A MULTILEVEL ANALYSIS OF QUALITY MANAGEMENT PRACTICES, COOPERATIVE CULTURAL VALUES AND WORK PERFORMANCE

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ABSTRACT

A MULTILEVEL ANALYSIS OF QUALITY MANAGEMENT PRACTICES, COOPERATIVE CULTURAL VALUES AND WORK PERFORMANCE

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Unsuccessful quality initiatives often are attributed to an organizational culture that does not value the cooperative nature of quality management practices. However, two opposing perspectives exist as to how quality practices may relate to cooperative cultural values, which is problematic for deciding where to allocate resources during a quality initiative. Moreover, how the performance effects of quality practices and cooperative cultural values change over time is unknown, which has important epistemic implications.

This research finds evidence for a reconceptualization that resolves the paradox created by the two opposing perspectives. First, secondary data is used to discriminate between organization-level and workgroup-level quality management practices. Second, support is found for a sociotechnical system theory-based explanation as to how cooperative cultural values relate to quality management within a multilevel model. Third, longitudinal evidence is provided that shows cooperative cultural values increasing in influence on workgroup performance while organization-level quality practice decrease in influence.

Based upon the results, quality management practices are seen as serving the dual role of instilling cooperative values at the organization level and enabling higher performance at the workgroup level. Also, managerial insights are provided that recommend a simultaneous approach to changing cultural

values and implementing quality management practices. Finally, quality managers from several manufacturing facilities were presented these results and their insights explain why further study is needed on this topic.

Dedication

This dissertation is dedicated to my son, Adam James Kull. He is my inspiration for being the best person I can possibly be.

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This dissertation would not have come into existence without the encouragement and dedication of my family and friends. My parents, David and Charlene Kull, were always there to support me in many different ways throughout my doctoral years. Also, the courage to end an industry career and begin an academic one emanated from my good friend Noelle Bowman, who also aided in editing this manuscript.

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along the way. They made the character of my doctoral studies to be as special and unique as they are.

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CHAPTER 1: INTRODUCTION

This chapter introduces the research topic for this dissertation and describes the motivations for pursuing this topic. The meso-paradigm adopted by this dissertation is presented, followed by the research methodology used. Contributions to both theory and practice are then discussed. The outline of the dissertation concludes this chapter.

1.1 Research Topic

This dissertation examines an aspect of the interface between operations management practice, organizational culture, and performance. Specifically this dissertation analyzes the relationship between quality management practices, cooperative cultural values, and work performance. The knowledge that quality management often has cultural value issues has been well established (Bright and Cooper, 1993; Huq, 2005; Jabnoun and Sedrani, 2005; Moore and Brown, 2006). Literature has associated successful implementation of quality management practices with organizational cultures possessing such characteristics as cooperative values (Detert, Schroeder, and Cudeck, 2003; Detert, Schroeder, and Mauriel, 2000; Kujala and Lillrank, 2004).

However what is not clear is *how* quality management practices are related to cooperative cultural values. Some research has argued that certain cultural values are prerequisites to successful operations management practices

(Nahm, Vonderembse, and Koufteros, 2004), while other research has argued that certain cultural values are a consequent of operations management practices (Naveh and Erez, 2004). This dissertation offers clarity to this apparent paradox through use of an insight suggested by Juran (1989) who distinguished between high level quality management practices and lower level quality management tools. Juran (1989) designated these two levels of quality management as ""big Q"" and "little Q." This dissertation utilized this insight to provide a richer conceptualization of how quality management practices are related to cooperative cultural values.

Although this research is restricted to cooperative cultural values and quality management practices, general inferences can be made to operations management practices and organizational culture. Tasks and routines embody how an organization creates value and performs its overall purpose (Thompson, 1967). Improvement initiatives alter the form of these tasks in some way. A quality improvement initiative is just one of these ways. In addition, an organization is a social construction (March and Simon, 1958). People within the organization have to cope with how to work together and how to adapt to external forces. This is how cultures form, through shared acceptance of certain beliefs, values and norms (Schein, 2004). Values are a useful proxy for culture as a whole (Chatman and Barsade, 1995). Hence this study helps the operations management field understand how an organization's practices, culture, and subsequent effectiveness interrelate.

The principal research questions of this dissertation are the following: What role, if any, do cooperative cultural values play in a quality management improvement initiative; and do the practice-value-performance relationships change over time? The next section elucidates the motivations for pursuing these research questions.

1.2 Motivations

This section describes both the epistemic and practical reasons for researching the relationships among quality management practices, cooperative cultural values and work performance.

1.2.1 Epistemic Motivations

A resolution to the question of how quality management practices are related to cooperative cultural values will have important theoretical value. At issue is the nature and effect of both practices and values. The claim that certain cultural values are antecedent to quality management implies that cultural values enable quality management to occur (Kujala et al., 2004; Miron, Erez, and Naveh, 2004). This means that social-cultural aspects of an organization will prevent or discourage quality management implementation. Such a characterization offers cultural values to be unchanging and highly influential. The other claim that certain cultural values are consequent to quality management implies that cultural values are enabled by quality management

(Boggs, 2004; Naveh et al., 2004). This means that social-cultural aspects of an organization will change or be encouraged by quality management implementation. This perspective sees cultural values to be changeable and influenceable. The current literature on quality management and cultural values is unable to resolve why these two perspectives coexist. The typical approach is to adopt one of the two perspectives and leave the other unexamined. This dissertation is motivated by a need to find evidence for a research framework that incorporates both perspectives.

Another theoretical issue pertains to *how* the relationships among quality management practices, cooperative cultural values and work performance change over time. The literature on quality management has noted the importance of the time dimension when examining the effects of quality initiatives (Narasimhan and Mendez, 2001; Schroeder, Linderman, and Zhang, 2005); however, few empirical analyses incorporate time (Hendricks and Singhal, 2001b). If a quality initiative can influence and be influenced by cooperative cultural values, do the relationships remain stable over time? Investigating the time oriented effects among quality management practices, cooperative cultural values and work performance are a motivation for this dissertation.

1.2.2 Practical Motivations

Many attempts at quality improvement fail to reap the rewards the organizational leaders intended to achieve (Hendricks et al., 2001b). A major reason given for failure is organizational culture (Detert et al., 2000), of which

cultural values are a part. That is, the organization's employees reject the main tenets of the improvement initiative because it conflicts with the prevailing 'way things are done.' Because cultural values affect how people perceive the world (Schein, 2004) and strongly influence norms of behavior (Dewey, 1939), attempts to improve an operation possessing values that are counter to the initiative is susceptible to rejection. Organizational culture has been identified as the main stumbling block in many companies. For instance, General Motors has tried numerous times to spread lean manufacturing practices via their NUMMI and Saturn operations, but with limited success (Inkpen, 2005). GM's culture was said to be a main problem.

With this in mind, prescriptive advice has been to align cultural values with the desired practice before attempting to implement the practice (Flanagan, 1995; McDermott and Stock, 1999). The argument is that without the appropriate values, the initiative at best will achieve mediocre results and at worst speed the organization toward failure. Embarking on cultural value change initiatives has therefore been advocated as the prescription for true improvement (Kujala et al., 2004). Two issues exist with this resource allocation prescription. First, how much time can the organization afford to take to change cultural values before embarking on the needed improvement? Culture change takes time, and the process isn't exact (Ogbonna and Harris, 1998). The multitude of social networks and groups within an organization, even relatively small ones, is difficult to identify and influence. Also, the effects of social networks can have unexpected consequences, which mean corrective actions will be needed along

the way (Harris and Ogbonna, 2002). Second, studies have shown that organizational cultural values can change as a result of improvement initiatives (Boggs, 2004; Naveh et al., 2004). Cultural values congruent with an excellent practice may be a result of practice implementation, not an antecedent. Therefore, a motivation for this dissertation is to provide practical advice as to where managers should allocate resources before and during a quality initiative.

1.3 Meso Paradigm

In general the practice-culture relationship, and in particular the quality management-cooperative cultural values relationship, is a paradox (Poole and Vandeven, 1989) that is unresolved by extant literature. However, the paradox may be resolvable by reconceptualizing this issue and adopting a multilevel or meso-paradigm (House, Rousseau, and Thomashunt, 1995). Discriminating between different levels of quality management is suggested by Juran's (1989) "big Q" and "little Q" insight.

On adopting the meso-paradigm, cooperative cultural values are seen to form and create social norms that exist at the organization level, but their influence manifests at the workgroup or individual level (Martocchio, 1994; Oreilly, Chatman, and Caldwell, 1991). This recognition of cross-level influence (i.e., from a higher to lower level or vice versa) is part of adopting a meso-paradigm. Moreover, recognition of within level influences should occur too. That is, effects that exist at either the organization level or workgroup level. Therefore by adopting the meso-paradigm, a conjecture can be made that quality

management may be *antecedent* to cooperative values within the organization level, but these values may in turn be *antecedent* to quality management across to the workgroup level. In addition, the effect of organization-level quality management practices may diminish over time, while the effect of workgroup-level quality management may increase. These multilevel and cross-level conceptualizations have been theoretically useful elsewhere (Hofmann, 1997) and were adopted in this dissertation for epistemic and practical purposes. Therefore, support for a meso-paradigm has implications for where managers should devote resources during a quality management initiative. The next section will review the methodology used to seek support for this meso-paradigm.

1.4 Methodology

This dissertation tested a multilevel model that utilized sociotechnical systems (STS) theory to explain the relationships among quality management practices, cooperative cultural values and work performance. Utilizing STS theory, hypotheses were made regarding what relationships were expected to be supported empirically. In addition, diffusion hypotheses were developed for the multi-year comparisons. The intention of this dissertation is to test the multilevel model on a secondary data source. This archival data came from a multi-year survey of U.S. federal government agencies during an enterprise-wide quality management initiative (O.P.M., 2002). Quality management and organization theory literatures were used to develop a well grounded measurement model that

was subsequently supported. The multilevel model was then tested against each of the survey years. Results from the HLM data analysis were utilized to draw conclusions regarding the single period and multi-period hypotheses. The result of this process was a richer conceptualization of the relationship between quality management, cooperative cultural values and work performance. The next section provides an overview of the dissertation findings and contributions.

1.5 Contributions

The first important finding that makes a substantial contribution to quality management knowledge is the empirical discrimination between organization-level and workgroup-level quality management practices. This discrimination was not only validated in the theory-based measurement model, but also in its effects within the research model. That is, these two levels of quality management practice influenced work performance in different ways over the course of the quality initiative. This differentiation in behavior further supports the importance of acknowledging the multilevel nature of quality management.

The second important finding is the support for the STS theory-based conjecture for how cooperative cultural values are related to quality management. That is, it was found that the archival data supported the hypothesis that organization-level quality management practices are antecedent to organization-level cooperative cultural values, and that these values are in turn antecedent to workgroup-level quality management practices. Such a finding supports the proposed resolution to the aforementioned practice-value relational

paradox. Moreover, this result also supports the applicability of sociotechnical systems theory to human issues in operations management. The implication for managers is that a quality initiative can be concurrent to the instillation of cooperative values, rather than post hoc. This finding therefore may help managers avoid unnecessary time delays in quality management implementation. Support for the proposed STS theory-based research framework therefore contributes both to practice and to theory.

A third finding that should be noted is the deeper understanding gained by examining and comparing the research framework over multiple years. The ability to assess the dynamics of how quality management practices diffuse through the organization and affect performance is unique in the operations management literature. In addition, it was found unexpectedly that the role of cooperative cultural values becomes more prominent over time; it becomes a key predictor of workgroup-level performance and quality management practice implementation – more so than organization-level quality practices. Without this multiple year examination, such a finding could not have been made. Thus, this dissertation contributes to the knowledge regarding the dynamics of quality management practices, cooperative cultural values and work performance.

Finally, when the results of this research were presented to quality managers, there was unanimous agreement that cooperative cultural values are highly influential in determining the permanence of quality management practices. They also concurred with the claim of sociotechnical system theory that cultural values can both be influenced by management practices. However,

the managers found it non-intuitive that organization-level quality management practices would be less influential over time. In addition, the difference between quality management and cooperative values was difficult to distinguish. By capturing the reactions of quality managers to the research findings, this dissertation makes an important link between theory and practice and motivates further research. Having described the major findings from this research, the outline of the dissertation is next presented.

1.6 Dissertation Outline

The next chapter will review the extant literature related to the pertinent concepts in this dissertation – i.e., quality management, organizational values, and sociotechnical system theory – as well as empirical studies related to this research topic. Chapter 4 will develop the multilevel research framework used examined in this dissertation. Six hypotheses were developed for single-period investigation while three diffusion hypotheses were developed for year-over-year comparisons. Chapter 5 provides a detailed description of the research methodology used. This chapter also provides extensive detail with respect to the archival data. In chapter 6 the results of the data analysis are presented and discussed, with the implications for these results described in chapter 7. Chapter 8 concludes the dissertation with a summary, managerial comments, limitations, and suggestions for future research.

1.7 Summary of Introduction

In this chapter the theoretical paradox of how quality management relates to cooperative cultural values was presented as a motivation for this research. Also discussed was the method used to find empirical support for a multilevel model, which suggests a resolution to the paradox. Finally, highlights of the contributions to knowledge and practice were made explicit. To understand how these research findings make a contribution, extant literature must be reviewed. This is accomplished in the next chapter.

CHAPTER 2: LITERATURE REVIEW

In this chapter, the pertinent literature will be reviewed and related to this dissertation. The first section will review research on quality management, with special attention given to the multilevel nature of quality management practices, the human issues within quality management and the performance implications of quality management. The second section reviews organizational values to reveal how extant literature has highlighted these as an important aspect of organizational culture and to review the pertinence of cooperative cultural values within this dissertation's context. Empirical studies are presented in section three to discuss the topics related to this dissertation that have been examined and where further work is needed. Finally, sociotechnical systems theory is reviewed in the fourth section. This theory serves as the basis for a richer conceptualization in this of how quality management, cooperative values and work performance are related.

2.1 Quality Management

Quality management is a well researched operations management topic. The roots of quality management trace back to the 1920s when W.A. Shewhart developed the process control techniques at the Bell Telephone Laboratories. The success of such tools as SPC were recognized and communicated by W.E. Deming, J. Juran, P.B. Crosby, and K. Ishikawa from the 1950s to the 1980s.

More general quality management ideals were added by these authors and others. Historically, quality management has been studied in the manufacturing environment, but more recently it has been examined in the services context -- for example, in schools (Detert et al., 2003), hospitals (Douglas and Fredendall, 2004), and government (Taveira, James, Karsh, and Sainfort, 2003).

Quality management practices have the goal of improving organizational effectiveness through the means of high quality processes and outputs. Unlike other operations management practices, like lean manufacturing and mass customization, quality management has a longer research history and thus other business disciplines – such as management and organizational behavior – have examined the topic as well.

2.1.1 Deming's Framework

Deming's management model was a famous example of the management-level counterpart to the technical-level quality management practices. This model contained 14 principles to guide management practices toward the goal of superior quality and operating performance (Deming, 1986). Deming's model has implications for an organization's top-management; however, it was intended to reach all levels of the organization. A main theme of the 14 points focuses on how to manage variability, which Deming saw as inherent in all processes and as essential to organizational survival (Gartner and Naughton, 1988). The model is applicable to multiple functions in an organization, and includes customers and suppliers (Gartner et al., 1988).

The Deming management model was later organized into seven interrelated theoretical constructs by Anderson, Rungtusanatham, and Schroeder (1994), which they said provided a foundation for its use in both products and services. The framework by Anderson et al. (1994) provides a basis for understanding the main themes of Deming's management model and is summarized by the authors in the following statement:

> 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-management practices, which, when implemented, support customer satisfaction and organizational survival through sustained employee fulfillment and continuous improvement of processes, products, and services.

Each construct is shown in Table 2-1 along with its definition in the second column. Examples of management practices are provided in the third column. The meso-paradigm as described in Chapter 1 is applied to this framework and the resultant organizational levels are shown in column four.

Although the original intent of Deming's management model was for it to be applicable to both products and services, the large majority of studies in quality management have been focused on manufacturing. Only recently has this quality management framework been applied to services. Douglas and Fredendall (2004), for instance, tested the Anderson et al. (1994) framework in a hospital environment. Their results were similar to the earlier studies in manufacturing environments (Anderson, Rungtusanatham, Schroeder, and Devaraj, 1995; Rungtusanatham, Forza, Filippini, and Anderson, 1998).

Table 2-1: Concepts within the Deming Management Model*			
Concept	Management practices exemplifying concept	Related Deming Principles	Meso-paradigm level
Visionary Leadership	Clarity of vision, long-range orientation, coaching management style, participative change, employee empowerment, and planning and implementing organizational change	1, 2, 7, 14	Organization level
Internal and external cooperation	Firm-supplier partnership, single supplier orientation, collaborative organization, teamwork, organization-wide involvement, systems view of the organization, trust and elimination of fear.	4, 7, 8, 9	Organization level Work-group level
Learning	Company-wide training, foundational knowledge, process knowledge, educational development, continuous self-improvement, and managerial learning.	6, 12, 13	Organization level Work-group level Individual level
Process Management	Management of process, prevention orientation, reduction of mass inspection, design quality, statistical process control, understanding variation, elimination of numerical quotas, elimination of management by objective, elimination of merit-reward systems, understanding motivation, total cost accounting and stable employment.	3, 4, 5, 10, 11, 12	Work-group level Individual level
Continuous Improvement	Continuous improvement activities	1, 5	Work-group level Individual level
Employee Fulfillment	Job satisfaction, job commitment, and pride of workmanship	10, 11, 12	Individual level
Customer Satisfaction	Customer-driven focus	Implicit	Organization level Work-group level
* Adapted from Anderson et al. (1994)			

Other studies have also found evidence for the efficacy of quality management in services – for instance Hays and Hill (2001) found support for portions of the Anderson et al. 1994 framework in hotel settings, while Zhao, Yeung, and Lee (2004) found the use of quality management systems in wholesaling, retailing, and trading industries in China.

