.87)				
17.	.463	.545	.574	.498	.718	(.88)			
18.	.046	.357	.293	-.019	.130	.170	(.72)		
19.	.177	.275	.335	.007	.141	.178	.532	(.77)	
20.	.237	-.142	-.052	.259	-.065	.067	.170	.298	(.89)

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Table C.2

Means, Standard Deviations, Coefficient Alphas, and Correlations Among Study Variables for Individual-Level Measures

Scale	Mean	SD	1	2
1. Idealized Influence (attributed)	2.52	.97	(.80)	
2. Idealized Influence (behavioral)	2.30	.90	.736	(.75)
3. Inspirational Motivation	2.64	.91	.709	.757
4. Intellectual Stimulation	2.35	.89	.726	.693
5. Individualized Consideration	2.28	.97	.747	.659
6. Contingent Reward	2.42	.91	.722	.698
7. Management by Exception (active)	1.80	.90	.031	.146
8. Management by Exception (passive)	1.37	.90	-.441	-.345
9. Laissez Faire	.96	.84	-.544	-.397
10. LMX	3.54	.87	.775	.636
11. Process Control Methods	3.12	.87	.240	.294
12. Process Feedback	3.14	.91	.383	.448
13. Employee Fulfillment	5.04	1.33	.296	.308
14. Self-efficacy	5.71	1.04	.070	.078
15. Personal Mastery	3.99	.53	.146	.188
16. Managing Mental Models	3.57	.81	.244	.203
17. Tenure (years)	7.23	7.13	-.023	.004

Note. Coefficient alphas appear in parentheses along the diagonal. Variables 1 to 9 were measured on a 0 to 4 scale; variables 10 to 12 and 15 to 17 on a 1 to 5 scale; variables 13 and 14 on a 1 to 7 scale. $N = 615$. Correlations greater than .108 are significant at $p < .01$, two-tailed. Correlations greater than .079 are significant at $p < .05$, two-tailed.

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Table C.2 (continued)

Means, Standard Deviations, Coefficient Alphas, and Correlations Among Study Variables for Individual-Level Measures

	3	4	5	6	7	8	9	10	11
1.									
2.									
3.	(.85)								
4.	.655	(.79)							
5.	.614	.722	(.77)						
6.	.687	.701	.706	(.77)					
7.	-.020	.086	.039	.162	(.70)				
8.	-.359	-.415	-.368	-.418	.109	(.72)			
9.	-.414	-.452	-.414	-.451	.015	.659	(.77)		
10.	.639	.664	.766	.730	-.034	-.438	-.559	(.91)	
11.	.206	.269	.229	.301	.247	-.219	-.198	.298	(.75)
12.	.381	.422	.389	.498	.212	-.326	-.350	.495	.607
13.	.279	.266	.255	.305	.022	-.138	-.144	.382	.223
14.	.080	.042	.046	.063	.040	.006	-.008	.143	.080
15.	.165	.159	.115	.144	.025	-.039	-.040	.167	.125
16.	.262	.255	.198	.246	-.091	-.330	-.306	.275	.136
17.	-.028	-.041	-.058	-.050	-.032	.020	.051	.045	.036

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Table C.2 (continued)
Means, Standard Deviations, Coefficient Alphas, and Correlations Among Study Variables for Individual-Level Measures

	12	13	14	15	16	17
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.	(.87)					
13.	.325	(.91)				
14.	.126	.507	(.80)			
15.	.169	.265	.290	(.79)		
16.	.204	.178	.115	.022	(.71)	
17.	.054	.168	.067	.021	-.084	(--)

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Appendix D: Study Introduction Letters

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Stephen W. King
Doctoral Candidate, Systems Science Ph.D. Program
Portland State University
P. O. Box 751
Portland, Oregon
(503) 579-3070

[Date]

[Key contact's name]
[Title]
[Organization name]
[Address]
[City, State, Zip]

Dear [contact name]:

I recently managed the Oregon Quality Award assessment process for Protocol Systems, Inc. in Beaverton. I am now a doctoral candidate at Portland State University conducting research on effective quality management practices. Since your organization is a past winner of an Oregon Quality Award, I think that you might find the research that I am doing interesting.

I am looking to gather data on organizations that have been recognized for their quality achievements. This research will reveal specific management practices that best support the achievement of quality-focused goals. The highlights of this study are:

Benefits	• Receive a benchmarking report showing how your company's quality management practices contrast with those of other Oregon Quality Award winners and with ISO 9000 firms. • Help advance the understanding of quality management.
Process	• Administer a short (20-25 minute) survey to at least 3 supervisors or managers in your organization, along with several of their subordinates. • Arrange for the completion of a very brief (5 minute) survey by an executive in your organization.
Confidentiality	• Confidentiality of managers and subordinates protected. Company name and proprietary information will remain confidential.

I will call you next week to discuss this research. I look forward to speaking with you, and thank you in advance for considering this proposal.

Sincerely,

Stephen W. King

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Stephen W. King
Doctoral Candidate, Systems Science Ph.D. Program
Portland State University
P. O. Box 751
Portland, Oregon
(503) 579-3070

[Date]

[Key contact's name]
[Title]
[Organization name]
[Address]
[City, State, Zip]

Dear [contact name]:

I recently managed part of the ISO 9000 program at Protocol Systems, Inc. in Beaverton. I am now a doctoral candidate at Portland State University conducting research on effective quality management practices. Since your organization is ISO 9000-certified, I think that you might find the research that I am doing interesting.

I am looking to gather data on organizations that have successful ISO 9000 programs. This research will reveal specific management practices that best support the achievement of quality-focused goals. The highlights of this study are:

Benefits	• Receive a benchmarking report showing how your company's quality management practices contrast with those of other ISO9000 firms and to recipients of the prestigious *Oregon Quality Award.*
	• Help advance the understanding of quality management.
Process	• Administer a short (20-25 minute) survey to at least 3 supervisors or managers in your organization, along with several of their subordinates.
	• Arrange for the completion of a very brief (5 minute) survey by an executive in your organization.
Confidentiality	• Confidentiality of managers and subordinates protected. Company name and proprietary information will remain confidential.

I will call you next week to discuss this research. I look forward to speaking with you, and thank you in advance for considering this proposal.

Sincerely,

Stephen W. King

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Appendix E: Subordinate Survey

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Stephen W. King
Doctoral Candidate, Systems Science Ph.D. Program
Portland State University
P. O. Box 751
Portland, Oregon
(503) 579-3070

Dear Employee:

I would like to ask you for your help. I am a Ph.D. candidate at Portland State University doing research on how quality is managed in Oregon companies. Your employer has agreed to participate in this research and has allowed me to ask randomly selected employees to complete a survey.

Your participation is completely voluntary. Your employer does not require that you complete the enclosed survey. But your participation is important to this research, because surveys that are not completed call into question the accuracy of the study's findings.

The enclosed survey asks for your perceptions about teamwork, customer focus, what supervisors and managers say and do, and so on. The survey takes about 20-25 minutes to complete. Your employer has agreed to allow you to complete this survey on company time.

Your answers are completely confidential. The survey does not ask for your name, and no one in your organization will receive any information about your answers. Your organization, along with other Oregon companies, will receive only a summary of the overall findings of this research, which will show how different activities and approaches affect quality management.

If you have concerns or problems about being asked to participate in this study, or your rights under this research, please contact the Human Subjects Research Review Committee, Office of Research and Sponsored Projects, 111 Cramer Hall, Portland State University, (503) 725-8182.

If you have any questions about the study itself, please call me at the phone number above. Remember, your participation in this research is very important to its success. If you decide to participate, please keep this letter for your records. Thank you in advance for your help in this study.

PS: If you decide not to participate in this research, please return the unanswered survey as instructed on the Instructions page. We need all of the survey forms back. Thank you.

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INSTRUCTIONS

Please complete the survey as follows:

Please answer every question. If a question does not apply to you or your work group, please leave the answer blank for that question.

Please mark your responses as shown below. You can use a **pen or pencil** to darken the circles. If you use pencil and decide to change an answer, please erase the old mark completely.