This dissertation will utilize Deming's (1986) management model and Anderson et al.'s (1994) conceptual descriptions to characterize quality management practices. Although other models are available, such as the Malcolm Baldridge Quality Award Criteria or the ISO-9000 quality standard, Deming's model has a longer history and has been researched in both the operations management and organizational behavior literatures. Moreover, Deming's (1986) model has been used as a basis for relating quality management to specific organizational cultural values (Detert et al., 2000).

2.1.2 The Multilevel Nature of Quality Management

A concept that has been proposed by Juran is the "big Q and little Q" distinction in quality management (Juran, 1989). "Big Q" refers to the quality management practices associated with the overall functioning of the organization such as continuous improvement in all activities; efficient deployment of resources; employee, supplier, and customer development and recognition; and the full participation of employees. In contrast, "little Q" designates those quality management practices associated with specific tools, techniques, and activities

associated with quality control – such as statistical process control, pareto analysis, and root cause analysis. This "big Q" / "little Q" differentiation highlights the fact that quality management can exist at different operational and organizational levels.

Juran's (1989) insight suggests that there is value in approaching quality management from a meso-paradigm – that is, examining quality management at multiple levels in an organization. By taking the multilevel perspective, researchers can bound the scope of their studies and managers can better identify the system in which quality management operates. Previous empirical work in quality management has predominantly been at one level, either the organization level or the work group (e.g.,, team) level. Examples of studies at the organization level are: Douglas and Fredendall (2004), Rungtusanatham et al. (1998), and Hendricks and Singhal (2001a). Examples of research studies in quality management at the workgroup level or lower include: Waldman (1994) ,who conceptualized quality management issues at the individual-level; Zbaracki (1998), who used qualitative data to present quality management issues at the managerial level; and Soltani, Van der Meer, and Williams (2004), who argued for the importance of the individual in quality management practices. Relatively few studies have adopted the meso-paradigm to examine cross-level influences in quality management; Naveh and Erez's (2004) study dealing with quality practices in workgroups is one recent example where teams and plants were examined simultaneously.

Using Juran's "big Q" / "little Q" concepts, this dissertation investigates quality management practices at multiple levels in an organization. The literature suggests that quality management practices are implemented at multiple levels in an organization – the organization level, the worksite level, the workgroup level and the individual level. However, what is not well understood is whether or not quality management practices interact with other organizational aspects differently at different levels. The conjecture that such interactions might exist and that they might differ significantly at different levels follows directly from Juran's insight regarding "big Q and little Q". For example, the skills and coordination requirements differ significantly between the "big Q" practice of cross-functional teams and the "little Q" practice of statistical process control.

2.1.3 Human Issues in Quality Management

According to Schroeder, Linderman and Zhang (2005, p. 472) in relation to quality management, "Research in human resources presents a great opportunity for further insights, and draws on the vast literature in organizational behavior. This literature can be used to develop interesting insights into implementation, change management, goals, culture and other issues that affect quality." Empirical studies examining human issues in quality management can be divided into two perspectives: studies relating to "enablers" and "inhibitors" of quality management. For instance, Gupta and Ash (1994) studied how allowing team self-regulation "enables" higher productivity and safety. Another example is Rungtusanatham's (2001) examination of how statistical process control

increases employee motivation through its job enriching properties. Stewart and Chase (1999) examined how human errors "inhibit" service quality. In a related study, Stewart and Grout (2001) examine how simple "mistake-proofing" devices achieve marked operational improvements by preventing human errors in processes. These studies underscore the importance of human issues in quality management practices.

One dominant human issue in the quality management literature pertains to organizational culture and, more specifically, organizational values. The topic of culture became popular with the Peters and Waterman (1982) study that introduced the strategic importance of organizational culture. Subsequent studies claimed that quality management makes a number of assumptions about an organization's culture (Bright et al., 1993), such as a culture that views conflict as dysfunctional, that sees management as rational and technical, and that is unified by the quality imperative. These assumptions were further articulated by Detert et al. (2000) to consist of eight underlying values and beliefs essential for a quality management initiative. These were referred to as TQM values and are shown in Table 2-2. Detert et al. (2000) posited that the values and beliefs that are closely tied to TQM are 1) factual decision-making, 2) a long-term orientation, 3) problems are systemic in nature, 4) never-ending improvement, 5) stakeholder satisfaction, 6) cooperation and collaboration, 7) employee involvement, and 8) customer driven. In a later study, Detert et al. (2003) found empirical support for these values and beliefs when examining the quality culture of primary and secondary schools.

Table 2-2: Cultural Values Related to TQM	
Cultural Dimension	TQM Value
1. The basis of truth and rationality in the organization	Decision making should rely on factual information and the scientific method.
2. The nature of time and time horizon	Improvement requires a long-term orientation and a strategic approach to management.
3. Motivation	Quality problems are caused by poor systems – not the employees. Employees are intrinsically motivated to do quality work if the system supports their efforts.
4. Stability versus change/ innovation/ personal growth	Quality improvement is continuous and never-ending. Quality can be improved with existing resources.
5. Orientation to work, task and coworkers	The main purpose of the organization is to achieve results that its stakeholders consider important. Results are achieved through internal process improvement, prevention of defects, and customer focus.
6. Isolation versus collaboration / cooperation	Cooperation and collaboration (internal and external) are necessary for a successful organization.
7. Control, coordination, and responsibility	A shared vision and shared goals are necessary for organizational success. All employees should be involved in decision making and in supporting the shared vision.
8. Orientation and focus – internal and/or external	An organization should be customer driven. Financial results will follow.

According to Cameron and Quinn (1999) organizational values greatly impact the implementation and efficacy of quality management practices in an organization – that is, values influence quality management. For example, an organization that is concerned for its people would be better prepared for employee involvement initiatives than an organization with a concern for control.

Also along this theme, Naveh and Erez (2004) found quality management practices to invoke an organization's "attention-to-detail" – that is, quality management influences values. As can be seen, the literature on quality management has highlighted the importance of the human issue of organizational culture and values but has yet to develop a full understanding of the relationship between quality management and culture.

Because this dissertation focuses on the antecedents and consequences of quality management practice implementation, the preceding discussion of extant literature suggests that human issues should be of particular interest in studying these interrelationships. Schroeder et al. (2005) suggest that research dealing with human resource issues and their relationship to quality management is especially fruitful. Because organizational culture in general, and cultural values specifically, have been discussed in the context of quality management, it follows that "values" should hold promise in relating quality management to human issues. In addition, a multilevel perspective of quality management practices should lend additional insights into how social factors influence and are influenced during a quality management initiative.

2.1.4 Performance Implications of Quality Management

As noted by Schroeder et al. (2005) one of the most common relationships studied empirically is between quality management and performance. This is not surprising as the intent of quality management is to improve the quality of products or services with the final goal to improve organizational performance.

Early works by Benson, Cunningham and Leachman (1995); Flynn, Schroeder, and Sankakibara (1995); and Powell (1995) all found partial support for the effect of quality management on performance, because each study revealed contingencies where quality management is and is not effective. Specifically, Benson et al. (1995) found that in semi-conductor manufacturing, quality management impacts seven unique metrics of quality and productivity differently. Flynn et al. (1995) found that only quality management "core" practices have a direct effect on performance, while deeper "infrastructure" practices only indirectly improve performance through their positive impact on "core" practices. Finally, Powell (1995) showed that just the "tacit" aspects of TQM, such as such an open culture and leadership commitment, contribute to competitive advantage not the "technical" aspects, such as benchmarking and training.

However, these findings led later authors to claim a "TQM paradox" existed between the popular prescription for TQM and the limited empirical support for this prescription (Choi and Eboch, 1998). That is, there seemed to be a contradiction between the supposed benefits of TQM and the dissatisfaction with TQM's results. This led many researchers to test explanations for why such a paradox existed. For instance, Choi and Eboch (1998) found that institutional pressures to appease customers was most related to TQM and that manufacturing performance found only weak and non-customer related improvement. Hendricks and Singhal (1997; 2001b) found that quality management performance effects occur over a longer period of time than implied by cross-sectional studies. Their studies suggested that up to five years might

be required for improvements to take effect. Kaynak (2003) argued that the disconnect between TQM and performance lies in scholarly inconsistencies in how quality management is related to performance. The empirical study by Kaynak (2003) showed that different levels of performance within an organization must be considered in order to understand the TQM benefits. These studies are listed only as representative of a theme in the literature, casting doubt on the direct and positive effect of quality management on performance.

2.1.5 Dynamics of Quality Management

An important aspect of empirical quality management research is the paucity of longitudinal studies, given their promise in exploring the temporal effects of quality management practices on performance. One finds repeated calls for "future research" to include longitudinal data in order to better explore the relationships found in cross-sectional data (Kathuria and Davis, 2001).

There are studies in the literature that have explored the dynamic interactions between quality management practices and performance. For example, Ahire and Ravichandran (2001) discuss a four-stage diffusion sequence: a*doption* – top management commitment and launching; *adaptation* – changes in the attitude of employees; *acceptance* – changes in employee behavior; and *use* – quality management actions improve operations. Full performance gains, according to Ahire and Ravichandran (2001), don't occur until the fourth diffusion stage. The authors found empirical support for this diffusion process within the automotive parts industry.

Another stream of research in quality management highlights the importance of time and dynamic relationships, albeit from an analytical perspective. Narasimhan, Ghosh and Mendez (1993) proposed a dynamic diffusion model where time delays between actual and perceived product quality impact the benefit an organization realizes from quality improvements. This dynamic was later developed in a study investigating the impact product pricing has on continuous quality improvements (Narasimhan, Mendez, and Ghosh, 1996). Furthering this research stream was a study by Narasimhan and Mendez (2001) that investigated the equilibrium properties of the dynamic relationship between an organization's quality reputation, marketing decisions, and long-term profitability. Finally, the temporal cost improvements of experience curves were studied as an important attribute of quality management dynamics (Mendez and Narasimhan, 2002).

The underlying themes to these longitudinal perspectives are not only that quality management practices take time to implement (e.g.,, because of resource issues or organizational cultural issues), but that quality management also is implemented in different sequences, delayed for strategic reasons and beneficial only after delays in customer/market feedback. Dynamics therefore have been shown to exist both internally, such as with experience curves, and externally, such as with market diffusion. Therefore, a review of the quality management literature reveals the criticality of incorporating the temporal effects in quality management research.

The purpose of implementing quality management practices is improved organizational effectiveness. Examining performance effects over time and in relation to other factors, such as human issues, will aid in developing a more complete understanding of how quality management practices impact performance than is currently available in extant literature. In addition, it could help resolve the TQM paradox discussed previously. For these reasons, this dissertation investigates work performance resulting from quality management implementation using panel data that enable an examination of performance effects over time. Having reviewed pertinent aspects of the quality management literature, the next section will present literature pertaining to an important concept related to quality management – organizational values.

2.2 Organizational Values

The previous section discussed research that establishes organizational culture as an important aspect to be considered when implementing quality management practices. The scope of literature dealing with organizational culture is vast. The literature relating to organizational values – an aspect of organizational culture – is of particular relevance to the issues addressed in this dissertation. The values of an organization are not only a significant feature of an organization's culture (Schein, 2004) but also a frequently used proxy for organizational culture in studies pertaining to quality management (Detert et al., 2000; Cameron and Quinn, 1999). Moreover, the shared values within an organization influence employee actions through the norms they create. This is

an informal and implicit force that may exist along with the more formal quality management initiative that an organization implements, and is, therefore, an important consideration in this research.

2.2.1 Organizational Cultural Values

Common among the organizational culture studies is the prescription that values should be studied when considering culture (Martin, 2002; O'Reilly, Chatman, and Caldwell, 1991; Quinn and Rohrbaugh, 1983; Schein, 2004). These espoused values can be considered ideological ways of operating or "theories-in-use" (Argyris and Schön, 1974; Schein, 2004). Although espoused values may not completely reflect an organization's culture, they are more readily discernible than tacit assumptions. The organizational culture framework of Schein (2004) sees organizational values as well established influential forces. For instance, if cooperative cultural values exist, they will strongly influence individuals to act cooperatively. Social penalties and rewards are bestowed upon employees based upon their adherence to the norms derived from these values. Additionally, cultural values designate what is of importance to the group and allow employees to prioritize and select from the various norms of behavior. This informal encouragement toward a mode of behavior enables the implementation of formal management systems requiring that behavior mode.

Detert, et al (2000) synthesized twenty years of organizational culture research to propose the following organizational cultural value dimensions: 1) the basis of truth and rationality; 2) the nature of time; 3) motivation; 4) stability vs.

change; 5) orientation to work, task, and coworkers; 6) isolation vs. collaboration, 7) control, coordination, and responsibility; and 8) internal vs. external focus. Organizational improvement initiatives are said to possess underlying values matching these dimensions, thereby allowing a comparison between an initiative and an organization's culture. To illustrate their conjecture, Detert et al. (2000) related quality management practices to specific cultural values along the eight dimensions and later found empirical support for these "quality values" (Detert et al., 2003).

An important issue with organizational values is how they are formed and how they change. This research topic, in general, is not well developed (Hitlin and Piliavin, 2004), but some suggestions have been made that are important for review. Values are thought to form, in part, as a response to an overwhelming amount of environmental information. That is, because data are available to people from too many sources, it is often not readily apparent how to use them as a guide for actions (March et al., 1958). To facilitate decision making, people form and use values to discern what is important and to what they need to be attentive (Dewey, 1939). Quinn and Rohrbaugh's (1983) competing values framework illustrates this by showing how organizations that value flexibility will be attentive to diversity and individual initiative, while organizations that value control will be attentive to structure and coordination. Exactly what values to choose often come from influential sources – such as leaders, cultural background, and social groups (Weiss, 1978). When individuals are thrust into

new situations in which they must make decisions, values aid the selection of information and choice of action.

Organizational values are said to change as a result of "critical reflection" within an organizational context (van Woerkom, 2004). As new situations and problems present themselves, employees must reflect upon the available information and goals in order to solve the problem. When similar problems continually occur, or when problems are highly impactful, deeper reflection into the very premises on which a problem rests is needed. This is "critical reflection" and it is the situation in which value change is most likely to occur. Van Woerkom (2004) likens this to organizational learning (Argyris and Schon, 1996) and states that processes like Deming's plan-do-check-act (PDCA) continuous improvement cycle can be catalysts for organizational value change.

An important feature of values is that they are projected onto others. In other words when one observes the actions of another that contradict one's values, one judges the other to be acting poorly or in bad behavior (Dewey, 1939). This essential feature of values is crucial toward understanding how they eventually influence organizational behavior. As values become shared and espoused within an organization, social norms of behavior begin to form around those values (Schein, 2004). Norms can be considered the rules of behavior that are enforced through such social processes as inclusion, acceptance, and ridicule. New members of an organization are especially apt to be influenced by the social norms and values as they make sense of their new and uncertain situation (Louis, 1980).

The above review reveals the multilevel nature of organizational values. When values are shared they exist at an organizational (i.e., high) level. The leadership that influences what is valuable in an organization operates at a high level. Organizational norms that follow from the underlying organizational values also exist at the organization level. However, norms form in order to influence individual (i.e., lower-level) action. In addition, values influence information selection as problems present themselves at these lower levels. This cross-level influence of organizational values fits well within the meso-paradigm described earlier.

This dissertation incorporates these ideas on cultural values. Specifically, the prominence of values as an influential force in human behavior in organizations justifies its consideration. However, recent research on how values change (Naveh et al., 2004; van Woerkom, 2004) supports this dissertation's perspective that cultural values are a malleable organizational characteristic. Therefore it is the perspective that *cultural values are both influenced and influential* that underpins the richer conceptualization in this dissertation of how cultural values interact with a quality management initiative.

2.2.2 Cooperative Cultural Values

Among the many researches that have investigated organizational values, a common element is the recognition that many types of values exist. For instance, O'Reilly et al. (1991) has elucidated over fifty different types of values

in their organizational culture profile (OCP). Schwartz (1992) also has described the different values that exist within a culture, such as individualism vs. collectivism. Quinn (1983) described multiple organizational values as well, but also showed how some are competing against each other – for instance, flexibility vs. control. It should be noted, therefore, that values are not only multifarious but are often incompatible.

The values surrounding collectivist-type values [e.g.,, cooperation (Chatman et al., 1995)] are of particular interest to this research because of their (often) assumed relationship to quality management (Detert et al., 2000). In particular, Detert et al. (2000) highlighted the following quality values that closely align with what can be termed cooperative-type values: 1) All employees should be involved in decision making and in supporting the shared vision, 2) Cooperation and collaboration are necessary for a successful organization, and 3) Employees are intrinsically motivated to do quality work if the system supports their efforts. Associations have also been made between the success of TQM in Japanese companies and the collectivist-type values of the Japanese in general.

In addition to the association with quality management, cooperative cultural traits have been associated with organizational effectiveness and performance. For instance, Denison and Mishra (1995) found that involvement and adaptability (as indicated by flexibility, openness, and responsiveness) helped predict organizational growth, quality, employee satisfaction, and overall performance. Later Song, Montoya-Weiss and Schmidt (1997) empirically found a strong, positive relationship between cross-functional cooperation and

performance in new product development. Jones and George (1998) have argued that interpersonal cooperation and teamwork is an important component of organizational performance and competitive advantage. Recently, Doolen, Hacker, and Van Aken (2003) empirically found that an organizational culture supportive of communication, integration, and cooperation between teams had a positive relationship with team effectiveness and team satisfaction.

This stream of research then allows this dissertation to focus on a specific cultural value – the value of cooperation. Because cooperative values have been prominently associated with quality management, and because values in general are important to quality management practice implementation, this dissertation will examine specific relationships between cooperative values and the implementation of quality management practices at multiple levels of an organization. Moreover, the performance effects that cooperation may have in an organization call for the joint examination of cooperative values and quality management practices. So far, this has not been done in the studies relating to quality management practices. However, empirical studies have been conducted relating quality management to other aspects of organizational culture. This literature is reviewed next.

2.3 Pertinent Empirical Studies

The following section describes empirical research that examined the relationships between operations management practices – in particular quality management – and aspects of organizational culture. Definite causal directions

within this interface of operations management and organizational behavior remain unresolved. However, what is strongly supported is that the presence of certain operations management practices and certain organizational cultural characteristics are concomitant. This section will review where quality management research specifically and operations management research generally have conducted empirical work. Following this, pertinent research gaps will be presented.

2.3.1 Quality Management and Organizational Culture Studies

In the operations management literature the association between organizational culture and TQM has been recognized. A likely reason for this is that TQM is both a set of observable practices (e.g.,, statistical process control and root cause analysis) and a host of managerial beliefs (e.g., Deming's 14 points and Taguchi's quality loss function). Bates, Amundson, Schroeder, and Morris (1995) found that quality management strategies and culture were significantly correlated, although they did not suggest directional influence. Later Detert et al. (2000) offered an interaction hypothesis, where TQM was considered an element in a more general set of improvement initiatives. Detert et al. (2000) argued that a unique value structure exists for all improvement initiatives and that implementation efforts will be less successful if the values that underpin the organizational culture are incompatible with the initiatives. Other authors have also dealt with the TQM-culture relationship, some implying that TQM practices can affect organizational culture (Mead, 1985; Patti, Fok, and

Hartman, 2004) or can be affected by organizational culture (Gallear and Ghobadian, 2004; Kujala et al., 2004). For instance, Mead (1985) examined a single case example where quality tools not only improved operating performance, but also brought new interactions and relationships among employees. Patti et al. (2004) validated a survey instrument that revealed *different levels* in the organization (i.e., managers and employees) perceive quality management practices to affect organizational culture differently. Gallear and Ghobadian (2004) argue, based on empirical evidence, that successful introduction and practice of quality management often requires culture change. Kujala and Lillrank (2004) also contend that successful quality management implementation requires an organizational culture compatible with quality management practice. A review of these studies reveals that organizational culture can influence and be influenced by quality management practice. That is, organizational culture matters to quality management, but how the quality management-culture relationship should be depicted remains unclear. These studies also reveal a research gap; no empirical work has incorporated the time dimension that is implicit in the quality management-culture relationship.

2.3.2 Practice-Culture Empirical Studies

Other operations management researches have investigated the relationship between organizational culture and operations management practices. McDermott and Stock (1999) utilized Quinn and Rohrbaugh's (1983) competing values framework to investigate if culture influenced the benefits from

implementing advanced manufacturing technologies (AMT). Their results revealed statistically significant relationships – some positive and some negative – among competing-value types, managerial AMT satisfaction, and competitive performance. Their conclusion was that organizational culture moderates the outcomes of AMT implementation.

Another study by Yauch and Steudel (2002) investigated how organizational culture may influence the formation, design, implementation, and operation of manufacturing cells. Utilizing Schein's (2004) framework, they found that cultural factors have little influence on the formation and design of cellular manufacturing but have wide influence during implementation and operation. Their conclusion was that organizational culture can impede the implementation of cellular manufacturing (i.e., implying a culture-as-antecedent hypothesis). The authors speculate as well that organizational culture can limit cellular manufacturing's effectiveness (i.e., inferring a culture-as-moderator hypothesis). Interestingly Yauch and Steudel mention, but do not explore, the idea that cellular manufacturing can impact organizational culture (i.e., accepting the possibility of a culture-as-consequent hypothesis).

Research by Nahm, Vonderembse, and Koufteros (2004) investigated the relationship between a customer orientation assumption, a set of integrative beliefs, time-based manufacturing practices (TBMP) and overall performance. Nahm et al. utilized the cultural framework of Schein (2004). Their proposition was that a customer orientation assumption leads to integrative beliefs, which leads to TBMP implementation and then firm performance. Evidence was found

for this sequential relationship in their survey-based study. The implication for managers was that creating a collaborative, customer-oriented culture should be done before employing such practice as TBMP (i.e., culture-as-antecedent).

Naveh and Erez (2004) investigated the relationship among quality improvement practices, the cultural values of innovation and attention-to-detail, and internal measures of performance. In a longitudinal data set collected from a single organization, they found support for their hypotheses that 1) quality improvement practices enable the two cultural values in question and that they coexist, and 2) performance is affected by the relationship between values and practices. The implication for managers was that quality improvement practices strongly communicate organizational goals and therefore elicit certain cultural values (i.e., culture-as-consequent) that in turn will impact performance.

In the light of these past empirical studies, there is little question that cultural values relate to quality management in some way. What remains less definitive is how cultural values should be related to quality management. One perspective would hold that cultural values are antecedent to quality management implementation, while another would view cultural values as a consequent. As was stated in Chapter 1, both views have different epistemic and practical implications.

This review of empirical studies reveals a deficiency in the literature to resolve how both perspectives can exist. That is, how can both perspectives coexist logically and be supported empirically? This dissertation seeks answers to this epistemic question by approaching the issue from a meso-paradigmatic

and sociotechnical theoretic perspective. The meso-paradigm was covered in Chapter 1, and sociotechnical system theory will be discussed next. In addition, longitudinal analysis of the quality management - cultural values relationship remains to be explored. Researchers have argued from a time oriented perspective, but have yet to validate these arguments empirically. This dissertation seeks to close this research gap as well by using longitudinal data to look for patterns of change in the relationships among variables to better explain quality management's relationship with cultural values.

2.4 Sociotechnical Systems Theory

Although quality management and cooperative values have been associated in the literature, sociotechnical systems (STS) theory provides a useful explanation as to how they are related within a meso-paradigm. STS theory originated in the 1950s to explain how changes in coal-mining techniques had social ramification and subsequent performance problems (Trist and Bamforth, 1951). Recently, the STS theory has been used to explain issues in mass customization (Liu, Shah, and Schroeder, 2006), project management (Wallace, Keil, and Rai, 2004), and management science (Rosenzweig, 1994). In this section the salient aspects of STS theory for this research will be presented. A longer development will be given in Chapter 3 as to how the quality management - cooperative values relationship can be explained with STS theory.

2.4.1 Sociotechnical System Frameworks

Sociotechnical system (STS) theory began with the works of Trist and other colleagues at the Tavistock Institute with initial studies of British coal mining methods (Trist et al., 1951). An outcome of these studies was the conclusion that the behavior of organizational employees was so tightly coupled to the way work was designed that the human system could not be understood without also understanding the technical system. Moreover, a change in technical system design would affect the social system and vice-versa (Pasmore, 1988). The STS perspective views the organization as made up of people who produce outputs using some technology, and that each affects the operation and appropriateness of the technology as well as the actions of the people who operate it (Pasmore, Francis, Haldeman, and Shani, 1982). Influencing both the organization's social and technical systems is the environmental system or "totality of systems surrounding and influencing a focal organization" (Pasmore, 1988). The environment (e.g., governmental, economic, industrial, transportation, and cultural systems) is acknowledged to be immensely complex and continually changing.

Most work with STS has been normative (Cherns, 1987; Clegg, 2000), but the more descriptive aspects (Pasmore, 1988; Seiler, 1967) will be utilized in this dissertation. According to Pasmore (1988) "the technical system of an organization consists of the tools, techniques, artifacts, methods, configurations, procedures, and knowledge used by organizational employees to acquire inputs, transform inputs into outputs, and provide output or services to clients or

customers." Generally, technical systems are the means to achieve organizational ends. The social system "is comprised of the people who work in the organization and all that is human about their presence" (Pasmore, 1988). It encompasses many things including attitudes, beliefs, group relations, cultures, values, norms, politics, cooperation, conflict, and emotions. Generally, social systems are the means to achieve human ends. Therefore, sociotechnical systems influence both organizational and human ends through technical and social means.

Numerous STS frameworks have been provided in the literature, predominantly in ergonomics and human-factors engineering journals (Carayon, 2006). However, examples exist in the organizational behavior literature as well (Barko and Pasmore, 1986; Pasmore et al., 1982; Seiler, 1967). A common feature of these frameworks, as shown explicitly by Moray (2000) and Rasmussen (2000), is the multilevel nature of STS. Moray's (2000) framework in particular shows that at the center of STS are physical devices, ergonomics, and individual behavior. The next layer is team and work-group behavior, of which communication, cooperation, and perceptions of responsibility play major roles. Beyond the work-group layer is organizational and management behavior, of which culture, work practices, and chain of command play significant roles. Finally, beyond the organizational layer is the legal and regulatory environment, and lastly the societal cultural layer. Such a framework shows how STS exists at and across many organization levels.

Table 2-3: Characteristics of Sociotechnical Systems*	
Technical features	Social features
T1: Input inducement of variation	S1: Codependency in work roles
T2: Work environment – stimulation & rigidity (directly related to task)	S2: Output responsibility in work roles
T3: Spatio-temporal distribution of entities (e.g., machines, workers)	S3: Distribution of resource allocation responsibility
T4: Automation level (i.e., amount of work done by humans) moderates effect of other features	S4: Social "diffusionality" of output affecting variances (i.e., ramifications that matter)
T5: Patterns in operational clusters (i.e., how work is grouped)	S5: Possibility for helpful interdependencies
T6: Flexibility in and human demands from operational method	S6: How roles affect individual experiences, values and identity
T7: Form and effectiveness of process maintenance	S7: Degree of social interdependencies that are task induced
T8: Input supply robustness (i.e., reliability with respect to variability)	S8: Congruence among individual goals, task interdependencies and formal structures
* Modified from Fox (1995)	

2.4.2 Reciprocal Influences Between Social and Technical Systems

To understand how the technical and social systems influence each other, Emery (1959) listed characteristics of sociotechnical systems – technical features (T1-T8) and social features (S1-S8) – that were later summarized by Fox (1995) and are shown in Table 2-3. As can be seen from Table 2-3, technical systems have a strong influence on how work and employees are arranged and also the communication effectiveness between work groups. A key component of social systems is the amount and form of interdependence that exists. Upon viewing

this table, one can see how a technical change in management practice (e.g., quality management) can lead to social changes (e.g., cultural values). For instance, new management methods that bring employees into cross-function teams (T3 and T5), changes the roles (S1), interdependencies (S7), and individual experiences (S6).

The multi-ordered effects of technological change described by Pasmore (1982) provide a useful description for how technological changes, in particular, influence social characteristics over time. The first-order effect of technological change is the association that employees make between the new work arrangements and the positive impact on efficiency and effectiveness. A second-order effect comes from the new work arrangements, which influence how coordination must be carried out among employees and leaders. Reward mechanisms (e.g., monetary, political) adapt to reinforce these new coordination requirements. A third-order effect involves the skills and knowledge required of employees involved in the new technology. New problem-solving skills require training, role adjusting, or hiring – all of which change the skill profile of the organization. Organizational structure is modified to accommodate the changing skill profile. New structures, different managerial relations, and modified reward mechanisms influences how workers are treated – changing employee self-conceptions and underlying value systems. These various effects take time to promulgate through the organization and therefore delay the impact of new management techniques.

2.4.3 Sociotechnical System Design

An important concept that falls under the more normative features of STS theory is the notion that only through "joint optimization" of both the social and technical systems can the sociotechnical system attain full potential (Pasmore et al., 1982). That is, only if the social and technological systems of the organization are designed to fit the demands of each other and the environment can performance gains be realized. Although this idea is more conceptual than analytical, the notion is "that the design and performance of new systems ... can only work satisfactorily if the social and the technical (aspects) are brought together and treated as interdependent aspects of a work system" (Clegg, 2000, p. 464). With this perspective in mind, Cherns (1976, 1987), Pasmore (1988), and Clegg (2000) have each developed a list of STS work-design principles meant to guide the process and content of developing operating systems. These principles have been used in research related to cellular manufacturing (Huber and Brown, 1991), lean production (Niepce and Molleman, 1998), mass customization (Liu et al., 2006), and other operational systems (Das and Jayaram, 2007). The overall support for the STS approach being related to organizational performance was provided in a review by Van Eijnatten (1992) of over 1,500 STS studies.

Table 2-4: Variations of STS Principles

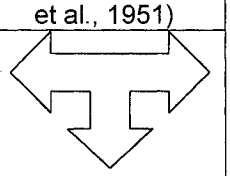
Cherns (1987)	Pasmore (1988)	Clegg (2000)
1. *Compatibility*: Work system design should involve employees and should be compatible with organizational long-term objectives. 2. *Minimal critical specifications*: How jobs are to be performed should be specified as little as possible. 3. *Variance control*: Variance control should be performed where variances originate and should not be exported across organizational boundaries. 4. *Boundary location*: Functional boundaries should not be drawn so as to impede the sharing of information, knowledge, and learning. 5. *Information flow*: Organizational systems should ensure that information is provided to those who require it when they require it. 6. *Power and Authority*: Those who need resources to complete their tasks should have access to, authority over, responsibility for, and economically use them. 7. *Multifunctionality*: Individuals should be capable of performing a diverse range of jobs. 8. *Support congruence*: Organizational functions that support operations should reinforce the behaviors the organization's structure is designed to elicit. 9. *Transitional Organization*: The design process should embody and facilitate organizational transitions in management philosophies. 10. *Incompletion*: Organization design should be continual and never completely stable, with its operating teams part of redesign via self-regulation and learning.	1. *Innovation versus preserving the status quo:* Creatively employ organizational resources to enhance organizational design, products, service, policies, work design, or technology. 2. *Development of human resources:* Encourage employees to develop their knowledge through training, reward systems, demanding jobs, organizational commitment, and expanded vertical responsibilities. 3. *Awareness of the external environment*: Regularly involve of all employees in scanning the organization's external environment to increase awareness of threats and opportunities. 4. *Maximize cooperative effort:* Ensure organizational units and actors pursue common goals in a cooperative fashion through autonomous workgroups. 5. *Developing commitment and energy:* Create social and organizational conditions that will invoke employee commitment and direct motivation toward organizational goals. 6. *Utilizing social and technical resources effectively:* Use variance analysis, select technologies deliberately and design operations with STS thinking to make better use of people and machines.	*Meta-Principles for Design* 1. Design is systemic. 2. Values and mindsets are central to design. 3. Design involves making choices. 4. Design should reflect the needs of the business, its users and their managers. 5. Design is an extended social process. 6. Design is socially shaped. 7. Design is contingent. *Content Principles of Design* 8. Core processes should be integrated. 9. Design entails multiple task allocations between and among humans and machines. 10. System components should be congruent. 11. Systems should be simple in design and make problems visible. 12. Problems should be controlled at source. 13. The means of undertaking tasks should be flexibly specified. *Design Process Principles* 14. Design practice is itself a sociotechnical system. 15. Systems and their design should be owned by their managers and users. 16. Evaluation is an essential aspect of design. 17. Design involves multidisciplinary education. 18. Resources and support are required for design. 19. System design involves political processes.

Variations exist upon the STS design principles as illustrated in Table 2-4. While Cherns and Pasmore focus almost exclusively on the organizational design characteristics recommended by STS theory, Clegg offers STS principles for how organizational design should be carried out (see Clegg's *meta-principles* and *process principles* in Table 2-4). There are at least four common design characteristics among each listing: 1) employee involvement in and responsibility for the work system; 2) employee knowledge, skills and activities beyond singular function; 3) coordination and integration of functions; and 4) deliberate connections to organizational goals.

The above presentation of STS theory is divisible into two main areas, basic and applied, both of which will be utilized in this dissertation. Firstly, the basic theoretical qualities of STS theory are useful for their frameworks and explanations for change. These frameworks not only give definitions of technical and social systems that encompass quality management practices and cultural values, they also match the multilevel quality management perspective of Juran's "big Q" and "little Q". STS's explanations for change in both technical and social entities provide plausible descriptions for why organizational leaders choose quality management and how organizational members change their values. Moreover, STS theory provides dynamic explanations for cross-level and multi-ordered change – this is particularly of interest for explaining the delayed effects of quality management. The application of STS theory involves the design principles and performance implications. The design principles are congruent with many elements of Deming's management model, and in so doing add a

theoretical dimension to quality management's connection to performance. In addition, STS design argues that performance benefits will be realized with cooperation within and between autonomous work units. Therefore, STS theory provides a framework for the research carried out in this dissertation.

Figure 2-1: Theoretical Grounding

<table>
<tr><td colspan="2">Quality Management Literature</td><td>Sociotechnical Systems Theory Literature</td><td colspan="2">Organization Theory Literature</td></tr>
<tr><td rowspan="2">(Anderson et al., 1994; Deming, 1986)</td><td rowspan="2">Quality Management Practices</td><td>(Emery, 1959; Pasmore, 1988; Seiler, 1967; Trist et al., 1951)</td><td rowspan="2">Cooperative Cultural Values</td><td rowspan="2">(Detert et al., 2000; Wagner, 1995)</td></tr>
<tr><td>  </td></tr>
<tr><td>(Douglas et al., 2004)</td><td colspan="3">Work Performance</td><td>(Denison et al., 1995)</td></tr>
<tr><td>(Juran, 1989)</td><td colspan="3">Meso-Paradigm</td><td>(Schein, 2004)</td></tr>
<tr><td>(Narasimhan et al., 2001)</td><td colspan="3">Dynamics</td><td>(van Woerkom, 2004)</td></tr>
</table>

2.5 Summary of Literature Review

Chapter 2 has presented literature pertinent to this dissertation's study of the multilevel relationship between quality practices, cooperative cultural values, and work performance. A summary of the theoretical grounding is provided in Figure 2-1, which depicts how extant literature is related to the topics of interest in this dissertation. The Deming management model was reviewed in detail because of

its popularity and relevance to this dissertation. A connection was made between quality management and cooperative values, an aspect of organizational culture. The lack of clarity in extant literature as to how these two concepts might relate was revealed through the review of empirical studies. Finally, sociotechnical systems theory was presented as a possible perspective that may provide a richer conceptualization of the relations between quality management, cooperative value, and work performance. Based upon extant literature, a research framework was developed to offer a resolution to the aforementioned theoretical paradox. This framework is presented in the next chapter.