Mark answers like this: ① ② ③ ● ⑤

Not like this: ① ② ③ ~~④~~ ⑤

Please complete the survey today or as soon as possible. When you are finished, please put your survey in the provided envelope.

If you decide that you do not want to participate in this research put the unanswered questionnaire in the envelope. No one from your company will know if you chose to answer the questions or not. We need all of the forms back, answered or not.

Thank you again for your help in conducting this research.

IMPORTANT DEFINITIONS

The following definitions will be helpful in answering the questions in this survey. Please read these carefully and refer to them as necessary.

"ORGANIZATION" refers to your company, agency or organization as a whole.

"WORK GROUP" refers to your immediate work group.

"SUPERVISOR" refers to the person, regardless of his or her title (e.g., supervisor, manager, etc.) who is currently responsible for judging your work performance.

"CUSTOMER" can be external or internal customer – whomever you see as your customer.

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Part 1: Your Supervisor

Directions: This part of the survey asks you to describe the style of your immediate supervisor, as you perceive it. Thirty-six statements are listed below. Please judge how frequently each statement fits your immediate supervisor. Use the following rating scale:

0	1	2	3	4
Not at all	Once in a while	Sometimes	Fairly often	Frequently, if not always

1. Provides me with assistance in exchange for my efforts	0	1	2	3	4
2. Re-examines critical assumptions to question whether they are appropriate	0	1	2	3	4
3. Fails to interfere until problems become serious..........	0	1	2	3	4
4. Focuses attention on irregularities, mistakes, exceptions, and deviations from standards	0	1	2	3	4
5. Avoids getting involved when important issues arise..........	0	1	2	3	4
6. Talks about their most important values and beliefs..........	0	1	2	3	4
7. Is absent when needed..........	0	1	2	3	4
8. Seeks differing perspective when solving problems..........	0	1	2	3	4
9. Talks optimistically about the future..........	0	1	2	3	4
10. Instills pride in me for being associated with him/her..........	0	1	2	3	4
11. Discusses in specific terms who is responsible for achieving performance targets..........	0	1	2	3	4
12. Waits for things to go wrong before taking action..........	0	1	2	3	4
13. Talks enthusiastically about what needs to be accomplished.....	0	1	2	3	4
14. Specifies the importance of having a strong sense of purpose...	0	1	2	3	4
15. Spends time teaching and coaching..........	0	1	2	3	4
16. Makes clear what one can expect to receive when performance goals are achieved.	0	1	2	3	4
17. Shows that he/she is a firm believer in "If it ain't broke, don't fix it."..........	0	1	2	3	4
18. Goes beyond self-interest for the good of the group..........	0	1	2	3	4

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Part 1: continued

0	1	2	3	4
Not at all	Once in a while	Sometimes	Fairly often	Frequently, if not always

19. Treats me as an individual rather than just as a member of a group .... ⓪ ① ② ③ ④
20. Demonstrates that problems must become chronic before taking action .... ⓪ ① ② ③ ④
21. Acts in ways that builds my respect .... ⓪ ① ② ③ ④
22. Concentrates his/her full attention on dealing with mistakes, complaints, and failures. .... ⓪ ① ② ③ ④
23. Considers the moral and ethical consequences of decisions...... ⓪ ① ② ③ ④
24. Keeps track of all mistakes........ ⓪ ① ② ③ ④
25. Displays a sense of power and confidence........ ⓪ ① ② ③ ④
26. Articulates a compelling vision of the future........ ⓪ ① ② ③ ④
27. Directs my attention toward failures to meet standards........ ⓪ ① ② ③ ④
28. Avoids making decisions........ ⓪ ① ② ③ ④
29. Considers me as having different needs, abilities, and aspirations from others........ ⓪ ① ② ③ ④
30. Gets me to look at problems from many different angles........ ⓪ ① ② ③ ④
31. Helps me to develop my strengths........ ⓪ ① ② ③ ④
32. Suggests new ways of looking at how to complete assignments........ ⓪ ① ② ③ ④
33. Delays responding to urgent questions........ ⓪ ① ② ③ ④
34. Emphasizes the importance of having a collective sense of mission........ ⓪ ① ② ③ ④
35. Expresses satisfaction when I meet expectations........ ⓪ ① ② ③ ④
36. Expresses confidence that goals will be achieved........ ⓪ ① ② ③ ④

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Part 1: continued

1. Do you know where you stand with your supervisor?

Rarely	Occasionally	Sometimes	Fairly Often	Very Often
1	2	3	4	5

2. Do you usually know how satisfied your supervisor is with what you do?

Rarely	Occasionally	Sometimes	Fairly Often	Very Often
1	2	3	4	5

3. How well does your supervisor understand your job problems and needs?

Not a bit	A little	A Fair Amount	Quite a Bit	A Great Deal
1	2	3	4	5

4. How well does your supervisor recognize your potential?

Not at all	A little	Moderately	Mostly	Fully
1	2	3	4	5

5. Regardless of how much formal authority he/she has built into his/her position, what are the chances that your supervisor would use his/her power to help you solve problems in your work?

None	Small	Moderate	High	Very High
1	2	3	4	5

6. Again, regardless of the amount of formal authority your supervisor has, what are the chances that he/she would "bail you out" at his/her expense?

None	Small	Moderate	High	Very High
1	2	3	4	5

7. I have enough confidence in my supervisor that I would defend and justify his/her decision if he/she were not present to do so.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

8. How would you characterize your working relationship with your supervisor?

Extremely Ineffective	Worse Than Average	Average	Better Than Average	Extremely Effective
1	2	3	4	5

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Part 2: Management Practices

Directions: The statements in this part describe various management practices. Please give us your opinion on how much each of these is practiced by your work unit. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. The people my work unit serves (i.e., our customers) meet with us regularly .... ① ② ③ ④ ⑤
2. My co-workers have a good understanding of who their customers are .... ① ② ③ ④ ⑤
3. The people my work unit serves (i.e., our customers) give us feedback on the quality of our work. .... ① ② ③ ④ ⑤
4. People in my work unit maintain close contact with the people we serve. .... ① ② ③ ④ ⑤
5. My work unit responds promptly to customer requests, needs and problems. .... ① ② ③ ④ ⑤
6. My work unit makes a real effort to keep our customers satisfied. ① ② ③ ④ ⑤
7. My work unit understands the concept of "continuous improvement." .... ① ② ③ ④ ⑤
8. My work unit has accepted the goal of continuous improvement. ① ② ③ ④ ⑤
9. We are committed to continuous improvement in our work. .... ① ② ③ ④ ⑤
10. My boss really believes we can improve our work continuously. .. ① ② ③ ④ ⑤
11. My work unit uses teams to solve problems. .... ① ② ③ ④ ⑤
12. Our work unit has embraced the team concept. .... ① ② ③ ④ ⑤
13. Many work problems are being solved through team meetings. ... ① ② ③ ④ ⑤
14. During team meetings, we make an effort to get all team members' opinions and ideas before making a decision............. ① ② ③ ④ ⑤

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Part 3: Process Management

Directions: The statements below describe some additional management practices. Please give us your opinion on how much each of these is practiced by your work group. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. Processes in our work group are designed to be "fool proof." .... ① ② ③ ④ ⑤
2. A large percent of the equipment or processes in our work group are currently under statistical quality control. .... ① ② ③ ④ ⑤
3. We make extensive use of statistical techniques to reduce variance in processes.. ① ② ③ ④ ⑤
4. We make extensive use of written procedures and/or work instructions in our work group... ① ② ③ ④ ⑤
5. Charts showing quality levels are readily available to me............ ① ② ③ ④ ⑤
6. Charts showing schedule compliance are readily available to me. ... ① ② ③ ④ ⑤
7. Charts plotting the frequency of production or processing problems are readily available to me.. ① ② ③ ④ ⑤
8. I am often told whether I am doing a good job. .... ① ② ③ ④ ⑤
9. Information on quality performance is readily available to me. ...... ① ② ③ ④ ⑤
10. Information on productivity is readily available to me. .... ① ② ③ ④ ⑤
11. My manager often comments about the quality of my work. .... ① ② ③ ④ ⑤