Chapter 3: RESEARCH FRAMEWORK

This chapter will present nine hypotheses on how quality management, cooperative values and work performance are related. An STS theory perspective will be given for each hypothesis, as well as context specific justification from previous studies. In this way, both organizational theory and quality management literature will be synthesized to provide justifications for the multiple hypotheses. Concluding this chapter is a multilevel theoretical model that shows how the hypotheses fit into a research framework.

3.1 Research Perspective

The total quality management (TQM) approach has been termed a sociotechnical system by organizational behaviorists (Schein, 2004) and operations management scholars (Ahire et al., 2001). This is likely because of the similarities between STS design principles (Cherns, 1987) and TQM recommendations (Deming, 1986). However, to name TQM a sociotechnical system may be too restrictive, as such a view does not take into consideration the potential sociotechnical forces operating outside the TQM purview. Essentially TQM can be seen as a normative set of management principles focused on organizational goals (Westphal, Gulati, and Shortell, 1997), while sociotechnical systems exist regardless of purposeful STS design based management methods (Seiler, 1967). TQM acknowledges the existence of

sociotechnical systems within the organization and thus attempts to control those forces at work.

By taking this viewpoint, this dissertation reaches beyond TQM and STS design literature to incorporate of the literature on STS theory. Such an approach expands the bounds of what is to be considered when describing how quality management and cooperative cultural values relate to each other and to performance. Moreover, STS theory provides useful descriptions for how quality management and cooperative values act in a multilevel manner (Emery, 1959; Moray, 2000; Rasmussen, 2000). Finally, STS theory indicates how the time element may play into the aforementioned relationships (Pasmore et al., 1982). It is for these reasons that the research framework of this dissertation rests on STS theory.

From an STS theory perspective, quality management practices are viewed as a management technology. As Pasmore (1988) described the technical system of an organization to consist of (among other things) techniques, methods, configurations, and procedures to provide services to clients, quality management is understood as the technical end of a sociotechnical arrangement within an organization. Concurrently, cooperative cultural values are a dimension of the social system within an organization. STS theory acknowledges that social values are part of the organizational culture and that they play a significant role in influencing human decisions and behavior (Cherns, 1987; Seiler, 1967). The particular link between quality management and cooperative value is studied because of the empirical concomitant variation

between the two (Detert et al., 2003) for which STS theory provides an explanation. That is, STS theory explains how technologies mediate human experience, how leaders choose technologies for environmental adaptation, how initiatives change social values, and how social systems influence individual behavior, of which technological acceptance is a part. Finally, the multi-ordered effects of technological change described by Pasmore (1982) provide a useful description for the changes in influence quality management and cooperative values have over time.

Although past research has studied cultural relations with quality management (Bates et al., 1995; Boggs, 2004; Gallear et al., 2004; Huq, 2005; Jabnoun et al., 2005; Kujala et al., 2004; Miron et al., 2004; Moore et al., 2006; Patti et al., 2004), no research has utilized the meso-paradigm along with the incorporation of time under a single theoretical explanation. In so doing, this dissertation sets itself apart from research on quality management. The following sections develop the research framework of this dissertation based on STS theory, the quality management literature and research on cooperation.

3.2 Development of Hypotheses

This section presents each hypothesis. All hypotheses are reasoned from STS theory first in generic form, and then reasoned from literature specifically pertaining to the hypothesized relationship. The first six hypotheses relate one concept to another, while the final three hypotheses pertain to expected effects of a concept over time.

3.2.1 Organization-level Quality Management Instills Cooperative Values

According to STS theory, technologies are often chosen by leaders within an organization as a response to changing external environmental pressures (Seiler, 1967). Management technologies such as quality management are no different, as they too can be externally motivated (Westphal et al., 1997; Zbaracki, 1998). However, technologies possess characteristics with social ramification, as shown in Table 2-3. Organizational quality management in particular possesses spacio-temporal characteristics (T3) in its emphasis on team-work – bringing employees into closer, more regular contact. Such a technical feature raises the possibility for interdependent help (S5) and new social interdependencies (S7). Moreover quality management's prescriptions of cross-functional decision-making groups work differently (T5) and increase codependency in work roles (S1) and output responsibility (S2). Couple these technological arrangements with the ideal of continuous improvement and the situation can induce a critical reflection that challenges employee preconceptions of what is good for the organization – that is, organizational values.

Ackoff and Emery (1972) show that when employees understand that the benefits of joint action outweigh the benefits from individual action, cooperation is more likely to occur. Moreover, adopting cooperative values solidifies the decision to act cooperatively; thereby reducing the uncertainty associated with trying to choose whether if acting collectively or individualistically is most

appropriate. In addition, STS theoreticians have argued that technology is inherently value-laden. Turning again toward quality management, Detert et al. (2003) found support for their list of underlying values to quality management as shown in Table 2-2. From this list, many values describable as cooperative cultural values can be found. In particular the positive attitude toward coworkers under dimension five, the collaborative preference toward organizing under dimension six, and the importance of coordination and shared vision described under dimension seven. The extent to which an organization-wide quality management implementation occurs communicates the extent to which cooperation is valued by organizational leaders, which in turn should influence the employees of the organization. Therefore, the following hypothesis is given:

Hypothesis 1: Organization-level quality management practices (Q^O) have a positive impact on organization-level cooperative cultural values (V^O)

3.2.2 Organization-level Quality and Workgroup-level Quality

An important component of the organization-level sociotechnical system is the organizational structure (Pasmore, 1988). This component provides the formal work relationships, such as the organizational chart (for direction and reporting purposes), as well as the formal reward systems, such as promotion and compensation. Although these structures exist at the organization level, their effects are designed to affect workgroups and individuals. Seiler (1967) points out that organizational structure is quite susceptible to change because of the ease with which such structures can be manipulated. Following from

Pasmore's multi-ordered effect of technological change, the implementation of organization-level quality management is expected to modify the organizational structure. For instance, monthly reporting meetings will likely include formal communication of quality management progress and promotion decisions could likely be influenced by success with the new quality management approaches. These formal mechanisms promote the ideals of quality management at the workgroup level and make implementation of quality management at that lower level more likely. From the workgroup-level perspective, the organizational structure embodies much of the workgroup's environment. As such, the STS perspective would view the workgroup as adapting to its environment by adopting quality management practices.

Additionally, the quality management literature has pointed out the criticality of top management support for its success. Adoption of the quality management paradigm at first requires a leap-of-faith in the cause-effect relationships promoted by such a management technology. Workgroups may see quality management as risky or distracting unless backed up by top management commitment, patience, and resources. As such, the implementation of organization-level quality management likely sends a strong message to workgroups that the leadership is committed to seeing this technology implemented. Often new management practices are talked about more than done – hence leading to the labeling "management fad". Such a label could be indicative of managerial lack of support. However, if employees generally see that organization-wide change is occurring, they are more likely to agree that

implementation of quality management in their workgroup is both appropriate and worthwhile. In addition, the presence of organization-level quality management should indicate the existence of resources available to workgroups to conduct the training and implement the changes required to adopt quality management at the workgroup level. Therefore, the following hypothesis is given:

> Hypothesis 2: Organization-level quality management practices (Q^O) have a positive impact on workgroup-level quality management practices (Q^W).

3.2.3 Cooperative Values Encourage Workgroup-level Quality

As social values are used to judge not only one's actions but also the actions of others, it follows that an organization's cultural values are a key determinant for cultural norms of behavior (Rokeach, 1973; Seiler, 1967). Cultural norms act as rules that when followed are rewarded socially – that is, via group inclusion or social status. Workgroup technologies set guidelines for employee behavior, but may contradict organizational social norms. This contradiction discourages acceptance and likely encourages only surface implementation of technologies – that is, tokenism. Moreover, STS theory sees technology implementation as predominantly a leadership decision based upon environmental adaptation. From a meso-paradigm viewpoint, a workgroup's environment is predominantly internal to an organization (e.g., organizational climate). Such a multilevel understanding leads to the possibility that organizational social values and norms create environmental characteristics to which a workgroup's leadership must adapt. This process is similar to the

changes in the organizational environment discussed in section 3.2.2, albeit an informal rather than formal process. This cross-level influence then would encourage and discourage certain workgroup technologies to be implemented.

As cooperative-type cultural values are tightly coupled with quality management practices (Detert et al., 2000), the presence of such cooperative values should invoke norms of cooperation that encourage quality management to be practiced by workgroups. In addition, cooperative cultural values represent part of the mental model within an organization that aids in uncertainty reduction. When employees are required to act in ways that oppose their mental models, dissonance and therefore resistance may ensue. Such could be the case with workgroups being asked to cross-train in other functions as part of a quality initiative. A lack of cooperative values indicates a mental model discouraging of collaborative and supportive behaviors. A cooperative act like teaching other employees one's function is dissonant with a more individualistic mental model, and thus the cross-training could be resisted or implemented half-heartedly. Therefore based upon these sociotechnical influences the following hypothesis is given:

> Hypothesis 3: Organization-level cooperative cultural values (V^O) have a positive impact on workgroup-level quality management practices (Q^W).

3.2.4 Quality Management at the Organization Level Improves Workgroup Performance

The relationship between organization-level quality management – as in Juran's "big Q" – and STS design principles has been observed (Schein, 2004). For instance the STS principle of technological system compatibility with organizational long-term objectives (Cherns, 1987; Liu et al., 2006) follows closely the quality management principle of a shared vision and constancy of purpose (Deming, 1986; Anderson et al., 1994). In addition, the STS principle of departmental boundary reduction aligns well with the quality management principle of cross functionality. Research has shown that STS design principles are beneficial to organizations. Moreover, they likely influence the organizational structures that allow workgroups to attain higher performance by removing internal barriers viewed as counterproductive. STS designs avoid conflicting goals between workgroups, increase multi-functionality and reduce the duplication of effort (Pasmore, 1988). Research in quality management has also found evidence that organizational performance, and by extension workgroup performance, improve with the implementation of quality management principles (Choi et al., 1998). Therefore the following hypothesis is given:

> Hypothesis 4: Organization-level quality management practices (Q^O) will have a positive effect on workgroup performance (P^W).

3.2.5 Cooperative Cultural Values Help Workgroup Performance

STS theory contends that social systems in an organization influence leadership's choice of organizational structure (Seiler, 1967). As the presence of cooperative cultural values would be a significant part of an organization's social system, it would be expected that organizational structures congruent with cooperation would emerge. Cooperative-type organizational structures could be flatter organizations, more frequent team oriented actions, many channels for information sharing, and higher trust between departments. These types of organizational attributes have been found to improve effectiveness – such as organizational growth and quality (Denison et al., 1995), or individual satisfaction and task performance (Denison et al., 1995; Jackson, Colquitt, Wesson, and Zapata-Phelan, 2006). Moreover, the presence of these types of structures are congruent with many STS design principles –such as, higher information sharing, multi-functionality, employee involvement and autonomy (Cherns, 1987; Liu et al., 2006) – and therefore should be associated with workgroup performance. Therefore, the following hypothesis is given:

Hypothesis 5: Organization-level cooperative cultural values (V^O) will have a positive effect on workgroup performance (P^W).

3.2.6 Workgroup Performance is Improved by Workgroup-level Quality Management

One of the founding ideals of STS design is the autonomous workgroup (Pasmore, 1988; Trist et al., 1951). The prescription is to allow workgroups to

self-adjust to uncertainties from their environment. Removing role and procedural restrictions, it is argued, allows for a better fit between situation, response, and therefore performance. Furthermore, other STS design principles predominantly manifest at the workgroup level. Examples include timely access to information, workers being capable of performing a diverse range of jobs, and variance control at the point of origin. These principles closely follow Juran's "little Q" designation of multiple quality management practices, such as tools for process control, information for corrective action and employee involvement in root cause analyses. These "little Q" practices, such as statistical process control, have been found to have benefits not only for the organization but for employee job enrichment as well (Rungtusanatham, 2001). Since both quality management and STS principles have been associated with performance, the following hypothesis is given strictly at the workgroup level:

> Hypothesis 6: Workgroup-level quality management practices (Q^W) will have a positive effect on workgroup performance (P^W).

3.2.7 Diminishing Effects of Organization-level Quality Management

Cultural beliefs and values change as disconfirming evidence is repeatedly presented to an organization's employees (Schein, 2004). In the case of quality management influencing the emergence of cooperative values, disconfirming evidence would be the observation of successful cross-functionality where before cross-functionality was deemed hurtful or a waste of time. Initially such disconfirmations of non-cooperative mental models are explained away as

chance events or necessary inefficiencies. However if the effort to retain quality management practices holds over time, the mounting evidence for valuing cooperation wins over social arguments against cooperation. Increasing interdependence, norms of cooperative behavior and successful outcomes then create self-reinforcing feedback, thereby diffusing cooperative values throughout the organization.

An organization is replete with differing values (O'Reilly et al., 1991) that are incommensurable and at time competing (Quinn et al., 1983). Observing the singular cooperative cultural value does not take into consideration the other values that vie for prominence in an organization. As cooperative values grow in popularity, they should begin to compete with deep-seated assumptions about individual freedom and responsibility. This would especially be true for organizations within a strongly individualistic national culture, like organizations with predominant operations in the United States (Hofstede, 1998). The above diffusion pattern should therefore manifest in an initial strong relationship between organization-level quality management and cooperative cultural values. However, the relationship strength should diminish in later years of a quality management initiative.

A similar pattern of decreasing influence is expected between organization-level quality management and the other constructs of interest – that is, workgroup-level quality management and workgroup-level performance. The primary reason for this is the intermediary influence of organizational structure. Quality initiatives often lead off with top management communications and

organization-level changes. Subsequently, training begins and resources are dedicated to departmental and workgroup-level quality management practice implementation (Ahire et al., 2001). Following STS theory, formal changes are made to organizational structures based upon this new management technology. More organizational structures will come in line with quality management principles, and should result in increased workgroup-level performance. However, the number of elements of an organization's structures is limited. Seiler (1967), for instance, lists 14 dimensions ranging from span-of-control and levels-of-authority to compensation and skill-levels. As these dimensions are modified less potential structural changes can occur later in the organizational quality initiative. In addition, organization-level quality management can only change workgroup-level activities up to a certain extent. STS theory would acknowledge that quality management is one of many technologies within an organization (Pasmore, 1988). It therefore follows that other management technologies – such as new information systems and human resource practices – will interact with quality management in unforeseen ways. In addition, researchers have observed that sustained workgroup-level performance truly depends upon activities at the workgroup level (Jones et al., 1998; Naveh et al., 2004). Following these reasons, the hypothesis is given:

> Hypothesis 7: The effects of organization-level quality management practices (Q^O) on cooperative values (V^O), workgroup-level quality management practices (Q^W) and workgroup-level performance (P^W) decrease over the years of a quality initiative.

3.2.8 Diminishing Effects of Cooperative Values

Changes to organizational cultural values modify cultural norms (Schein, 2004), which in turn influence the organization's environment – both its structure and its culture (Seiler, 1967). As an organization embarks on a quality management initiative, structures and norms based upon older sociotechnical influences are modified based on the newer influences. For example, a norm of mono-functionality would yield to a norm of multi-functionality. However, after sustained effort is given to quality management implementation the number of organizational elements unaligned with quality management diminishes. This in turn reduces the impact that organizational cooperative values have at the workgroup level. Such a process is similar to the diminishing effect of organization-level quality management practices, albeit from an informal structure point of view. Therefore, cooperative cultural values should have the highest influence on workgroup-level quality management practice implementation in earlier years of a quality initiative. Because cooperative-type organizational structures should benefit workgroup-level performance, as less structures are available to change, then lower performance benefits should be gained because of cooperative cultural values. Because of these reasons, the following hypothesis is given:

Hypothesis 8: The effects of organization-level cooperative cultural values (V^O) on workgroup-level quality management practices (Q^W) and

workgroup-level performance (P^W) decrease over the years of a quality initiative.

3.2.9 Workgroup-Level Quality Management Improves With Time

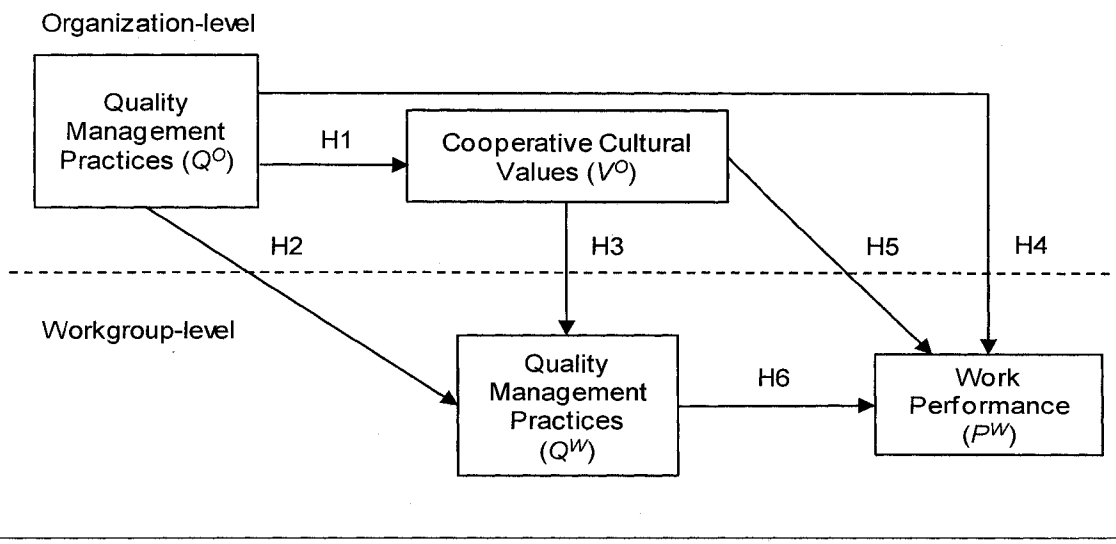
A delayed increase in effect is expected for workgroup-level quality management on workgroup-level performance. This reason for this is two-fold. First, workgroups are interdependent with other workgroups in the organization. This is a reality that both STS and quality management principles acknowledge and leverage. Inter-workgroup formal and informal structural inconsistencies can cause problems for the individual workgroup. For instance, if workgroup A is seeking cross-functional knowledge from workgroup B, but workgroup B has not adopted cooperative values, then the amount of help workgroup A will receive is likely to be less. In addition, if information sharing in workgroup B is being highly utilized, but not in workgroup A, the interdependence of the workgroups will make the information sharing process less helpful for workgroup B.

The second reason a delay in workgroup-level performance is expected follows from the same empirical observation made at the organization level. Quality management practices take time to reap benefits (Schroeder et al., 2005). This is because of learning curves as experienced with other technologies (Yelle, 1979). Additionally, root cause systemic corrections take time. For both theoretical and observational reasons, an increase in benefit of workgroup-level quality management is expected in the later years of implementation. Therefore the following hypothesis is given:

Hypothesis 9: The effect of workgroup-level quality management practices (Q^W) on workgroup-level performance (P^W) will increase over the years of a quality initiative.

In the next section, each of the hypotheses discussed are presented together in order to depict the full network of relationships being examined in this dissertation.

Figure 3-1: Expected Relationships Within a Single Time Period

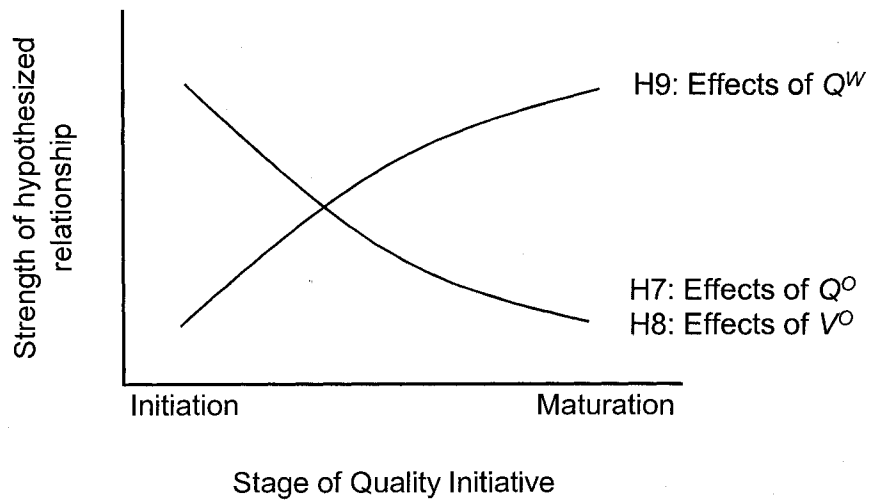


3.3 Research Models

To position each of the above hypothesized relationships, two research models are presented. Hypotheses 1 through 6 are shown in Figure 3-1, and hypotheses 7, 8, and 9 are shown in Figure 3-2. Figure 3-1 is depicted in a manner congruent with Snidjers and Bosker's (1999) method of presenting

multilevel models. The upper left shows an exogenous organization-level quality management, which is consistent with STS theory's perspective that technologies are chosen as adaptations to external environmental forces. This depiction is also consistent with the notion of an organization-wide quality management initiative. All other concepts are endogenous, with only cooperative cultural values being the other organization- level factor. Both organization-level quality practices and cooperative values then influence workgroup-level quality practices. The only fully dependent factor is workgroup-level performance shown in the lower right corner.

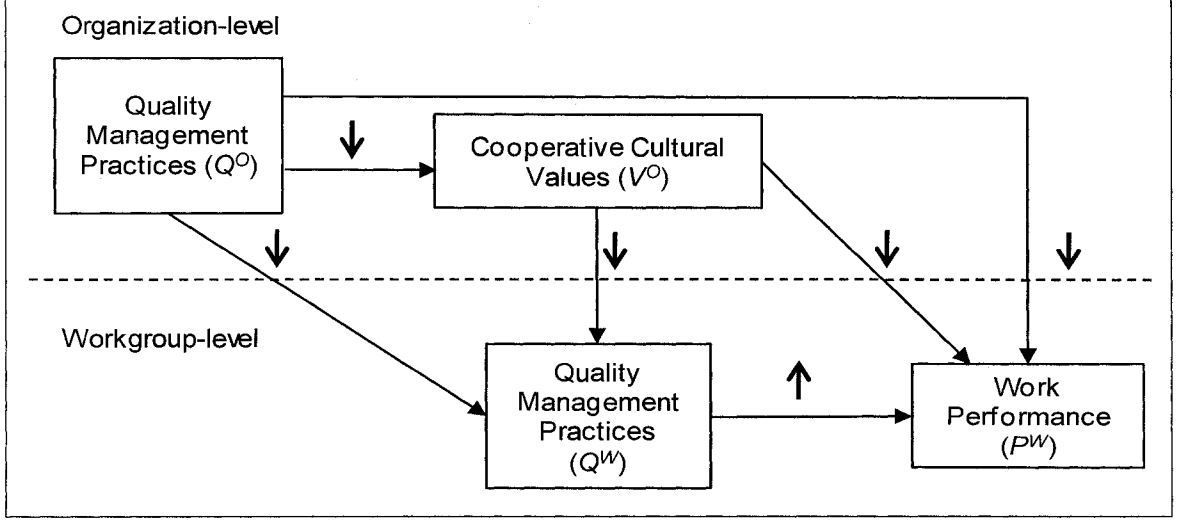
Figure 3-2: Qualitative Depiction of Expected Changes Over Time



The qualitative nature of each curve in Figure 3-2 represents hypotheses 7, 8, and 9. The expected changes over time for each relationship are shown in Figure 3-3. As Figure 3-2 shows, the effects of workgroup-level quality management practices increase from the beginning stages of a quality initiative to the maturation stages. The expected rise in effectiveness of workgroup-level

quality management practices is shown by the up arrow by the Q^{W}-*to*-P^{W} relationship shown in Figure 3-3. The shape of the other curve in Figure 3-2 represents qualitatively the expected decrease in strength of the V^{O} and Q^{O} effects. These decreasing effects are depicted in Figure 3-3 as down arrows for each of the relationships captured by hypothesis 7 and 8. Together, Figures 3-1 and 3-3 depict the overall research framework for this dissertation.

Figure 3-3 : Expected Direction of Change in Relationships Over Multiple Periods



3.4 Summary of Research Framework

Chapter 3 discussed the new perspectives possible if quality management is understood to be a technical component of the sociotechnical systems in an organization. These new perspectives give insight to the multilevel nature of quality management, and in so doing provide a plausible explanation for why cooperative cultural values are concomitant with quality management. Moreover,

STS theory provides explanations as to how workgroup performance gains emerge within the new network of relationships. Finally, the multi-ordered effects explained in STS describe what changes to the hypothesized relationship should be expected over time. To find support for this research framework, an empirical approach was used and is presented in the next chapter.

CHAPTER 4: RESEARCH METHODOLOGY

This chapter explains the methodological approach used in this dissertation. The data requirements and collection method are first presented, followed by the details of the archival data used in this study. Then, the measurement model based on dissertation objectives and data availability is discussed. Finally, the data analysis techniques used in this study are described and summarized in a flow chart.

4.1 Data Collection

This dissertation seeks empirical support for the hypothesized multilevel, time-varying relationships among quality practices, cooperative values and work performance. As such, the data set needs to meet three criteria. The first criterion is that these concepts need to be measured within the context of a quality management initiative, as this is a basic premise of the STS theory-based relationships that were hypothesized in Chapter 2. In addition, this is a practical motivation for this research – that is, explaining variation in the effectiveness of quality management programs. The second criterion is that multiple levels within organizations need to be sampled. This requirement follows from STS theory's multilevel description of social effects (Moray, 2000; Rasmussen, 2000; Seiler, 1967) and Juran's (1989) observations highlighting the importance of distinguishing "big Q" and "little Q" initiatives. The third criterion is the need for

longitudinal and specifically, multiyear data. This requirement is caused by prior research evidence showing that quality management effects do not manifest immediately and in fact may take several years to unfold (Mitra and Golder, 2007; Schroeder et al., 2005). Each of these requirements was considered in selecting the data source for this dissertation.

4.1.1 Data Collection Approach

There were two options to collect field data that meet the above requirements. The first option was to develop an original measurement instrument that would then be sent to multiple individuals in many organizations over multiple years. The sample would have to be carefully chosen to include only those organizations implementing quality management initiatives. This first option was discarded because of time and cost constraints. In addition, the nature of a dissertation places constraints upon the amount of time over which one can sample. Therefore, pursuing this option was deemed prohibitively "expensive." The second option was to resort to archival data from a publically available data source pertaining to quality management practice implementation in multiple organizations. Following this option required that the data adequately match the concepts of interest and be readily accessible. This is a common concern when using secondary data; it is generally resolved by ensuring that a proper theoretical "network" surrounds the concepts used (Houston, 2004). Three stages of validation are prescribed: 1) ensuring that a theoretical basis exists for the secondary measures; 2) assessing the ability of the measures to

serve as indicators; and 3) assessing if the measurements reflect how concepts are expected to relate nomologically (Houston, 2004). Although less control over measurement instrument design in the use of archival data may pose a threat to validity, with proper theoretical grounding this option would be a viable approach. Therefore it was decided to pursue this option for data collection.

Many channels were explored to discover an appropriate data source. Various online search engines were investigated, as well as financial reports from large corporations. Major employee surveys were identified, such as General Electric's workplace survey[1] but access to some of these data was unavailable. Another option was suggested by a recent special issue of the Journal of Operations Management, in which operations management issues were being explored in not-for-profit organizations (Verma, Youngdahlb, McLaughlinc, and Johnstond, 2006). This special issue set in motion a search for data on the well-known initiative by the federal government to implement quality management practices[2]. It was discovered that a survey was conduct by the United States Office of Personnel Management (O.P.M.) over three years across many agencies within the U.S. government. After further investigation into the content and context of the survey, it appeared this data source may be appropriate. The fact that this data had been validated by other research was also attractive (Chun and Rainey, 2005).

[1] see http://www.ge.com/en/citizenship/employees/employee.htm
[2] see http://govinfo.library.unt.edu/npr/index.htm

4.1.2 The National Partnership for Reinventing Government

The National Partnership for Reinventing (NPR) Government conducted a three-year employee survey from 1998 to 2000 as part of a government-wide initiative to improve operating practices by installing various quality management practices (O.P.M., 2002). The survey was intended to gather feedback for agencies so they could focus on employee satisfaction, increase the performance of government services, and better serve customers. A desire was also to assess the progress of organizational changes in agencies – especially in relation to efforts to reinvent internal operations. These efforts were a major initiative within the federal government to improve governmental operations through quality management practices. The initiative was spearheaded by then Vice President Al Gore, beginning in 1993 and continuing until 2001 (Kamensky, 1996; Qiao and Thai, 2002). Rather than use external consultants, an internal group of champions was selected from each major agency within the federal government to develop plans to implement quality management practices and to execute reinvention projects. Midway through the initiative, an interest arose regarding organizational climate and culture. This interest partly motivated the administration of the NPR survey.

The NPR survey was developed by a team of survey experts from the O.P.M., the Merit Systems Protection Board (MSPB), and the Federal Aviation Administration (FAA). The 32-item survey (shown in Table 4-1) was administered by the O.P.M. and was designed to assess employee opinions on workplace attitudes and the progress of reinvention through the implementation

of quality management practices in the federal agencies. About half of the items on the survey were taken from O.P.M.'s organizational assessment survey. Each year, the NPR survey instrument was reviewed by the O.P.M. to determine areas of improvement and as such minor modifications were made in wording and some items were removed or added.

The NPR survey instrument is divided into four sections. The first section (questions 1 – 21) consists of items measuring the degree to which certain organization and workgroup traits exist, such as organizational systems for customer feedback (question 2) and workgroup productivity (question 17). These were scaled one to five from "strongly disagree" to "strongly agree." The second section (questions 22-28) measured the extent to which specific practices could be characterized, such the extent to which hiring practices are "streamlined" (question 23). These were scaled one to five from "not at all" to "very great extent." The third section (questions 29-33) possessed items seeking the judgment of the respondent, such as job satisfaction (question 29) and workgroup quality (question 33). These were also scaled one to five, either on a "satisfaction" continuum or "goodness" continuum. The final section contained demographic and other items that were not made available to the public except for question 42, querying to which organization (agency) the respondent was employed.

Table 4-1: National Partnership for Reinventing Government Employee Survey, 1998		
#	Description	Measurement Scale
01	There are service goals aimed at meeting customer expectations	1 - strongly disagree 2 - disagree 3 - neither 4 - agree 5 - strongly agree
02	There are well-defined systems for linking customers feedback/complaints to employees who can act on the information	
03	Managers communicate the organizations mission, vision, and values	
04	My immediate supervisor has organized our work group effectively to get the work done	
05	At the place I work, my opinions seem to count	
06	A spirit of cooperation and teamwork exists in my immediate work unit	
07	Teams are used to accomplish organizational goals, when appropriate	
08	Employees are rewarded for working together in teams (for example, performance ratings, cash awards, certificates, public recognition)	
09	Employees in different work units participate in cross-functional teams to accomplish work objectives	
10	Recognition and rewards are based on merit	
11	Creativity and innovation are rewarded	
12	Employees receive training and guidance in providing high-quality customer service	
13	Employees receive the training they need to perform their jobs (for example, on-the-job training, conferences, workshops)	
14	Differences among individuals (for example, gender, race, national origin, religion, age, cultural background, disability) are respected and valued	
15	Supervisors/team leaders understand and support employees family/personal life responsibilities	
16	My organization has made reinvention a priority (for example, working smarter and more efficiently)	
17	In the past 2 years, the productivity of my work unit has improved	
18	In the past 2 years, I have been given more flexibility in how I accomplish my work	
19	Employees are required to report the hours they work on a daily basis	
20	Corrective actions are taken when employees do not meet performance standards	
21	Management and the union(s) work cooperatively on mutual problems	

Table 4-1: National Partnership for Reinventing Government Employee Survey, 1998 (continued)		
22	Has your organization implemented simplified travel regulations?	1 - not at all 2 - limited extent 3 - moderate extent 4 - great extent 5 - very great extent
23	Has your organization streamlined the process for hiring employees?	
24	Has the use of government credit cards for small office purchases been implemented in your org?	
25	Are you clear about how good performance is defined in your organization?	
26	Do you have electronic access to information needed to do your job?	
27	Is your org working with its regulated community to achieve better compliance through partnerships?	
28	Is your org working to streamline its regulatory program to make it more readable and customer-focused?	
29	Considering everything, how satisfied are you with your job?	1 - very dissatisfied 2 - dissatisfied 3 - neither 4 - satisfied 5 - very satisfied
30	How satisfied are you with your involvement in decisions that affect your work?	
31	How satisfied are you with the recognition you receive for doing a good job?	
32	Overall, how good a job do you feel is being done by your immediate supervisor/team leader?	1 - very poor 2 - poor 3 - fair 4 - good 5 - very good
33	How would you rate the overall quality of work being done in your work group?	
42	Organization code	Various codes

4.1.3 Sampling

Between 1998 and 2000 the U.S. government averaged civilian employment of more than 2.7 million employees within the legislative, judicial, and executive branches. Of these, the executive branch comprised more than 95% of the employees. The NPR survey was administered to about 30% of the executive agencies at the time of the survey. Table 4-2 presents the list of agencies sampled in 1998, among which included 12 incidences of "other" agencies. Section 4.3 describes for how these "other" codes were accounted.

A key factor in selecting the agencies to participate in the NPR survey was the extent to which their services impacted service to the public. Thirty-two federal agencies had 90 percent of the federal government's contact with the public. The performance of these high-impact agencies was seen as central to restoring America's trust in government. Therefore, in 1998 and 1999, 31 of the high-impact agencies, as well as 17 other agencies, participated in the NPR survey. In 2000, all high-impact agencies, as well as 17 other agencies, participated. Individual employees were randomly selected and invited to participate in the survey. Employees received the survey at either their homes or their offices, but responses were returned by mail to the address of a consultant (O.P.M., 2002).

Table 4-2: Federal Agencies Participating in NPR Survey

Code	Description	Code	Description
100	Dept of Air Force	213	All *other* Interior
110	Dept of Army	221	Immigration and Natural. Serv
120	Dept of Navy	222	All *other* Justice
131	Defense Logistics Agency	231	Occup. Safety & Health Admin
132	All *other* Defense	232	All *other* Labor
141	Forest Service	241	Bureau of Consular Affairs
142	Food Safety/Inspection Service	242	All *other* State
143	Animal/Plant Health Insp Serv	251	Federal Aviation Admin
144	Food & Consumer Services	252	All *other* Transportation
145	All *other* Agriculture	261	Internal Revenue Service
161	Nat Oceanic & Atmospheric Admin	262	US Customs Service
162	Patent & Trademark Office	263	Financial Management Service
163	Bureau of the Census	264	All *other* Treasury
164	Internat Trade Administration	271	Veterans Health Admin
165	All *other* Commerce	272	Veterans Benefits Admin
171	Off of Post-Secondary Educ	273	All *other* Dept of VA
172	All *other* Education	290	Environmental Protection Agency
180	Dept of Energy	300	Equal Employ. Oppor. Commission
191	Food & Drug Admin	310	Federal Emergency Management Agency
192	Health Care Financing Admin	320	General Service Admin
193	Admin for Children & Families	330	Nat Aeronautics & Space Admin
194	All *other* HHS	340	Small Business Admin
200	Dept of Housing & Urban Dev	350	Social Security Admin

Table 4-2: Federal Agencies Participating in NPR Survey (continued)			
211	National Park Service	360	US Office of Personnel Mgmt
212	Bureau of Land Management	999	Unspecified Agency

The 1998 NPR Employee Survey was administered to 34,401 employees representing 48 government agencies and resulted in a 40% response rate, which was based on the return of 13,657 completed surveys (O.P.M., 2002). In September 1999, the NPR Employee Survey was administered to 32,265 employees in the same government organizations, of which 12,755 surveys were returned for a 40% response rate. The 2000 NPR Employee Survey was administered to 50,844 employees, with an overall response rate of 42% based on receiving 21,157 completed surveys. These response rates are higher than the typical response rate reported in current operations management literature (Frohlich, 2002).