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Part 4: Work Change

Directions: Please answer these questions by indicating how frequently your work group does each. Use the following rating scale:

1	2	3	4	5	6	7
Always	Very often	Often	Sometimes	Rarely	Very rarely	Never

In your work group, how often do you and your coworkers:

1. Implement successful new ways to solve problems .... ① ② ③ ④ ⑤ ⑥ ⑦
2. Find better ways to do your work .... ① ② ③ ④ ⑤ ⑥ ⑦
3. Put new ways of accomplishing goals into practice .... ① ② ③ ④ ⑤ ⑥ ⑦
4. Successfully deal with non-routine or unique problems..... ① ② ③ ④ ⑤ ⑥ ⑦
5. Improve results by doing things in a new way .... ① ② ③ ④ ⑤ ⑥ ⑦
6. Improve the quality of your work .... ① ② ③ ④ ⑤ ⑥ ⑦

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Part 5: Employee Sentiments

Directions: The statements below describe how one feels about one's job. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1	2	3	4	5	6	7
Strongly Disagree			Neither Agree nor Disagree			Strongly Agree

1. I really feel a sense of pride or accomplishment as a result of the type of work I do... ① ② ③ ④ ⑤ ⑥ ⑦
2. I am confident in my ability to do well in my work .... ① ② ③ ④ ⑤ ⑥ ⑦
3. My work gives me a feeling of pride in having done the job well .... ① ② ③ ④ ⑤ ⑥ ⑦
4. I very much like the type of work that I am doing .... ① ② ③ ④ ⑤ ⑥ ⑦
5. When it comes to my work, I generally do well. .... ① ② ③ ④ ⑤ ⑥ ⑦
6. My job gives me a chance to do the things that I do best. ... ① ② ③ ④ ⑤ ⑥ ⑦
7. My work is my most rewarding experience .... ① ② ③ ④ ⑤ ⑥ ⑦
8. I tend to do better in my work than most people. .... ① ② ③ ④ ⑤ ⑥ ⑦
9. I like my job very much .... ① ② ③ ④ ⑤ ⑥ ⑦

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Part 6: Approach to Work

Directions: The statements below describe various ways in which people may approach their work and how they work together. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. I am always trying to make my goals a reality. .... ① ② ③ ④ ⑤
2. If my life is not going the way I want, I change things. ...... ① ② ③ ④ ⑤
3. I know how to work toward the future that I have chosen for myself. .... ① ② ③ ④ ⑤
4. I willingly change my strategies to better meet my personal goals. .... ① ② ③ ④ ⑤
5. I am committed to my personal growth. .... ① ② ③ ④ ⑤
6. In my organization I am criticized for doing things a new way. .... ① ② ③ ④ ⑤
7. My coworkers think I am stubborn. .... ① ② ③ ④ ⑤
8. People in this organization say I don't understand their point of view. .... ① ② ③ ④ ⑤
9. This work group contributes to my growth. .... ① ② ③ ④ ⑤
10. People in my work group help me do a better job. .... ① ② ③ ④ ⑤
11. My work group often discusses opportunities for improvement. .... ① ② ③ ④ ⑤
12. In our organization we are all working together toward the same future. .... ① ② ③ ④ ⑤
13. In our organization we all agree on what our mission is. .... ① ② ③ ④ ⑤
14. We are all committed to the long term goals of our organization. .... ① ② ③ ④ ⑤
15. In our organization we understand how to improve the way the organization functions. .... ① ② ③ ④ ⑤
16. In our organization we know how to make things work properly. .... ① ② ③ ④ ⑤
17. We know how to make changes to improve the organization as a whole. .... ① ② ③ ④ ⑤

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Demographic Information

The following information is very important and is needed to accurately describe the characteristics of those who participated in this research. Please darken the appropriate response or fill in the blank.

(1) How old were you on your last birthday?________ years

(2) Are you male or female? Ⓜ Male Ⓕ Female

(3) Is your immediate supervisor male or female? Ⓜ Male Ⓕ Female

(4) Which of the following best describes your immediate supervisor?

Ⓐ Supervisor or team leader
Ⓑ Manager
Ⓒ Director of managers
Ⓓ General or division manager
Ⓔ Executive or vice-president
Ⓕ Other (please specify): ____________________

(5) Are you (choose one):
Ⓐ a regular full-time employee?
Ⓑ a part-time employee?
Ⓒ a contract employee or independent contractor?
Ⓓ a temporary employee working for an agency?
Ⓔ a consultant?
Ⓕ Other (please specify): ___________________

(6) How long have you been reporting to your current supervisor at this organization?
________ years OR ________ months

(7) How long have you been employed by this organization?
________ years OR ________ months

(8) How many years of experience do you have doing the general kind of work you do now?
________ years OR ________ months

(9) Which of the following bests describes your primary role in the organization?
Ⓐ Individual contributor or worker
Ⓑ Supervisor
Ⓒ Manager
Ⓓ Director of managers
Ⓔ General or division manager
Ⓕ Other (please specify): _________________

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Demographic Information (continued)

(10) Which of the following bests describes your functional specialty or area?

- Ⓐ Administration or general management
- Ⓑ Manufacturing, Production or Warehouse
- Ⓒ Engineering, Software Development or Research & Development
- Ⓓ Customer Service
- Ⓔ Finance or Accounting
- Ⓕ Quality Assurance or Inspection
- Ⓖ Marketing, Sales or Public Relations
- Ⓗ Human Resources, Personnel, Facilities, etc.
- Ⓘ Professional Staff (includes teachers)
- Ⓙ Other (please specify): ______________

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Appendix F: Leader Survey

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Stephen W. King

Doctoral Candidate, Systems Science Ph.D. Program
Portland State University
P. O. Box 751
Portland, Oregon
(503) 579-3070

Dear Manager or Supervisor:

I would like to ask you for your help. I am a Ph.D. candidate at Portland State University doing research on quality management at ISO 9000 firms. Your employer has agreed to participate in this research and has allowed me to ask you to complete a survey, and to ask you for your permission to distribute similar surveys to some of your subordinates.

Your participation and that of your subordinates is completely voluntary. Your employer does not require that you or your employees complete a survey. But full participation is very important to this research, because surveys that are not completed call into question the accuracy of the study's findings.

The surveys ask for people's perceptions about teamwork, customer focus, what supervisors and managers say and do, and so on. The survey takes about 20-25 minutes to complete. Your employer has agreed to allow you and your employees to complete this survey on company time.

All answers are completely confidential. The survey does not ask for anyone's name, and no one in your organization will receive any information about your answers or those of your subordinates. Your organization, along with other Oregon companies, will receive only a summary of the overall findings of this research, which will show how different activities and approaches affect quality management.

I'll contact you to see if you are willing to participate. If you are, I'll work with you to distribute surveys to several randomly selected individuals who report to you.

If you have concerns or problems about being asked to participate in this study, or your rights under this research, please contact the Human Subjects Research Review Committee, Office of Research and Sponsored Projects, 111 Cramer Hall, Portland State University, (503) 725-8182. If you have any questions about the study itself, please call me at the phone number above.

Remember, your participation in this research is very important to its success. Thank you in advance for your help in this study.

PS: If you decide not to participate in this research, please return the unanswered surveys as instructed on the Instructions page. We need all of the survey forms back. Please keep this letter for your records. Thank you.

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Stephen W. King

Doctoral Candidate, Systems Science Ph.D. Program
Portland State University
P. O. Box 751
Portland, Oregon
(503) 579-3070

Dear Manager or Supervisor:

I would like to ask you for your help. I am a Ph.D. candidate at Portland State University doing research on quality management. Your company was selected for this research because it received an Oregon Quality Award recognizing its achievements in managing quality. Your employer has agreed to participate in this research and has allowed me to ask you to complete a survey, and to ask you for your permission to distribute similar surveys to several of your subordinates.

Your participation and that of your subordinates is completely voluntary. Your employer does not require that you or your employees complete a survey. But full participation is very important to this research, because surveys that are not completed call into question the accuracy of the study's findings.

The surveys ask for people's perceptions about teamwork, customer focus, what supervisors and managers say and do, and so on. The survey takes about 20-25 minutes to complete. Your employer has agreed to allow you and your employees to complete this survey on company time.

All answers are completely confidential. The survey does not ask for anyone's name, and no one in your organization will receive any information about your answers or those of your subordinates. Your organization, along with other Oregon companies, will receive only a summary of the overall findings of this research, which will show how different activities and approaches affect quality management.

I'll contact you to see if you are willing to participate. If you are, I'll work with you to distribute surveys to several randomly selected individuals who report to you.

If you have concerns or problems about being asked to participate in this study, or your rights under this research, please contact the Human Subjects Research Review Committee, Office of Research and Sponsored Projects, 111 Cramer Hall, Portland State University, (503) 725-8182.

If you have any questions about the study itself, please call me at the phone number above. Remember, your participation in this research is very important to its success. If you decide to participate, please keep this letter for your records. Thank you in advance for your help in this study.

PS: If you decide not to participate in this research, please return the unanswered surveys as instructed on the Instructions page. We need all of the survey forms back. Please keep this letter for your records. Thank you.

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INSTRUCTIONS

Please complete the survey as follows:

Please answer every question.

Please mark your responses as shown below. You can use a **pen or pencil** to darken the circles. If you use pencil and decide to change an answer, please erase the old mark completely.

Mark answers like this: ① ② ③ ● ⑤

Not like this: ① ② ③ ~~④~~ ⑤

When you are finished, please put your survey in the provided envelope.

If you decide that you do not want to participate in this research, put your unanswered questionnaire in the envelope. We need all of the forms back, answered or not.

Thank you again for your help in conducting this research.

IMPORTANT DEFINITIONS

The following definitions will be helpful in answering the questions in this survey. Please read these carefully and refer to them as necessary.

"ORGANIZATION" refers to your company as a whole.

"WORK GROUP" or **"WORK UNIT"** refers to your immediate work group (the one you supervise).

"CUSTOMER" can be external or internal customer – whomever you see as your customer.

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Part 1: Management Practices

Directions: The statements in this part describe various management practices. Please give us your opinion on how much each of these is practiced by your work unit. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. The people my work unit serves (i.e., our customers) meet with us regularly........ ① ② ③ ④ ⑤
2. My subordinates have a good understanding of who their customers are........ ① ② ③ ④ ⑤
3. The people my work unit serves (i.e., our customers) give us feedback on the quality of our work........ ① ② ③ ④ ⑤
4. People in my work unit maintain close contact with the people we serve........ ① ② ③ ④ ⑤
5. My work unit responds promptly to customer requests, needs and problems........ ① ② ③ ④ ⑤
6. My work unit makes a real effort to keep our customers satisfied.... ① ② ③ ④ ⑤
7. My work unit understands the concept of "continuous improvement."........ ① ② ③ ④ ⑤
8. My work unit has accepted the goal of continuous improvement. ... ① ② ③ ④ ⑤
9. We are committed to continuous improvement in our work. .... ① ② ③ ④ ⑤
10. My subordinates really believe we can improve our work continuously........ ① ② ③ ④ ⑤
11. My work unit uses teams to solve problems........ ① ② ③ ④ ⑤
12. Our work unit has embraced the team concept........ ① ② ③ ④ ⑤
13. Many work problems are being solved through team meetings....... ① ② ③ ④ ⑤
14. During team meetings, we make an effort to get all team members' opinions and ideas before making a decision........ ① ② ③ ④ ⑤

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Part 2: Process Management

Directions: The statements below describe some additional management practices. Please give us your opinion on how much each of these is practiced by your work group. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

1. Processes in our work group are designed to be "fool proof."...... ① ② ③ ④ ⑤
2. A large percent of the equipment or processes in my work group are currently under statistical quality control. .... ① ② ③ ④ ⑤
3. We make extensive use of statistical techniques to reduce variance in processes.. ① ② ③ ④ ⑤
4. We make extensive use of written procedures and/or work instructions in my work group.. ① ② ③ ④ ⑤
5. Charts showing quality levels are readily available to my subordinates. .... ① ② ③ ④ ⑤
6. Charts showing schedule compliance are readily available to my subordinates .... ① ② ③ ④ ⑤
7. Charts plotting the frequency of production or processing problems are readily available to my subordinates. .... ① ② ③ ④ ⑤
8. My subordinates are often told whether they are doing a good job. ① ② ③ ④ ⑤
9. Information on quality performance is readily available to my subordinates. .... ① ② ③ ④ ⑤
10. Information on productivity is readily available to my subordinates.. ① ② ③ ④ ⑤
11. I often comment on the quality of my subordinate's work. .... ① ② ③ ④ ⑤

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Part 3: Work Change

Directions: Please answer these questions by indicating how frequently your work group does each. Use the following rating scale:

1	2	3	4	5	6	7
Always	Very often	Often	Sometimes	Rarely	Very rarely	Never

In your work group, how often do your subordinates:

1. Implement successful new ways to solve problems .... ① ② ③ ④ ⑤ ⑥ ⑦
2. Find better ways to do the work .... ① ② ③ ④ ⑤ ⑥ ⑦
3. Put new ways of accomplishing goals into practice .... ① ② ③ ④ ⑤ ⑥ ⑦
4. Successfully deal with non-routine or unique problems........ ① ② ③ ④ ⑤ ⑥ ⑦
5. Improve results by doing things in a new way .... ① ② ③ ④ ⑤ ⑥ ⑦
6. Improve the quality of the work .... ① ② ③ ④ ⑤ ⑥ ⑦

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Part 4: Approach to Work

Directions: The statements below describe various ways in which people may approach their work and how they work together. Please answer by indicating to what extent you agree or disagree with each statement. Use the following rating scale:

1 Strongly Disagree	2 Disagree	3 Neither Agree nor Disagree	4 Agree	5 Strongly Agree

1. I am always trying to make my goals a reality. .... ① ② ③ ④ ⑤
2. If my life is not going the way I want, I change things. .... ① ② ③ ④ ⑤
3. I know how to work toward the future that I have chosen for myself. ① ② ③ ④ ⑤
4. I willingly change my strategies to better meet my personal goals. ... ① ② ③ ④ ⑤
5. I am committed to my personal growth. .... ① ② ③ ④ ⑤
6. In my organization I am criticized for doing things a new way. .... ① ② ③ ④ ⑤
7. My coworkers think I am stubborn. .... ① ② ③ ④ ⑤
8. People in this organization say I don't understand their point of view. ① ② ③ ④ ⑤
9. This work group contributes to my growth. .... ① ② ③ ④ ⑤
10. People in my work group help me do a better job. .... ① ② ③ ④ ⑤
11. My work group often discusses opportunities for improvement. ...... ① ② ③ ④ ⑤
12. In our organization we are all working together toward the same future. .... ① ② ③ ④ ⑤
13. In our organization we all agree on what our mission is. .... ① ② ③ ④ ⑤
14. We are all committed to the long term goals of our organization. ..... ① ② ③ ④ ⑤
15. In our organization we understand how to improve the way the organization functions. .... ① ② ③ ④ ⑤
16. In our organization we know how to make things work properly. ...... ① ② ③ ④ ⑤
17. We know how to make changes to improve the organization as a whole. .... ① ② ③ ④ ⑤

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Demographic Information

The following information is very important and is needed to accurately describe the characteristics of those who participated in this research. Please darken the appropriate response or fill in the blank.