4.1.4 Assessment of NPR Survey

A review of the NPR survey instrument was conducted for this dissertation to ascertain its applicability. The first requirement was for the measures to adequately reflect the concepts of interest. That is, would the responses to the survey items indicate the use of quality management practices, cooperative values and work performance? Using extant literature as a guide, it was determined that the NPR survey would adequately serve this purpose (the next section will make this explicit). The second requirement was for the data to possess a multilevel nature. That is, not only should the items be related to multiple levels of an organization, but also multiple responses had to be nested

within each organizational unit. The NPR survey satisfies this requirement as well. Finally, an appropriate sample size over multiple years is needed to pursue the objective of this research and to test the hypotheses relating to time; the NPR survey satisfies this requirement. Therefore, after extensive review, the NPR survey was deemed appropriate for use in the research study and measurement model development.

The data were made publicly available in 2002 through the Inter-university Consortium for Political and Social Research (ICPSR) – a part of the Institute for Social Research (ISR) of the University of Michigan[3]. ICPSR maintains and provides member institutions access to an archive of social science data for research and instruction. Michigan State University is a member of the ICPSR Direct program. This program allows access to ICPSR's data holdings for all member institution students, faculty, and staff; and the data can be directly downloaded from the ICPSR website. In order to comply with human-subjects research issues that concern the many Institutional Review Boards (IRBs) of universities, data acquired by ICPSR undergoes confidentiality reviews to discover information to identify respondents. If information is found, it is altered after consultation with the principal investigator to create files that limit the risk of disclosure. In the case of the NPR data files, no respondent information was made available except for a unique identifier and an organizational code with which the respondent was associated. Communications with the ICPSR revealed that no issues exist with use of this data for the purposes of this

[3] See http://www.icpsr.umich.edu/index.html

dissertation. The above assessment established the promising nature of this data set. As such, a measurement model was developed and is presented next.

4.2 Measurement Model

This section describes in detail the background to and the justification for the initial selection of construct measurement items.

4.2.1 Background to Model Development

An initial set of items to construct relationships was needed in order to begin the process of measurement model development. In order to do this, first the various concepts of relevance needed to be identified from literature. Using the frameworks of Anderson et al. (1994) and Detert et al. (2000), the items corresponding to quality management and cooperative values were identified. The items for work performance were identified based on service operations literature (Douglas et al., 2004; Parasuraman, Zeithaml, and Berry, 1988; Schmenner, 2004). The second task was to make the multilevel differentiation between the organization and workgroup levels. This was accomplished similar to the approach of Meade and Eby (2007). Use of the terms "organization, employees, or workplace" designated the item as reflective of an organization-level construct. Use of the terms "you, your work unit, or your supervisor" designated an item as reflective of workgroup-level phenomena. Items without such explicit designations were assessed for their implicit levels. Based on this

approach, the initial measurement model was created as shown in Table 4-3. A discussion of each concept follows.

Table 4-3: Initial Construct Measures

NPR Questions	Quality practice for which measure is reflective
Quality Management: Organization level (Q^O)	
1. There are service goals aimed at meeting customer expectations.	Customer Service (Anderson et al., 1994; Cronin et al., 1992)
2. There are well-defined systems for linking customers' feedback and complaints to employees who can act on the information.	Customer Service (Anderson et al., 1994; Cronin et al., 1992; Zhao et al., 2004)
3. Managers communicate the organization's mission, vision, and values.	Visionary leadership (Douglas et al., 2004; Zhao et al., 2004)
7. Teams are used to accomplish organizational goals, when appropriate.	Support internal cooperation (Anderson et al., 1994)
8. Employees are rewarded for working together in teams (for example, performance ratings, cash awards, certificates, public recognition).	Human Resource Focus (Zhao et al., 2004)
9. Employees in different work units participate in cross-functional teams to accomplish work objectives.	Support internal cooperation (Anderson et al., 1994)
12. Employees receive training and guidance in providing high-quality customer service	Focus on Human Resources (Zhao *et al.*, 2004) Training (Douglas *et al.*, 2004; Zhao *et al.*, 2004)
13. Employees receive the training they need to perform their jobs (for example, on-the- job training, conferences, workshops).	Focus on Human Resources (Zhao *et al.*, 2004) Training (Douglas *et al.*, 2004; Zhao *et al.*, 2004)
20. Corrective actions are taken when employees do not meet performance standards.	Continuous improvement (Deming, 1986; (Douglas *et al.*, 2004)
Quality Management: Workgroup-level (Q^W)	
10. Recognition and rewards are based on merit.	Human Resource Focus (Zhao et al., 2004)

Table 4-3: Initial Construct Measures (continued)	
11. Creativity and innovation are rewarded.	Continuous improvement (Deming, 1986; Douglas et al., 2004; Amabile, 1996)
18. In the past two years, I have been given more flexibility in how I accomplish my work.	Empowerment (Anderson *et al.*, 1994)
26. Do you have electronic access to information needed to do your job?	Process Management (Anderson *et al.*, 1994), Information (Zhao *et al.*, 2004), Manage by Fact (Douglas *et al.*, 2004)
29. Considering everything, how satisfied are you with your job?	Understanding motivation & employee fulfillment (Anderson et al., 1994)
30. How satisfied are you with your involvement in decisions that affect your work?	Employee empowerment (Anderson *et al.*, 1994), Elimination of fear (Deming, 1986)
31. How satisfied are you with the recognition you receive for doing a good job?	Understanding motivation & employee fulfillment (Anderson *et al.*, 1994)
Cooperative Values: Organization level (V^O)	
5. At the place I work, my opinions seem to count.	Employee involvement in decision making (Detert et al., 2000)
14. Differences among individuals (for example, gender, race, national origin, religion, age, cultural background, disability) are respected and valued.	Willingness to work together (Wagner, 1995), Collaboration (Detert et al., 2000)
15. Supervisors/team leaders understand and support employees' family/personal life responsibilities.	Concern for others (Chatman et al., 1995), Achieving results that stakeholders consider important (Detert et al., 2000)
16. My organization has made reinvention a priority (for example, working smarter and more efficiently).	Shared vision is necessary, Improvement is valued (Detert et al., 2000)
21. Management and the union(s) work cooperatively on mutual problems. ("If you don't know leave this item blank" was added in 1999.)	Cooperation helps everyone (Chatman et al., 1995), Cooperation and collaboration (Detert et al., 2000)
25. Are you clear about how "good performance" is defined in your organization?	Shared vision is necessary (Detert et al., 2000)

Table 4-3: Initial Construct Measures (continued)	
Work Performance: Workgroup-level (P^W)	
4. My immediate supervisor has organized our work group effectively to get the work done.	Effectiveness of teamwork (Douglas et al., 2004)
17. In the past 2 years, the productivity of my work unit has improved.	Work flow (Schmenner, 2004)
32. Overall, how good a job do you feel is being done by your immediate supervisor/team leader?	Effectiveness of teamwork (Douglas et al., 2004)
33. How would you rate the overall quality of work being done in your work group?	Service quality (Parasuraman et al., 1988)

4.2.2 Organization-level Quality Practices (Q^O)

As shown in Table 4-3, organization-level quality management practices were associated with nine items. These nine items were related to five quality management practices: customer service, visionary leadership, supportive of internal cooperation, continuous improvement, and a focus on human resources (Anderson et al., 1994; Zhao et al., 2004). Items 1 and 2 relate to customer service goals and feedback, which are indicative of a *customer-service focus* (Anderson et al., 1994) and implicitly exist at the organization level. Item 3 reflects Anderson et al.'s (1994) *visionary leadership* category, while items 8, 12 and 13 reflect Zhao et al.'s (2004) *focus on human resources* – rewarding or developing employees. Anderson et al.'s (1994) category of quality management practices that support internal collaboration / cooperation are shown in items 7 and 9 related to the use of teams and cross-functionality. Finally, the item 20 relating to corrective actions is expected to indicate the presence of *continuous*

improvement practices (Anderson et al., 1994). Many of these items refer to *employees* and are deemed to relate to organization-level initiatives.

4.2.3 Workgroup-level Quality Practices (Q^W)

Seven items were identified as likely measures for workgroup-level quality practices. These items were deemed to relate to workgroup-level initiatives because they explicitly ask about the respondent's immediate environment (e.g., flexibility in their work, their involvement in decisions) or ask about initiatives implicitly local within the organization [e.g., creative or meritorious work (Amabile, 1996; Brown, 2001; Drazin, Glynn, and Kazanjian, 1999)]. Specifically, item 10 measures the presence of a *human resource focus* (Zhao et al., 2004), while item 11 assesses *continuous improvement* (Anderson et al., 1994) because of its emphasis on innovation. Items 18 and 30 ascertain the level of *employee empowerment* (Anderson et al., 1994) by asking respondents about flexibility and involvement, respectively. The question as to whether employees have electronic access to information in item 26 is reflective of *process management* (Anderson et al., 1994) and emphasizing *information* (Zhao et al., 2004). Finally, item 29 is concerned with satisfaction while item 31 relates to recognition; both are indicative of the workgroup's *understanding of motivation* and *employee fulfillment* (Anderson et al., 1994). Together these items were expected to reflect workgroup-level quality practices.

4.2.4 Organization-level Cooperative Values (V^O)

Organizational cultural values are an aspect of organizational culture and are understood to exist at the organization level (Schein, 2004). Many of the values described by Detert et al. (2000) associated with quality practices can be described as reflective of a cooperative environment and perceptual measures reflecting those values were identified from the NPR survey. For instance with respect to item 5, if many respondents agree that their "opinions seem to count," this could be construed to reflect an organization that values *employee involvement in decision making* (Detert et al., 2000). Item 14 asks if "differences are respected," which captures a *willingness to work together* (Wagner, 1995) and valuing *collaboration* (Detert et al., 2000). Item 15, which asks a question regarding the support for employee personal issues, could be indicative of a *concern for others* (Chatman et al., 1995), especially when employees are considered *stakeholders* (Detert et al., 2000). When employees recognize that their organization has made "reinvention a priority" (item 16) and are clear as to what is "good" performance (item 25), these reflect valuing a *shared vision* of *improvement* (Detert et al., 2000). Finally, an organization that believes *cooperation helps everyone* (Chatman et al., 1995; Detert et al., 2000) would be indicated by a high degree of mutual problem solving between management and an employee union (item 21). These six measures are expected to collectively indicate the presence of cooperative cultural values in an organization.

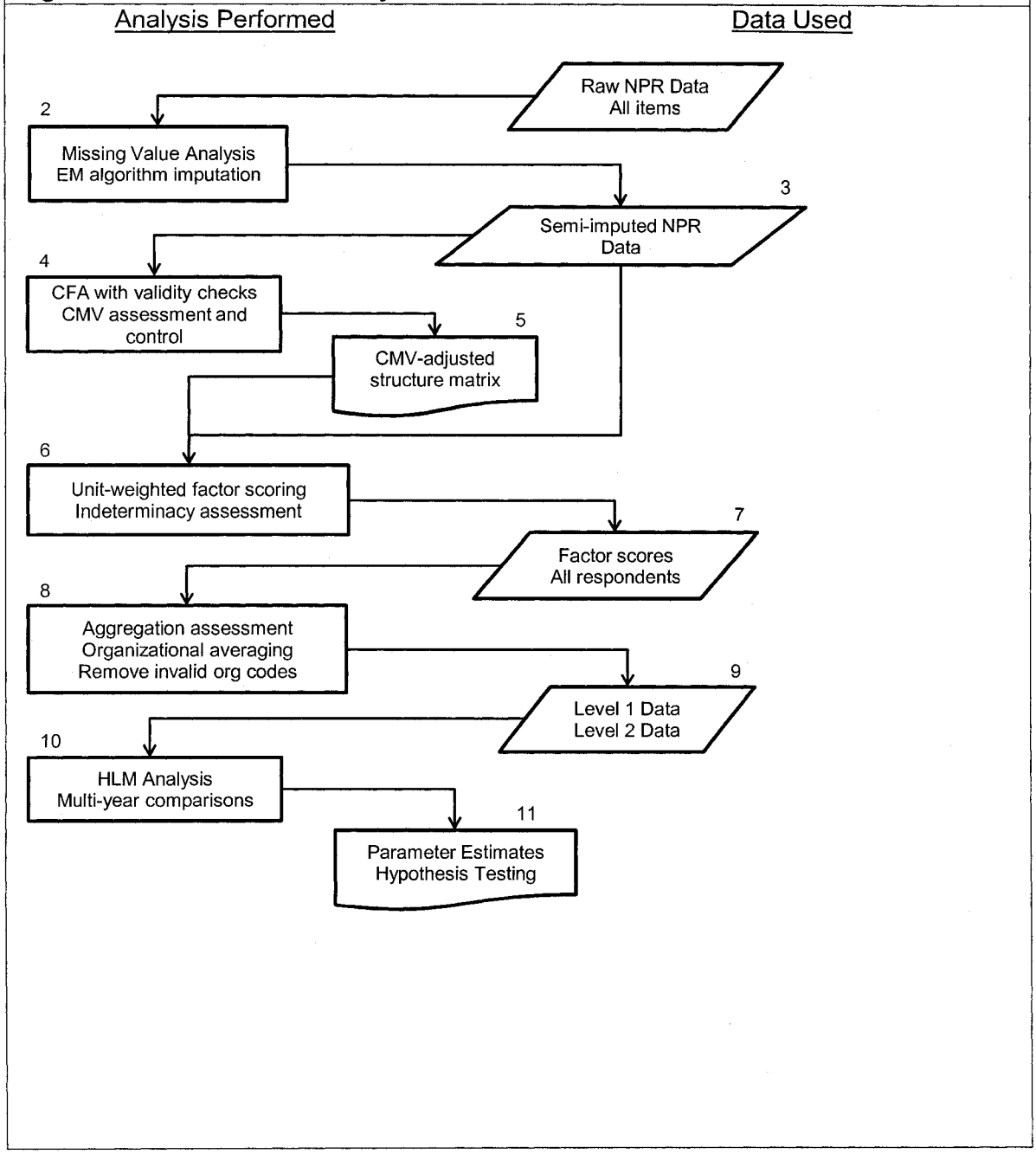
4.2.5 Workgroup-level Work Performance (P^W)

Performance is often measured in terms of efficiency and effectiveness (Douglas et al., 2004; Miron et al., 2004; Schmenner, 2004) and three of the four work performance items seek to measure efficiency and effectiveness. Specifically, items 4 and 32 measure the degree of effective workgroup organization and management similar to Douglas et al.'s (2004) idea of *effectiveness of teamwork* in a service setting. Work unit productivity is measured in item 17, which parallels Schmenner's (2004) *work flow* performance concept. The fourth performance item (item 33) is a perceptual measure of the quality of work being done. In a service setting, this can be equated to *service quality* (Parasuraman et al., 1988). It should be noted that each item relates to either the respondent's immediate supervisor or the workgroup. As such, each of these four perceptual measures is reflective of performance at the workgroup level. While this section discussed the conceptual validity of the measurement items, the next section presents the data analysis method used in this research.

4.3 Data Analysis Method

The data analysis approach used in this dissertation is presented in Figure 4-1. The data analysis avoided unnecessary aggregation, averaging or dichotomizing of the data. In addition, efforts were made to avoid eliminating data to maximize the use of the available information. Although the number of respondents in the data set is quite large, a relatively small number of

Figure 4-1: Flow Chart of Analysis Method



organizations exist within the sample. The organizations coded as *other* were problematic because multiple organizations could be present within each *other* category. Therefore, responses with *other* designation were utilized for data analysis until a specific organization assignment was required (i.e., item 8 in

Figure 4-1). In addition, respondents with missing items were retained. The expectation-maximization (EM) algorithm available in SPSS 15.0 was used for dealing with missing values (Dempster, Laird, and Rubin, 1977). Although some issues have been raised with earlier SPSS versions of missing value analysis (von Hippel, 2004), all respondents and all items were utilized for imputing the missing values in order to increase imputation effectiveness (Acock, 2005).

4.3.1 Factor analysis

To refine the initial measurement model, a confirmatory factor analysis (CFA) was conducted at the respondent level on the 1998 data. After modifications, the resultant measurement model was then validated using the 1999 data. An important goal of the CFA process was to end with at least three if not four items per construct, provided that the model attained acceptable fit indices (Anderson and Gerbing, 1988; Bentler, 1995). The measurement model was modified iteratively using the Lagrange Multiplier (LM) test for item deletion, while retaining the proper theoretical content in the model. Once a preliminary acceptable model was identified, a series of composite reliability and discriminant validity tests were conducted (Fornell and Larcker, 1981; Venkatraman, 1989). Any issues identified during these tests were resolved through further model modifications. Following these validity checks, an assessment was made for common method variance (CMV), which is likely to occur with perceptual measures with social desirability (Malhotra, Kim, and Patil, 2006; Podsakoff, MacKenzie, Lee, and Podsakoff, 2003; Song and Zahedi, 2005). Based upon

the constructs of interest, an intermixing of construct items was observed in the NPR survey instrument, which aids in CMV control (Podsakoff et al., 2003). However, a significant presence of CMV would further be controllable via the correlated uniqueness approach within the CFA. As shown in Figure 4-1, at the end of this series of tests, a valid measurement model was developed.