(1) How old were you on your last birthday?________ years

(2) Are you male or female? Ⓜ Male Ⓕ Female

(3) Which of the following best describes <u>your immediate supervisor</u>?
- Ⓐ Supervisor or team leader
- Ⓑ Manager
- Ⓒ Director of managers
- Ⓓ General or division manager
- Ⓔ Executive or vice-president
- Ⓕ Other (please specify): ________________

(4) Are you (choose one):
- Ⓐ a regular full-time employee?
- Ⓑ a part-time employee?
- Ⓒ a contract employee or independent contractor?
- Ⓓ a temporary employee working for an agency?
- Ⓔ a consultant?
- Ⓕ Other (please specify): ________________

(5) How long have you been employed by this organization?
________ years OR ________ months

(6) How many years of experience do you have doing the general kind of work you do now?
________ years OR ________ months

(7) Which of the following bests describes <u>your</u> primary role in the organization?
- Ⓐ Supervisor
- Ⓑ Manager
- Ⓒ Director of managers
- Ⓓ General or division manager
- Ⓔ Other (please specify): ________________

(8) Which of the following bests describes your functional specialty or area?
- Ⓐ Administration or general management
- Ⓑ Manufacturing, Production or Warehouse
- Ⓒ Engineering, Software Development or Research & Development
- Ⓓ Customer Service
- Ⓔ Finance or Accounting
- Ⓕ Quality Assurance or Inspection
- Ⓖ Marketing, Sales or Public Relations
- Ⓗ Human Resources, Personnel, Facilities, etc.
- Ⓘ Professional Staff (includes teachers)
- Ⓙ Other (please specify): ______________

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Appendix G: Executive Survey

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Stephen W. King
Doctoral Candidate, Systems Science Ph.D. Program
Portland State University
P. O. Box 751
Portland, Oregon
(503) 579-3070

[Date]

[Executive's name]
[Title]
[Organization name]
[Address]
[City, State, Zip]

Dear [Executive's name]:

Thank you for agreeing to participate in the research study I'm doing as part of my doctoral program at Portland State University. As you know, this research focus on how different activities and approaches affect quality management.

In addition to the surveys that are being completed by randomly selected employees and managers, I'd like to ask you to respond to a special questionnaire. As a senior executive, you are in the best position to respond to a focused series of questions on the business environment faced by your organization. It should take about 5 minutes or so to answer the questions. The answers to these questions will help to explain how differences in the business environment affect various facets of quality management.

Just as all employees' participation in this research is strictly voluntary, your personal participation is entirely voluntary as well. And as with the employee surveys, all information provided will be held strictly confidential. No company-specific information or statistics will be divulged to any person for any reason.

If you have concerns or problems about being asked to participate in this study, or your rights under this research, please contact the Human Subjects Research Review Committee, Office of Research and Sponsored Projects, 111 Cramer Hall, Portland State University, (503) 725-8182. If you have any questions about this research in particular, please don't hesitate to contact me at the number above.

Thank you again for your support and assistance.

Sincerely,

Stephen W. King

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INSTRUCTIONS

A **pair** of statements appears on each line of the tables on the following pages. Please read both statements, and then indicate where your organization's situation falls between the two statements. Here's an example:

Our company must rarely change its marketing practices to keep up with the market and competitors.	① ② ③ ④ ⑤	Our company must change its marketing practices frequently (e.g., semi-annually)

Indicate your organization's situation by marking a response in the center column of the tables. Mark answer "1" if you strongly agree with the statement in the left column (nearest the "1"). Mark answer "5" if you strongly agree with the statement in the right column (nearest the "5"). Mark an in-between answer (2, 3, or 4) to indicate intermediate levels of agreement. Mark the middle choice, "3" if your firm's situation falls in the middle of the two statements.

Please answer every question. If a question does not apply to your organization, please leave the answer blank for that question.

Please mark your responses as shown below. You can use a **pen or pencil** to darken the circles. If you use pencil and decide to change an answer, please erase the old mark completely.

Mark answers like this: ① ② ③ ● ⑤

Not like this: ① ② ③ ~~④~~ ⑤

Please complete the survey within the next five business days. When you are finished, please seal your survey in the provided envelope and drop it in the mail.

If you decide that you do not want to participate in this research, seal the unanswered questionnaire in the envelope and mail that back. I need all of the forms back, answered or not.

Thank you again for your help in conducting this research.

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Executive Survey

1. With respect to our industry...

Our company must rarely change its marketing practices to keep up with the market and competitors.	① ② ③ ④ ⑤	Our company must change its marketing practices frequently (e.g., semi-annually)
The rate at which products and services are getting obsolete in the industry is very slow (e.g., basic metals).	① ② ③ ④ ⑤	The rate of obsolescence is very high (as in some fashion goods).
Actions of competitors are quite easy to predict (as in some basic industries).	① ② ③ ④ ⑤	Actions of competitors are unpredictable.
Demand and consumer tastes are fairly easy to forecast (e.g., for milk products).	① ② ③ ④ ⑤	Demand and tastes are almost unpredictable.
The production and service technology is not subject to very much change and is well established (e.g., in steel products).	① ② ③ ④ ⑤	The modes of production and service change often and in a major way (e.g., advanced electronic components).

2. How would you characterize the external environment within which your company functions?

Very safe, little threat to the survival and well-being of my company.	① ② ③ ④ ⑤	Very risky, one false step can mean my company's undoing.
Rich in investment and marketing opportunities.	① ② ③ ④ ⑤	Very stressful, exacting, hostile; very hard to keep afloat.
An environment that the company can control and manipulate to its own advantage, such as a dominant firm has in an industry with little competition and few hindrances or competitive forces.	① ② ③ ④ ⑤	A dominant environment in which the company's initiatives count for very little against the tremendous political, technological or competitive forces.

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An environment demanding little in the way of technological sophistication.	① ② ③ ④ ⑤	Technologically, a very sophisticated and complex environment.

3. How much research and development activity takes place within your company's principal industry?

Virtually no R&D in industry (e.g., bakery).	① ② ③ ④ ⑤	Extremely R&D oriented industry (e.g., telecommunications).

4. With respect to our industry...

Our company can be successful by focusing sales or services within the region in which we are located.	① ② ③ ④ ⑤	To be successful, or company must seek to expand its sales or services into regions other than the one in which we are located.
Our company can be successful by focusing our sales or services domestically.	① ② ③ ④ ⑤	To be successful our company must seek to extend its sales or services internationally.

5. Other attributes of our company's principal industry...

Average industry profits are very low.	① ② ③ ④ ⑤	Average industry profits are very high.
Projected long-term (five years or more) industry profits probably will be very low.	① ② ③ ④ ⑤	Projected long-term (five years or more) industry profits probably will be very high.
The market growth rate for our industry for the last three years has been very low.	① ② ③ ④ ⑤	The market growth rate for our industry for the last three years has been very rapid.
The projected long-term (five years or more) market growth rate for our industry indicates very slow growth.	① ② ③ ④ ⑤	The projected long-term (five years or more) market growth rate for our industry indicates very rapid growth.
The competitive intensity within our industry is minimal.	① ② ③ ④ ⑤	The competitive intensity within our industry is extreme.

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Appendix H: Dissertation Defense Slide Presentation

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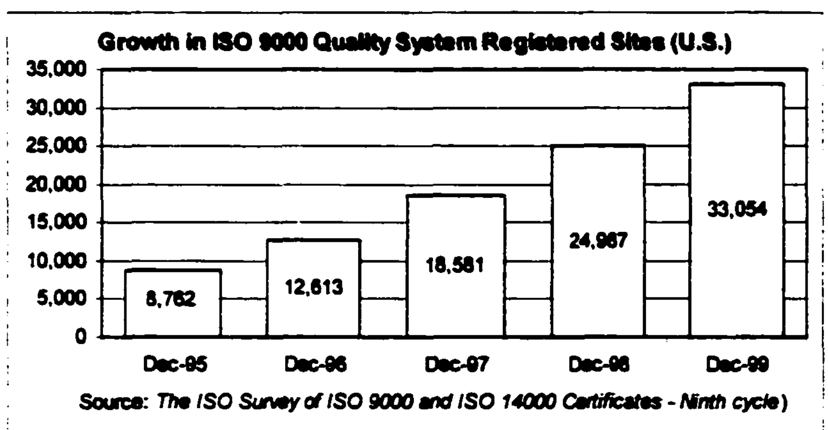
Effective Leadership
for
Quality Achievement
and
Organizational Learning

By

Stephen W. King

Ph.D. Candidate

Quality management programs in American industry are ubiquitous (Uzumeri, 1997)



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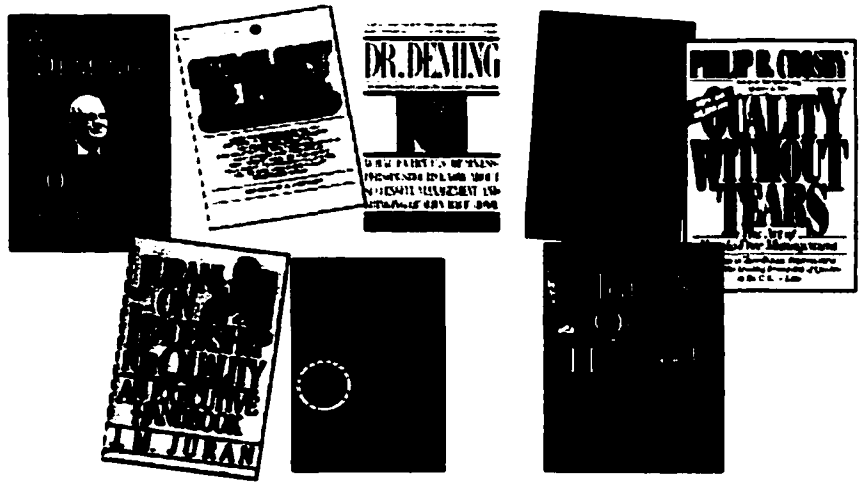
The literature frequently cites the importance of leadership in such programs (Avolio, 1994)



5

Nevertheless ...

Little research has been done to evaluate the linkages between specific leadership behaviors and the goals of quality management programs.
(Sosik & Dionne, 1997)

And ...

6

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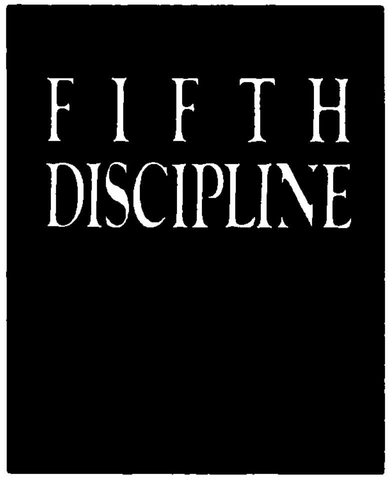
There is a paucity of empirical work on the relationships among Senge's (1990) learning disciplines, supportive leadership behaviors and ties to quality management.



7

Research Overview

Work group leaders and their immediate subordinates were researched to identify the interrelationships among:

- Leadership Behaviors
- Quality Management's Supportive Principles
- Process Management Practices
- Process Outcomes
- Disciplines of the Learning Organization

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Study's Contributions

- Theoretical:
  - This study adapts and integrates the Deming-based quality management model developed by Anderson, Rungtusanatham and Schroeder (1994)
  - with the multi-factor leadership model developed by Bass (1985)
  - and ties the foregoing to the five disciplines of the learning organization (Senge, 1990).
- Empirical:
  - The theoretical framework is then subjected to empirical verification using data drawn from a variety of organizations.

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Central Research Questions

1. How do leadership behaviors affect the degree to which organizations exhibit the fundamental underlying principles of quality management?
2. How does the extent of adoption of quality management's underlying principles affect process management practices?
3. How do process management practices affect quality-related process outcomes?
4. How are the disciplines of the learning organization associated with quality-related process management practices and process outcomes?
5. How do leadership behaviors affect the realization of the various disciplines of the learning organization?

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Leadership Dimensions

- Transactional
  - ➢Active & Passive MBE
  - ➢Contingent Reward
- Transformational
  - ➢Intellectual Stimulation
  - ➢Individualized Consideration
  - ➢Idealized Influence (attributed & behavioral)
  - ➢Inspirational motivation
- Laissez-faire

11

Learning Discipline Dimensions

- Shared Vision
  - ➢Collective sense of direction, purpose, understanding.
- Mental Models
  - ➢Surfacing, sharing & discussing assumptions underlying one's thinking.
- Personal Mastery
  - ➢Focusing on one's desired future.
- Team Learning
  - ➢Group-based discovery of insights through dialogue and discussion.
- Systems Thinking
  - ➢Observing totalities and wholes rather than isolated parts.

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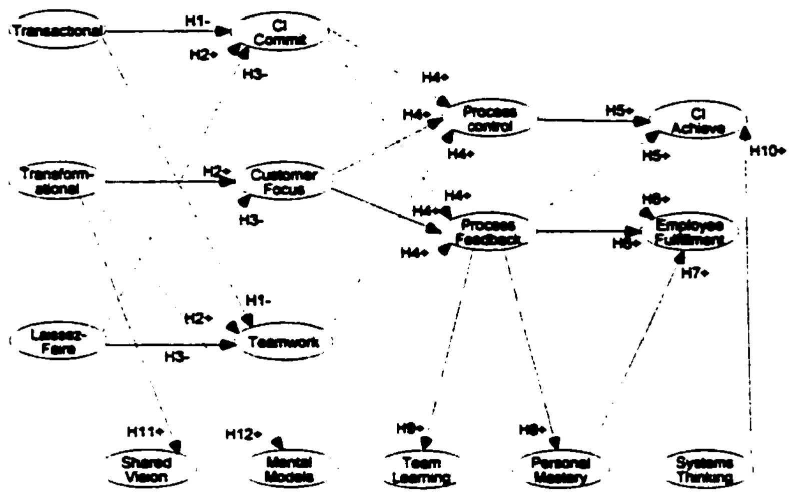
Hypothesized Relationships



13

Participants

- 19 quality-focused organizations in Oregon. Quality focus demonstrated by:
  - Either ISO 9000 certified quality system or
  - Receipt of a state-level Baldrige-based quality achievement award.
- 104 work group leaders.
- 615 direct subordinates of those leaders.

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Measures

Previously validated survey instruments were used or adapted from a variety of researchers:

Measurement Scale	Source
Leadership Behaviors (MLQ)	Bass & Avolio, 1996
Leader-Member Exchange Quality (LMX)	Graen & Uhl-Bien, 1995; Bauer & Green, 1996
Teamwork, Customer Focus, Continuous Improvement Commitment	Morrow, 1997; Gatewood & Riordan, 1997
Process Control, Process Feedback	Flynn, Schroeder & Sakakibara, 1994
Employee Fulfillment	Miller, 1967
Continuous Improvement Achievement	Frenkel, Korczynski, Shire & Tam, 1999
Organizational Learning Disciplines	Tetrick, Jones, Latting, Da Silva, Slack, Etchegaray & Beck, 2000
Perceived Environmental Uncertainty	Dickson & Weaver, 1997
Self-efficacy	Truxillo, Bauer & Sanchez (2001)

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Research Design

- **Quasi-experimental, cross-sectional correlational field study.**
- **Case for causality made on theoretical grounds.**
- **Self-administered surveys completed by employees, work group leaders and executives to provide a range of perspectives.**
- **Multi-stage random sampling strategy.**
  (I.e., workers nested within work groups, and work groups nested within organizations.)

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3-Stage Testing Procedure

1. Tested individual hypotheses.
    - Analytic method: Ordinary least squares regression –
        - multiple linear regression
        - hierarchical regression
        - canonical regression
        - bivariate correlation
    - Included individual (worker) and group (work team) levels of analysis.
    - Supplemented by exploratory analysis if H_0 unsupported.

3-Stage Testing Procedure

Problems with Ordinary Least Squares:

- *Staged random sampling design violates independence of observations assumption of OLS regression.*
- *Consequently, OLS-based significance levels may be optimistically biased.*
- *Potential group-level effects not recognized by uni-level analysis (i.e., each OLS regression is at a specified level of analysis).*

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3-Stage Testing Procedure

2. To recognize possible group-level effects, rechecked the statistical significance of the OLS regression coefficients from a multilevel perspective.