4.3.2 Data aggregation

The multilevel analysis method used in this dissertation is termed hierarchical linear modeling (HLM). In order to prepare the data for the HLM analysis, some degree of aggregation was necessary. That is, in the context of this dissertation, HLM was not to be used for covariance analysis like structural equations modeling (SEM). Instead, estimated values for each concept (i.e., factor values) were required for each respondent. For example, a single value for workgroup-level performance (P^W) was required for the each respondent. These values were then used as workgroup responses within each organization. When needed, the values within each organization were aggregated via an average. For example, the workgroup response values for organization-level quality management practices (Q^O) within each organization were averaged. Before aggregating, interclass correlation (ICC) values and within group correlations (r_{wg}) values were assessed (de Jong, de Ruyter, and Wetzels, 2005).

One approach to estimating factor values for each respondent is to sum or average the item values. Although this approach is common, it not only ignores CFA information (i.e., factor loadings), it also removes the CMV controls present

within the CFA. Another approach would be to use factor scores; however, many methods assume factors to be orthogonal (Gorsuch, 1983), which in the nomological context of this dissertation is incorrect. Therefore a unit-weighting approach was chosen, which is recommended by Grice (2001) for computing factors assumed to be non-orthogonal – i.e., oblique. This method utilizes the structure matrix computed from the CFA, which in this case is CMV controlled, as will be demonstrated in Chapter 5. Under the unit-weighting procedure, individual items estimated to correlate over a certain threshold with any factor are used to compute that factor score. A unit-weight is used, not the structure matrix value, but the sign of the correlation is preserved. In this approach, one item may positively and/or negatively affect multiple factors. The resultant set of values (i.e., -1, 0 or 1) resides in a weight matrix that can be used in subsequent data sets. Grice (2001) found this approach to reproduce factor correlations favorably and to be stable over multiple periods. The unit-weight factor scoring approach was chosen for this reason. Finally, a concern with factor scores is the issue of indeterminacy (Wilson, 1928). Therefore, the approach for indeterminacy evaluation provided by Gorsuch (1983) was utilized.

4.3.3 Hierarchical Linear Modeling

Two sets of data were generated for each year. The first set of data, termed level-1, contained the responses for workgroup *i* within organization *j* for each factor (i.e., Q^{O}_{ij}, V^{O}_{ij}, Q^{W}_{ij}, and P^{W}_{ij}). The second data set was termed level-2 and it contained the aggregated (i.e., averaged) values for the theory-based

organization-level factors (i.e., $Q^{O}_{.j}$ and $V^{O}_{.j}$). As was stated, multilevel modeling is necessary for testing the hypotheses and the postulated relationships among these variables (constructs). However, multilevel modeling has difficulties with endogenous relationships like those shown in Figure 3-1 because of the resultant correlated effects (Kim and Frees, 2006). Unlike SEM and other simultaneous equation methods, HLM requires that one dependent variable to be specified (Snijders et al., 1999). One approach to accommodate mediating factors is the use of instrumental variables (Kim et al., 2006). Another approach has been to test models with mediation in multiple stages (de Jong et al., 2005; Naveh et al., 2004). Because of the ability to isolate specific relationships for examination, the multi-stage approach was chosen for this dissertation. This approach will test multiple models in a sequential manner as shown in Table 4-4. The first analysis will test the relationship between Q^{O} and V^{O} (Model 1) to draw conclusions with respect to hypothesis 1. The second analysis will test the relationships among Q^{O}, V^{O} and Q^{W} (Model 2) to make conclusions regarding hypotheses 2 and 3. Lastly, the relationships among Q^{O}, V^{O}, Q^{W} and P^{W} (Model 3) will be analyzed to make conclusions regarding hypotheses 4, 5, and 6.

Table 4-4: Hypothesis Testing Framework

	Dependent Factor		
	Model 1	Model 2	Model 3
Independent Factor	V^{O}	Q^{W}	P^{W}
Q^{O}	H1 (γ_1^V)	H2 (γ_1^Q)	H4 (γ_{01}^P)
V^{O}		H3 (γ_2^Q)	H5 (γ_{02}^P)
Q^{W}			H6 (γ_{10}^P)

4.3.3.1 Model 1 Formulation

The first stage of HLM analysis tests the hypothesized relationship between Q^O and V^O through a type of random-intercept model known as means-as-outcomes model (Raudenbush and Bryk, 2002).

Level 1: $V_{ij}^O = \beta_{0j}^V + r_{ij}^V$ (1)

Level 2: $\beta_{0j}^V = \gamma_0^V + \gamma_1^V (Q_j^O - \overline{Q}_{..}^O) + u_j^V$ (2)

Where,

V_{ij}^O = Cooperative cultural values in organization *j* measured by workgroup *i*

β_{0j}^V = Parameter estimate of aggregate of *V* in organization *j*

r_{ij}^V = Variation of *V* for workgroup *i* in organization *j*, assuming $r_{ij}^V \sim N(0, \sigma^2)$

γ_0^V = Parameter estimate of overall aggregate of *V*

γ_1^V = Parameter estimate of effect of Q_j^O on aggregate of *V* in organization *j*

Q_j^O = Organizational quality management practices in organization *j* = $\sum Q_{ij}^O / n_j$

$\overline{Q}_{..}^O$ = Grand mean of Q^O for all organizations

u_j^V = Organization *j* unique variation, assuming $u_j^V \sim N(0, \tau_{00})$

In this two-level model, the variance of level-1 dependent variable shown in (1) is explained by two parameters: the random intercept β_{0j}^V that varies by organization and error r_{ij}^V that varies by workgroup. The intercept is interpreted as

the organizational mean V^O. This intercept is the level-2 dependent coefficient in (2) and is explained by a grand V^O mean γ_0^V, a grand centered mean organization value of Q^O, and a random effect associated with each organization u_j^V. The organization-level predictor Q^O is grand-mean centered to enable interpretation of γ_0^V to be the grand mean of V^O (Raudenbush et al., 2002). An assumption is that Q^O influences the workgroup-level response through the organization-level mean of V^O. Thus, HLM will fit this system of nested models and test for the significance of γ_1^V thereby providing a test of hypothesis 1 that posits Q^O to positively influence V^O.

4.3.3.2 Model 2 Formulation

The second stage of HLM analysis will test the hypothesized relationship between Q^O, V^O and Q^W also through a means-as-outcomes model.

Level 1: $Q_{ij}^W = \beta_{0j}^Q + r_{ij}^Q$ (3)

Level 2: $\beta_{0j}^Q = \gamma_0^Q + \gamma_1^Q(Q_j^O - \overline{Q}_{..}^O) + \gamma_2^Q(V_j^O - \overline{V}_{..}^O) + u_j^Q$ (4)

Where,

Q_{ij}^W = Quality management implemented by workgroup *i* in organization *j*

β_{0j}^Q = Parameter estimate of aggregate of Q^W in organization *j*

r_{ij}^Q = Variation of Q^W for workgroup *i* in organization *j*, assuming $r_{ij}^Q \sim N(0,\sigma^2)$

V_j = Cooperative cultural values in organization *j* = $\sum V_{ij} / n_j$

$\overline{V}_{..}^{O}$ = Grand mean of V^O for all organizations

γ_0^Q = Parameter estimate of overall aggregate of Q^W

γ_1^Q = Parameter estimate of organizational Q_j^O effect on Q^W in organization *j*

γ_2^Q = Parameter estimate of organizational V_j effect on Q^I in organization *j*

u_j^Q = Organization *j* unique variation, assuming $u_j^Q \sim N(0, \tau_{00})$

The variance of level-1 dependent variable Q^W shown in (3) is explained by two parameters: the random intercept β_{0j}^Q that varies by organization and error r_{ij}^Q that varies by workgroup. The intercept is interpreted as the organizational mean Q^W. This intercept is the level-2 dependent variable shown in (4) and is predicted by an estimated grand Q^W mean γ_0^Q, two grand-mean centered organization values Q^O and V^O, and a random effect associated with each organization u_j^Q. The organization-level predictors are grand-mean centered to enable interpretation of γ_0^Q to be the grand mean of Q^W. A special note is that V^O is the average cooperative value factor score within organization *j*. Thus, HLM will fit this system of nested models and test for the significance of γ_1^Q and γ_2^Q thereby providing a test of hypotheses 2 and 3 that posit Q^O and V^O positively influence Q^W.

4.3.3.3 Model 3 Formulation

The third stage of HLM analysis will test the hypothesized relationships between Q^O, V^O, Q^W and P^W through a random-intercept with level-1 covariate model (Raudenbush et al., 2002).

Level 1: $P_{ij}^W = \beta_{0j}^P + \beta_1^P(Q_{ij}^W - \overline{Q}_j^W) + r_{ij}^P$ (5)

Level 2: $\beta_{0j}^P = \gamma_{00}^P + \gamma_{01}^P(Q_j^O - \overline{Q}_{..}^O) + \gamma_{02}^P(V_j^O - \overline{V}_{..}^O) + u_{0j}^P$ (6)

Level 2: $\beta_1^P = \gamma_{10}^P + u_1^P$ (7)

Where,

P_{ij}^W = Workgroup-level work performance for workgroup *i* in organization *j*

β_{0j}^P = Parameter estimate of average P^W in organization *j*

β_{1j}^P = Parameter estimate of workgroup Q_{ij}^W effect on P^W in organization *j*

$\overline{Q}_j^W$ = Mean of Q^W for organization *j*

r_{ij}^P = Variation of P^W for workgroup *i* in organization *j*, assuming $r_{ij}^P \sim N(0,\sigma^2)$

γ_{00}^P = Parameter estimate of overall average of P^W

γ_{01}^P = Parameter estimate of organizational Q_j^O effect on P^W in organization *j*

γ_{02}^P = Parameter estimate of organizational V_j effect on P^W in organization *j*

γ_{10}^P = Parameter estimate of overall effect of Q^W on P^W

u_{0j}^P = Organization *j* unique variation in aggregate of P^W, assuming $u_{0j}^P \sim N(0,\tau_{00})$

u_{1j}^P = Error in estimated effect of P^W, assuming $u_{1j}^P \sim N(0,0)$

The variance of level-1 dependent variable P^W shown in (5) is explained by an intercept β_{0j}^P that varies by organization, a workgroup-level group-centered Q^W, and error r_{ij}^P that varies by workgroup. The intercept is interpreted as the organizational mean P^W.

In model 3, two level-2 equations exist. In the first, the level-1 intercept is the level-2 dependent variable shown in (6) and is predicted by an estimated grand P^W mean γ_{00}^P, two grand-mean centered organization values Q^O and V^O, and a random effect associated with each organization u_{0j}^P. The organization-level predictors are grand-mean centered to enable interpretation of γ_{00}^P to be the grand mean of P^W. In the second level-2 equation (7) the slope β_1^P representing the workgroup-level effect of Q^W is the dependent variable. This slope is assumed non-randomly varying for statistical efficiency and computational stability (Raudenbush et al., 2002). Thus, it is predicted solely by a grand effect γ_{10}^P with no error (i.e., u_1^P is assumed to have a mean and variance of zero, it is retained in the model for post-hoc analysis). Thus, HLM will fit this system of nested models and test for the significance of γ_{01}^P, γ_{02}^P, and γ_{10}^P thereby providing a test of hypotheses 4, 5, and 6 that posit Q^O, V^O and Q^W positively influence P^W respectively.

4.3.4 Estimation Procedure

To estimate level-2 parameters, HLM uses a Generalized Least Squares (GLS) estimation procedure. This provides a weighted level-2 regression such that the groups with more precise level-1 estimates of the dependent variable receive more weight in the level-2 regression equation (Hofmann, 1997; Snijders et al., 1999). For each individual, two predicted intercept and slope values can be estimated: one from the level-1 model, and the other from the level-2 model. To combine both estimates, HLM computes an empirical Bayes estimate of the level-I intercepts and slopes for each individual that optimally weights the Ordinary Least Squares (OLS) level-I estimates and the level-2 predicted values for these same estimates. These empirical Bayes estimates are contained in the residual file generated by the HLM software. Hypothesis testing will be conducted using the point estimates and significance levels for the parameters corresponding to the relationships hypothesized above. See Table 4-4 for the explicit hypothesis-parameter correspondence. The next section discusses the approach for testing the three diffusion hypotheses.

4.4 Testing Diffusion Hypotheses

In order to test the diffusion hypotheses 7, 8, and 9; year-over-year comparisons were made for each of the parameters shown in Table 4-4. The expected parameter changes suggested by the diffusion hypotheses are shown in Table 4-5. Hypothesis 7 consists of three relationships that are represented by parameters γ_1^V, γ_1^Q and γ_{01}^P. A significant decrease in strength is expected for each

from 1998 to 1999 and from 1999 to 2000. Hypothesis 8 consists of two relationships represented by parameters γ_2^Q and γ_{02}^P. A significant year-over-year decrease in strength is also expected for these two parameters. Hypothesis 9 consists of one relationship represented by parameter γ_{10}^P, of which a significant increase in strength from year to year is expected. An equality of coefficients t-test utilizing parameter and standard error estimates was used to detect changes from year-to-year. The test results were compared to the hypothesized changes and conclusions were drawn.

Table 4-5: Expected Changes in Effects

Hypothesis	Relationship	Parameter	Expected Pattern
7: Effects of Q^O	$Q^O \rightarrow V^O$	γ_1^V	$\gamma_{1,1998}^V > \gamma_{1,1999}^V > \gamma_{1,2000}^V$
	$Q^O \rightarrow Q^W$	γ_1^Q	$\gamma_{1,1998}^Q > \gamma_{1,1999}^Q > \gamma_{1,2000}^Q$
	$Q^O \rightarrow P^W$	γ_{01}^P	$\gamma_{01,1998}^P > \gamma_{01,1999}^P > \gamma_{01,2000}^P$
8: Effects of V^O	$V^O \rightarrow Q^W$	γ_2^Q	$\gamma_{2,1998}^Q > \gamma_{2,1999}^Q > \gamma_{2,2000}^Q$
	$V^O \rightarrow P^W$	γ_{02}^P	$\gamma_{02,1998}^P > \gamma_{02,1999}^P > \gamma_{02,2000}^P$
9: Effects of Q^W	$Q^W \rightarrow P^W$	γ_{10}^P	$\gamma_{10,1998}^P < \gamma_{10,1999}^P < \gamma_{10,2000}^P$

4.5 Summary of Research Methodology

In this chapter the research methodology used was presented in detail. The data requirements were first described which led to the use of secondary, archival data from the National Partnership for Reinventing Government. This data was assessed based upon extant literature to see if the concepts of interests could be ascertained from the survey instrument. After this was confirmed, the item-to-construct relationships were presented. The remainder of

the chapter described the data analysis approach to test the hypotheses developed in chapter 3. This approach included a CMV-controlled CFA, a unit-weighting factor score approach, and a multi-stage HLM process. Having described the methodological approach for testing the nine research hypotheses, the next chapter will present the results of this analysis and testing.

CHAPTER 5: ANALYSIS RESULTS

This chapter will review the process of data preparation, the results of the hierarchical linear modeling (HLM) and the year-over-year test results. In addition, the data validation, factor analysis and measurement model validation are presented. Conclusions are drawn with respect to the empirical support of the nine research hypotheses.

5.1 Data validation

Upon initial examination of the NPR data it was discovered that a majority of cases had some degree of missing data. That is, either the respondent had left an item blank or had responded with a *don't know* answer. As shown in Table 5-1, although generally each item is missing, less than 5% of values, a list-wise deletion of respondents would result in only 31% to 46% of usable cases, depending upon the year. As this is a substantial loss of information, replacing missing values was deemed essential. There was a general increase in the percent of missing values within each item in later years. As was stated in Chapter 4, the EM algorithm available in SPSS version 15.0 was used to impute these missing values using all respondents and all 32-33 items in the survey.

Table 5-1: Percent of Responses with Missing Values			
	1998	1999	2000
Sample Size	13,689	18,154	31,975
Number valid if had list-wise deleted	4,188 (31%)	8,384 (46%)	11,543 (36%)
NPR Questions			
Quality Management: Organization-level (Q^O)			
1	0.8	3.6	6.5
2	0.9	4.5	9.8
3	0.5	1.4	2.5
7	0.4	2.2	6.3
8	0.4	3.4	7.0
9	0.6	4.0	9.0
12	0.5	1.5	2.8
13	0.3	0.5	0.7
20	1.5	8.1	9.0
Quality Management: Workgroup-level (Q^W)			
10	0.6	2.7	3.2
11	0.8	2.0	3.4
18	1.5	2.8	5.1
26	1.8	2.3	15.8
29 ($28^\dagger$)	0.9	1.1	0.5
30 ($29^\dagger$)	1.0	1.1	0.6
31 ($30^\dagger$)	1.1	1.1	0.8
Cooperative Values: Organization-level (V^O)			
5	0.3	1.9	1.7
14	1.3	2.2	1.8
15	1.2	2.6	3.2
16	1.6	3.6	7.1
21	4.3	43.5	42.1
25	1.9	4.0	6.9

Table 5-1: Percent of Responses with Missing Values (continued)			
Work Performance: Workgroup-level (P^W)			
4	0.4	1.6	3.0
17	1.5	5.2	9.1
32 (31†)	1.1	1.2	0.9
33 (32†)	1.2	1.4	1.0
† Question number for 1999 & 2000			

An important consideration with missing data is the assessment of whether the data are missing completely at random (MCAR). When missing values are considered MCAR they are considered to be randomly distributed across all observations. In such instances missing case may be ignored through listwise deletion, otherwise imputation is warranted (Little and Rubin, 1989). Little's MCAR chi-square test was performed for each year, where an insignificant result means the data are MCAR. For each year the MCAR hypothesis was rejected: For 1998 χ^2 = 18152 (17,538), p<.01; for 1999 χ^2= 71,108 (62,436) p<.001; for 2000 χ^2 = 169,361 (155,329) p<.001. The assumption was therefore made that the data were missing at random (MAR), which means the missing data depends upon the non-missing data. Using all the available response data, missing values were then imputed using the EM algorithm. An assessment of the impact this imputation had on the means and correlations of the variables was done (see Appendix A.1). These differences were deemed not substantial to warrant concern and therefore analysis progressed to factor analysis.

5.2 Measurement model construction and validation

Upon establishing the data set as acceptable to conduct analysis, the process of refining and validating the measurement model ensued. This section presents the steps taken during this process.