   Analytic method: Hierarchical Linear Modeling (HLM)

3-Stage Testing Procedure

3. Constructed, tested and refined a series of multivariate models to illustrate the system of supported hypothesized relationships and significant exploratory findings.

   Analytic method: Structural Equation Modeling (SEM)

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Findings Overview

Hypotheses supported:

- H1 (R^2 = .368; Wilks' Λ = .568, $F(4, 404)$ = 15.50, p < .001).
- H2a (R^2 = .514; Wilks' Λ = .457, $F(15, 268)$ = 5.85, p < .001).
- H3 (R^2 = .281, $F(3,101)$ = 13.16, p < .001)
- H6 (ΔR^2 for process control = .011 above control vars, p < .01; ΔR^2 for process feedback = .018 above control vars, p < .001).
- H7 (personal mastery ΔR^2 = .036 above control vars, p < .001).
- H8a (process feedback ΔR^2 = .017 above control vars, p = .001).
- H9 (r = .467, p < 001).
- H10a (R^2 = .152, $F(2, 96)$ = 8.56, p < .001).
- H11 (r = .338, p < 001).
- H12 (r = .255, p < .001).

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Findings Overview

Hypotheses not supported:

- H2b (ΔR^2 = .054, $F(6, 82)$ = 1.71, *ns*).
- H4 (Wilks' Λ = .867, $F(6, 190)$ = 2.33, *ns*).
- H5a, H5b (R^2 = .062, $F(5,94)$ = 1.25, *ns*).
- H8b (Self-efficacy x Feedback term *ns*).
- H10b (moderation *ns*).

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Specific Findings (OLS)

Hypothesis supported: H1

Active and passive management by exception are negatively associated with continuous improvement commitment and teamwork.

$R^2 = .368$

Wilks' $\Lambda = .568$, $F(4, 404) = 15.50$, $p < .001$

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Specific Findings (OLS)

Hypothesis supported: H2a

Transformational leadership behaviors are positively associated with teamwork, customer focus and continuous improvement commitment.

$R^2 = .514$

Wilks' $\Lambda = .457$, $F(15, 268) = 5.85$, $p < .001$

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Specific Findings (OLS)

Hypothesis NOT supported: H2b

There is a stronger positive relationship between transformational leadership behaviors and teamwork, customer focus and continuous improvement commitment in work groups with leaders at higher organizational levels than with leaders at lower levels.

R^2 = .568 moderated model
R^2 = .514 main effects model
ΔR^2 = .054, $F(6, 82) = 1.71$, *ns*

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Specific Findings (OLS)

Hypothesis supported: H3

Laissez-faire leadership is negatively associated with teamwork, customer focus and continuous improvement commitment.

R^2 = .281
$F(3,101) = 13.16$, $p < .001$

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Specific Findings (OLS)

Hypothesis NOT supported: H4

The more a work group is characterized by teamwork, customer focus and continuous improvement commitment, the more process management practices are characterized by process control and process feedback systems.

Wilks' $\Lambda = .867$, $F(6, 190) = 2.33$, *ns*

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Specific Findings (OLS)

Hypotheses NOT supported: H5a, H5b

a) The more process management practices include process control methods and process feedback to organizational members the more frequently continuous improvement is achieved.

b) There is a stronger positive relationship between process management practices and continuous improvement achievement under conditions of low perceived environmental uncertainty than under conditions of high perceived environmental uncertainty.

$R^2 = .062$, $F(5,94) = 1.25$, *ns*
All regression terms *ns*

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Specific Findings (OLS)

Hypothesis supported: H6

The more process management practices include process control methods and process feedback to organizational members, the greater employee fulfillment.

ΔR^2 for process control = .011 above control variables, $p < .01$

ΔR^2 for process feedback = .018 above control variables, $p < .001$

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Specific Findings (OLS)

Hypothesis supported: H7

The more individuals feel a sense of personal mastery, the greater their degree of employee fulfillment.

ΔR^2 = .036 above control variables, $p < .001$

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Specific Findings (OLS)

Hypothesis supported: H8a

The more process feedback is made available to organizational members, the more individuals feel a sense of personal mastery.

ΔR^2 = .017 above control variables, p = .001

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Specific Findings (OLS)

Hypothesis NOT supported: H8b

Individuals with high self-efficacy demonstrate a stronger positive connection between receipt of process feedback and sense of personal mastery compared to individuals with low self-efficacy.

Self-efficacy x Feedback term *ns*

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Specific Findings (OLS)

Hypothesis supported: H9

The more process management practices include quality-related process feedback to organizational members, the more team learning occurs.

$r = .467$, $p <$ 001

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Specific Findings (OLS)

Hypothesis supported: H10a

The more systems thinking occurs the more frequently continuous improvement is achieved.

$R^2 = .152$, $F(2, 96) = 8.56$, $p < .001$

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Specific Findings (OLS)

Hypothesis NOT supported: H10b

There is a stronger positive relationship between systems thinking and continuous improvement achievement under conditions of high perceived environmental uncertainty than under conditions of low perceived environmental uncertainty.

Moderation term *ns*

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Specific Findings (OLS)

Hypothesis supported: H11

The inspirational motivation component of transformational leadership is positively associated with shared vision.

$r = .338$, $p < 001$

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Specific Findings (OLS)

Hypothesis supported: H12

The intellectual stimulation component of transformational leadership is positively associated with managing mental models.

$r = .255, p < .001$

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Significance Check (HLM)

- **Level-2 effects did not bias standard errors estimated by OLS methods to the point of making significant regression coefficients insignificant.**
- **Wide range of intraclass correlations (ρ) observed. E.g.:**
  - **Personal mastery (ρ = .001)**
  - **Employee fulfillment (ρ = .051)**
  - **Customer focus (ρ = .302)**

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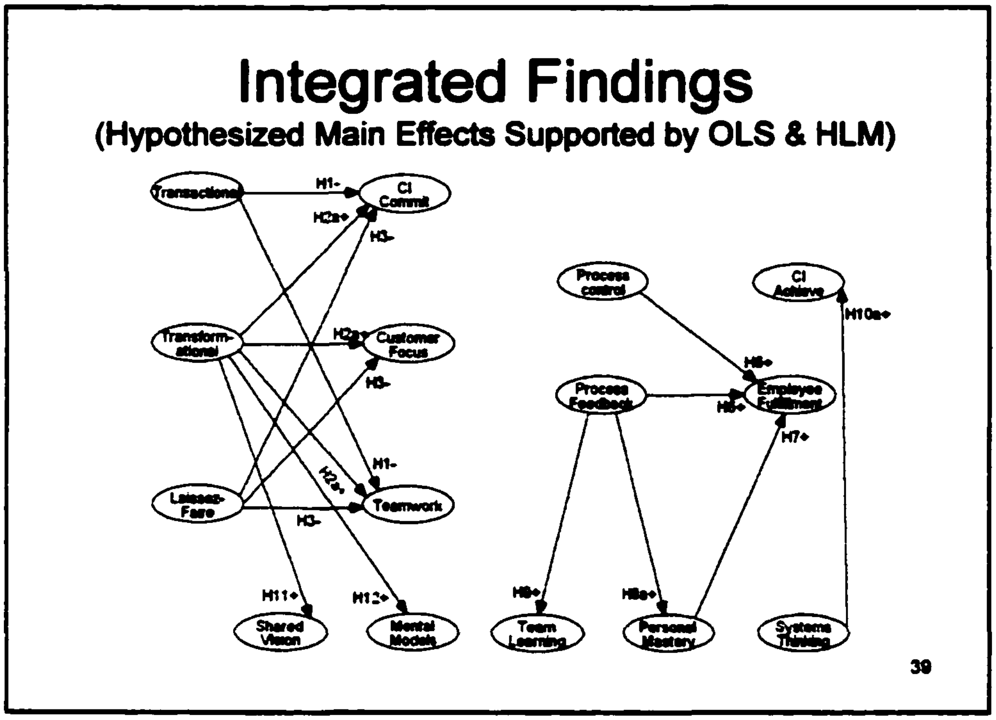

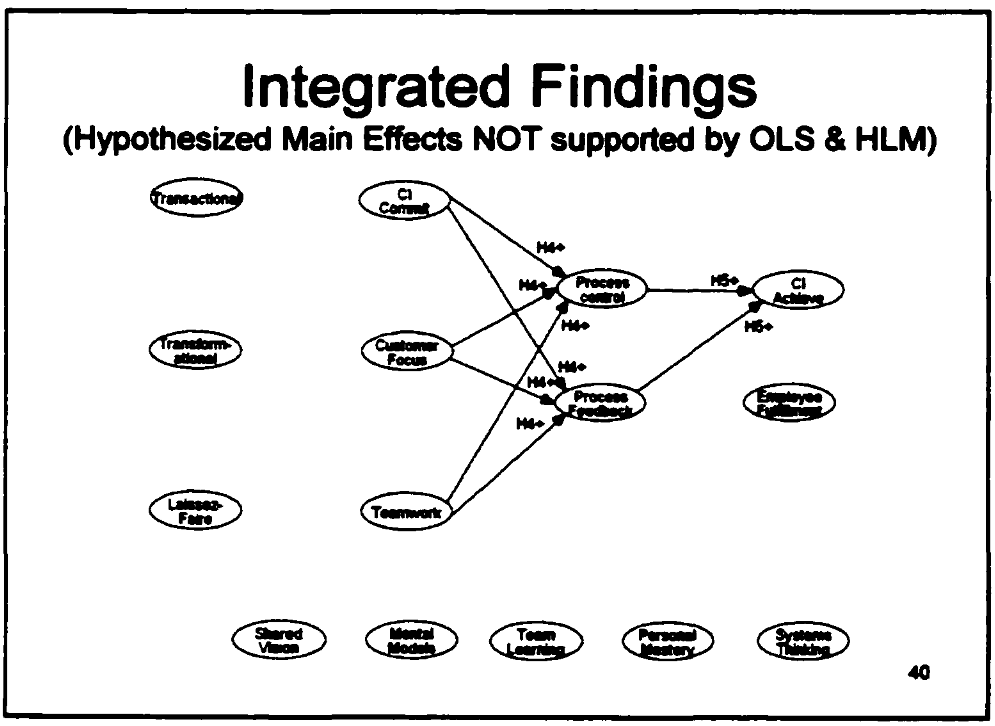

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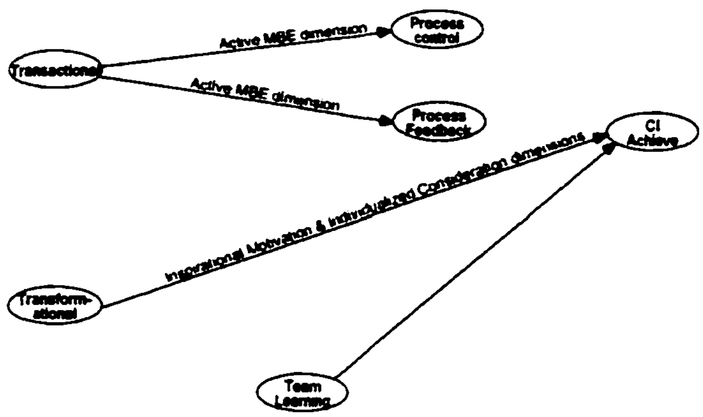
Exploratory Findings

(Observations from Regression Analysis)



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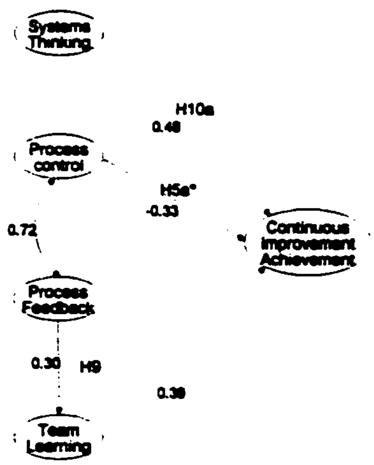
Structural Equation Models

(Continuous Improvement Achievement Model)



Fit Indices

$X^2/df = 1.40$

NFI = .856

CFI = .953

RMSEA = .06

* Opposite to theorized direction

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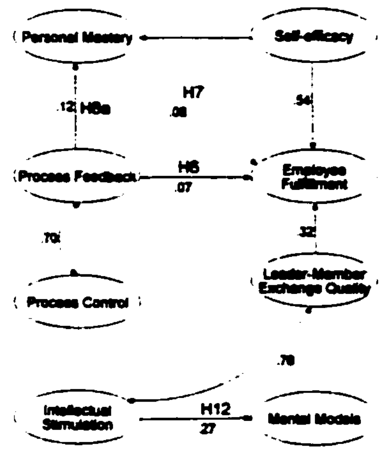
Structural Equation Models

(Individual-Level Effects Model)



Fit Indices

$X^2/df = 2.34$

NFI = .871

CFI = .922

RMSEA = .05

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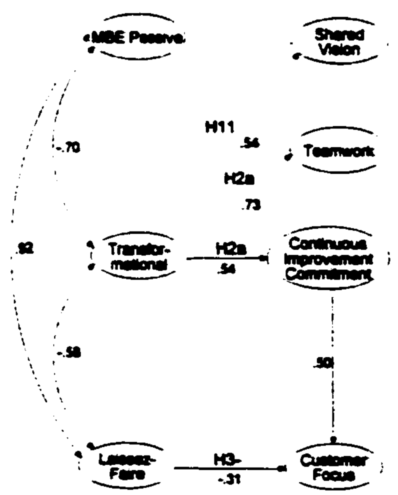
Structural Equation Models

(Leadership Effects Model)



Fit Indices

$X^2/df = 1.31$

NFI = .800

CFI = .943

RMSEA = .05

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Conclusions

1. To encourage teamwork, customer focus and commitment to continuous improvement:
   - Communicate an optimistic vision of the future.
   - Spend time teaching and coaching, and treat employees as individuals.
   - Communicate values and important beliefs.
   - Establish a collective sense of purpose and common mission.
   - Encourage subordinates to question the established ways of doing things and reexamine assumptions.
   - Seek different perspectives when solving problems.
   - Don't wait for things to go wrong before getting involved and taking action.

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Conclusions

2. Teamwork, customer focus and commitment to continuous improvement are not positively associated with the use of process control and process feedback mechanisms.

   Conjectures:
   - Environmental factors (competitive, regulatory) may be a driving force behind process management usage.
   - Organizational culture may play a role in the use of process control techniques like statistical process control (Bushe, 1988).
   - Measurement scale for Process Control problematic.

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Conclusions

3. Use of process control methods (e.g., SPC) not positively related to continuous improvement achievement.

   Conjecture: Common usage of SPC is maintenance of the status quo; feedback info not being used to gain systems understanding of the process which could lead to permanent improvement in systems.

4. Group-based learning (team learning) and systems thinking are tied to continuous improvement achievement.

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Conclusions

5. Greater use of process feedback is associated with higher levels of personal mastery.

6. Validated Senge's (1990) assertion that the greater one's degree of personal mastery, the higher the degree of personal fulfillment.

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Conclusions

7. To encourage a sense of common purpose (shared vision), leaders should communicate an optimistic vision of the future and express confidence that goals will be achieved (inspirational motivation).

8. To surface underlying assumptions held by workers (mental models), leaders should seek workers' perspectives when solving problems (intellectual stimulation).

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Implications For Research

Identification of constructs with strong intraclass correlations (ρ) may be useful to identify organization-level influences on work team phenomena. Strongest for:

- Customer focus, $\rho = .302$
- Shared vision, $\rho = .283$
- Teamwork, $\rho = .275$
- Continuous improvement commitment, $\rho = .265$
- Use of process control, $\rho = .227$
- Use of process feedback, $\rho = .180$

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