5.2.1 Confirmatory Factor Analysis

Subsequent to replacement of missing values, a CFA was performed using EQS 6.1 (Bentler, 1995) on the 1998 data with the initial set of target items (as shown in Table 4-3 in Chapter 4). The result was χ^2 (df) = 33,913 (372), RMSEA = 0.081; NFI = 0.84; CFI = 0.84. For the alternative fit statistics – such as NFI and CFI – to be considered acceptable, their values should be at least 0.90 and approaching 0.95 (Bentler and Bonett, 1980; Hu and Bentler, 1999). Also, the RMSEA value should be below 0.8 (Curran, Bollen, Chen, Paxton, and Kirby, 2003). The fit indices for this initial model were therefore deemed unacceptable. Model modification was subsequently performed utilizing the lagrangian multiplier (LM) test to detect where significant χ^2 changes may result from model changes. Items cross-loading were eliminated unless they possessed important theoretical content. For instance, question 9 regarding cross-training has important sociotechnical implications and was retained. Also, the motivation to have three or more items per construct led to the retention of question 4.

The result of the model modification process for the 1998 data is shown in Table 5-2. A four-item-per-factor model was produced with fit statistics as

follows: χ^2 (df) = 5,821 (98), RMSEA = 0.065; NFI = 0.94; CFI = 0.94. The CFI and NFI fit statistics are well above the 0.90 criterion and the RMSEA value is well below the 0.8 criterion. All loadings were significant (p<.01) and above 0.5 except for question 26, which was 0.44. Although this was below a 0.5 ideal value, retaining four items for Q^W was deemed more crucial for measurement validity.

Table 5-2: Final Measurement Model from 1998 Data

Measures	Loadings	*t*-value
Fit Indices χ^2 (df) = 5821 (98); RMSEA = 0.065; NFI = 0.94; CFI = 0.94		
Quality Management: Organization-level, Q^O (n = 4; CR = 0.74)		
2. There are well-defined systems for linking customers' feedback and complaints to employees who can act on the information.	0.61	73.70
3. Managers communicate the organization's mission, vision, and values.	0.75	96.84
9. Employees in different work units participate in cross-functional teams to accomplish work objectives.	0.61	73.54
13. Employees receive the training they need to perform their jobs (for example, on-the-job training, conferences, workshops).	0.62	74.99
Quality Management: Workgroup-level, Q^W (n = 4; CR = 0.82)		
11. Creativity and innovation are rewarded.	0.78	105.18
26. Do you have electronic access to information needed to do your job?	0.44	51.04
30. How satisfied are you with your involvement in decisions that affect your work?	0.80	109.27
31. How satisfied are you with the recognition you receive for doing a good job?	0.80	109.29
Cooperative Values: Organization-level, V^O (n = 4; CR = 0.72)		
14. Differences among individuals (for example, gender, race, national origin, religion, age, cultural background, disability) are respected and valued.	0.59	72.38
16. My organization has made reinvention a priority (for example, working smarter and more efficiently).	0.66	81.52
21. Management and the union(s) work cooperatively on mutual problems. ("If you don't know leave this item blank" was added in 1999.)	0.50	59.53
25. Are you clear about how "good performance" is defined in your organization?	0.70	88.10

Table 5-2: Final Measurement Model from 1998 Data (continued)		
Work Performance: Workgroup-level, P^W (n = 4; CR = 0.85)		
4. My immediate supervisor has organized our work group effectively to get the work done.	0.84	116.55
17. In the past two years, the productivity of my work unit has improved.	0.60	74.26
32. Overall, how good a job do you feel is being done by your immediate supervisor/team leader?	0.86	120.40
33. How would you rate the overall quality of work being done in your work group?	0.66	83.25
Note: All *t*-values are significant at $p<.05$, CR = composite reliability		

In order to assess if the model adequately represents the proportion of measured variance attributable to the latent variable, composite reliability ρ_C values were computed (Venkatraman, 1989). A ρ_C over 0.5 implies that the variance captured by the model is more than the error components. These values for 1998 ranged from 0.72 to 0.85 and were therefore deemed reliable. Further testing was done on 1999 data for validation purposes. The CFA for 1999 produced the following fit statistics: χ^2 (df) = 4,115 (98), RMSEA = 0.064; NFI = 0.94; CFI = 0.94. All loadings followed acceptable patterns. These results revealed that the measurement model was acceptable. Next, tests for unidimensionality and other conventional validation test were carried out, which are discussed in the following sections.

5.2.2 Unidimensionality

To assess the unidimensionality and convergent validity of each construct, the approach suggested by Venkatraman (1989) was utilized. In this approach the goodness-of-fit for each item-construct set is assessed independently

through a CFA. The χ^2 value and incremental fit index Δ (Bentler and Bonett, 1980) are computed for each CFA. The incremental fit index indicates the practical significance of the model in explaining the data and is computed with the equation $(F_0 - F_k)/F_0$, where F_0 is the null model and F_k is the specific model for construct k. These results are presented in Table 5-3. Although all χ^2 values are significant ($p<.001$), this is not surprising because of the large sample size. Alternatively each Δ is above the 0.95 recommended threshold (Bearden, Sharma, and Teel, 1982). Based on this information, it was concluded that each construct passed the tests for unidimensionality and convergent validity at the monomethod level of analysis. This established confidence that the measures reflected their expected constructs. However, quality management and cooperative values are closely associated; therefore tests were conducted to assess discrimination between the constructs, which are discussed next.

Table 5-3: Unidimensionality Test - Monomethod

		CFA Results			
Factor	No. of indicators	χ^2	df	*p*-level	Δ
Q^O	4	96.776	2	<.001	0.992
Q^W	4	71.335	2	<.001	0.996
V^O	4	11.848	2	<.001	0.999
P^W	4	998.199	2	<.001	0.956

5.2.3 Discriminant Validity

After establishing reliability and unidimensionality, the discriminant validity of the constructs was tested. The results are shown in Table 5-4. Pair-wise tests between constructs were made to assess if construct correlations are

significantly different from unity. To do this, pair-wise CFAs with correlations constrained to be one were compared with unconstrained pair-wise CFAs. Significantly lower χ^2 values for the unconstrained model supports discriminant validity. Six tests were performed for each unique pair with each $\Delta\chi^2$ assessed. Significantly lower values were found, thereby providing support for discriminant validity. The relationship between Q^O and V^O was noted to be highly correlated; however, more discrimination occurred later with the CMV modifications.

Table 5-4: Discriminant Validity

Test#	Pair	ML est (pairwised) Unconstrained Correlation (*t*-value)	Constrained model χ^2	df	Unconstrained model χ^2	df	$\Delta\chi^2$	Sig.
	Q^O to							
1	Q^W	0.865 (176.1)	2,412.39	20	1,569.02	19	843.37	<.001
2	V^O	0.975 (197.2)	442.51	20	415.62	19	26.89	<.001
3	P^W	0.779 (137.8)	4,722.94	20	2,301.32	19	2,421.62	<.001
	Q^W to							
4	V^O	0.921 (199.9)	1,176.05	20	879.15	19	296.90	<.001
5	P^W	0.801 (173.0)	5,561.11	20	2,236.16	19	3,324.96	<.001
	V^O to							
6	P^W	0.796 (136.3)	3,692.50	20	2,102.81	19	1,589.70	<.001

5.2.4 Predictive Validity

A final validity assessment was made that assesses if the constructs correspond to each other in a nomological network (Gerbing and Anderson, 1988). This was done in a structural equations model (SEM) with the entirely dependent construct P^W being predicted by the other three constructs Q^O, Q^W and V^O. Note that the true theoretical test is in the HLM context – that is, Q^O and

V^O operate at a level higher than at the CFA respondent level. Therefore this SEM was used solely to assess for construct (i.e., predictive) validity. The result of this test is shown in Table 5-5 with the strength of each structural relationship represented by γ. All relationships were found to be significant, thereby bolstering the claim of predictive validity. Due to nature of the constructs, however, the correlations observed could be explained by social desirability and use of a single measurement instrument. To assess and control for this, common method variance analysis was conducted and is discussed next.

Table 5-5: Assessment of Predictive Validity†

	Fully Dependent Factor V^O	
Explanatory Factors	γ	t-value
Q^O	0.318	34.776 (***)
Q^W	0.510	47.165 (**)
P^W	0.249	28.219 (***)

†All respondents from all organizational codes
(**)–$p < 0.05$.
(***)–$p < 0.01$.

5.3 Common method variance control

This next section reviews the process for how common method variance (CMV) was assessed and controlled. First preliminary tests were done to assess the degree to which CMV was present. A moderate amount of CMV was detected and therefore without controls some erroneous inferences might have been made. The last portion of this section details the method used to control for CMV.

5.3.1 Preliminary assessments

A basic concern regarding CMV is erroneous inferences about the effect of exogenous constructs on endogenous constructs caused by the common survey instrument. Multiple CMV assessment techniques were used to detect the degree to which this is a possibility. One approach used was the *marker variable technique* (Malhotra et al., 2006) where the lowest element in Σ matrix from the CFA indicates a percent of method bias. For the 1998 data this value was 0.197 indicating a possible 19.7% inflation. Another approach is Harmon's one-factor assessment using exploratory factor analysis (Podsakoff, 2003). This approach estimated that 45% of the 1998 data variance can be explained by one factor. The problem with this technique is that it includes true variance as well as method variance.

5.3.2 Correlated uniqueness

The final test conducted has been termed the *correlated uniqueness* test, where construct item errors between constructs of concern are allowed to covary in a CFA (Podsakoff, 2003). The effect of free error covariance is then assessed and, if necessary, controlled. In a CFA this equates to certain free off-diagonal elements in the Θ_δ matrix. Because the construct Q^O was the only true exogenous factor, its four item errors were free to correlate with the other 12 endogenous construct item errors. Constraints were then placed upon each free path to equate to zero but were allowed free if the LM test revealed a significant impact. Comparisons were made with and without correlated uniqueness

Table 5-6: Effect of Correlated Uniqueness - Common Method Variance (CMV) Control						
Fit indices	Before CMV control X^2 = 5822 (98); NFI=.941; CFI=.942; RMSEA=.065			After CMV control X^2 = 3762 (61); NFI=.962; CFI=.963; RMSEA=.067		
Question	Loading	Error Variance	R^2	Loading	Error Variance	R^2
Organization-level Quality Practices						
Q2	0.608	0.794	0.370	0.634	0.773	0.403
Q3	0.753	0.658	0.567	0.770	0.639	0.592
Q9	0.606	0.796	0.367	0.568	0.823	0.322
Q13	0.615	0.788	0.379	0.587	0.809	0.345
Workgroup-level Quality Practices						
Q11	0.782	0.623	0.612	0.773	0.635	0.597
Q26	0.437	0.900	0.191	0.429	0.903	0.184
Q30	0.804	0.594	0.647	0.807	0.590	0.652
Q31	0.806	0.592	0.649	0.814	0.581	0.662
Organization-level Cooperative Values						
Q14	0.594	0.804	0.353	0.608	0.794	0.369
Q16	0.656	0.755	0.430	0.637	0.771	0.406
Q21	0.503	0.864	0.253	0.497	0.868	0.247
Q25	0.697	0.717	0.486	0.705	0.709	0.497
Workgroup-level Work Performance						
Q4	0.841	0.541	0.707	0.839	0.545	0.703
Q17	0.604	0.797	0.365	0.595	0.804	0.354
Q32	0.859	0.511	0.739	0.870	0.493	0.757
Q33	0.661	0.750	0.437	0.656	0.754	0.431

controls. Without error covariances χ^2 (df) was 5,821 (98) with a *consistent Akaiki information criteria* (CAIC) of 4790. The LM test suggested 37 of the 48 possible $\Theta_{\delta(en,ex)}$ elements should be freed. Upon doing so the result was a χ^2 (df) of 3762 (61) with a CAIC of 3120. This represented about a 35% model improvement – large enough to warrant CMV control. Such a control was accomplished through retention of the 37 free error covariances when computing the structure matrix used for calculating factor scores. For illustrative purposes Table 5-6 reveals the change in factor loadings as a result of CMV-control. As shown, some loadings increase while others decrease. An important note is in relation to the discriminant validity concern between Q^O and V^O noted earlier.

Prior to CMV control the $\Delta\chi^2$ was 26.89 (see Table 5-4, test #2), indicating a slight but significant discrimination. However, with CMV control the $\Delta\chi^2$ value increased to 105.39, indicating an improvement in discrimination. This process controlled for method variance, thereby giving higher confidence towards inferring correlations to be of causal and not methodological origins. Because singular values for each construct are required for multilevel analysis, a factor scoring process was used and is discussed in the next section.

5.4 Factor Scoring

With CMV controlled, a unit weighting factor scoring procedure was used to derive factor scores for each respondent (Grice, 2001). The procedure is shown in Table 5-7. In step one; the 1998 data was used to derive a full structure weight matrix, which is the estimated degree to which each item correlates with an underlying construct. Correlations exist between each item-construct pair. In steps two and three, the most salient items were parsed out based upon the threshold value α. The outcome is a unit weight matrix $\mathbf{W}^U$ based upon the 1998 analysis. In step four, the same $\mathbf{W}^U$ is used to compute factor scores for 1998, 1999 and 2000. The approach used to determine α and the unit-weight matrix are detailed in the Appendix section A.2.

Table 5-7: Unit-Weight Factor Scoring Procedure
1st : Compute Full Structure Weight Matrix, $\mathbf{W}^{FS} = \mathbf{R}_{vv}^{-1}\mathbf{S}_{vf}$ $\mathbf{R}_{vv}^{-1}$ = Inverse of actual correlation matrix of *v* variables $\mathbf{S}_{vf}$ = Structure matrix (variable to factor correlations) from CMV-controlled CFA
2nd : Create absolute valued $\mathbf{W}^{FS}$, determine max value per factor (MAX_f)
3rd : Create Unit Weight Matrix ($\mathbf{W}^{U}_{vf}$) For each element of $\mathbf{W}^{FS}$, if element $\lvert w^{FS}\rvert/MAX_f > \alpha$, then $w^{U} = 1$ or -1 depending on sign of original w^{FS}, where α = salience value
4th : Compute factor scores $\mathbf{F}^{U}_{nf} = \mathbf{Z}_{nv}\mathbf{W}^{U}_{vf}$, where $\mathbf{Z}_{nv}$=standardized *n* responses to *v* variables

Before accepting the computed factor scores as valid, the degree of indeterminacy was assessed by observing the v*alidity coefficients* in the diagonal of $\mathbf{R}_{fs}$. The issue of indeterminacy, long noted as a problem in factor analysis (Wilson, 1928), pertains to the fact that an "an infinite number of ways for scoring the individuals on the factors could be derived that would be consistent with the same factor loadings" (Grice, 2001, 430). Therefore, an assessment of the computed factor scores' indeterminacy should be conducted to determine their reliability. The v*alidity coefficients* represent the correlations between the theoretical factors and the factor score estimates, and a value above .90 is desirable (Gorsuch, 1983). The $\mathbf{R}_{fs}$ correlation matrix is derived from the following expression: $\mathbf{R}_{fs} = \mathbf{S}'_{fv}\mathbf{W}_{vf}\mathbf{S}_{ss}^{-1}$, where $\mathbf{W}_{vf}$ is the factor score unit-weight matrix, $\mathbf{S}'_{fv}$ is the factor structure matrix, and $\mathbf{S}_{ss}^{-1}$ is the diagonal matrix of factor score standard deviations (Gorsuch, 1983). Validity coefficients for Q^O, Q^W, V^O and P^W were 0.931, 0.938, 0.9442 and 0.916 respectively. Therefore, factor indeterminacy was not deemed problematic.

Following these validity checks, factor scores were derived for 1998, 1999 and 2000. These scores were subsequently standardized because in later HLM analysis the meaning of a zero value becomes important. That is, without standardization, a zero value is meaningless because on the original survey instrument a zero was not a valid response. With standardization, a zero represents the average value for a respondent, with below and above average values having salience within the context of cooperative values, work performance and the like. The factor correlations for each year are shown in Table 5-8 and their revealed consistency supports Grice's (2001) claim to the stability of the unit weight scoring procedure.

Table 5-8: Correlation Matrices of Factor Scores

	1998				*1999*				*2000*			
	Q^O	Q^W	V^O	P^W	Q^O	Q^W	V^O	P^W	Q^O	Q^W	V^O	P^W
Q^O	1	.941	.962	.749	1	.938	.963	.753	1	.935	.962	.743
Q^W	.941	1	.961	.815	.938	1	.963	.816	.935	1	.960	.807
V^O	.962	.961	1	.790	.963	.963	1	.799	.962	.960	1	.790
P^W	.749	.815	.790	1	.753	.816	.799	1	.743	.807	.790	1
N	13,689				18,154				31,975			

The overall descriptive statistics are shown in Table 5-9 for each factor, for each year, assessed at the respondent (i.e., workgroup) level. All "other" organizations have been removed, which explains why the means for each factor are not zero. The normality assumption that is required within HLM can be problematic with data derived from Likert-type responses. However this assumption was supported upon viewing that the skewness and kurtosis values were within +/-2 and +/-4 respectively. Not only was this true overall but for each organization also. With the basic assumptions of normality verified, the next step

was to aggregate the responses for the organizational-level constructs. However, an assessment of workgroup consistency within each organization is needed to validate such a step. This assessment is presented next.

Table 5-9: Overall Descriptive Statistics			
	1998	1999	2000
N	10220	10343	27702
Organization-level Quality Management (Q^O)			
Mean	-0.001	0.027	-0.008
Std. Deviation	1.003	0.997	0.992
Skewness	-0.241	-0.260	-0.284
Kurtosis	-0.565	-0.528	-0.371
Workgroup-level Quality Management (Q^W)			
Mean	-0.003	0.036	-0.005
Std. Deviation	1.003	1.004	0.988
Skewness	-0.276	-0.302	-0.317
Kurtosis	-0.682	-0.658	-0.485
Organization-level Cooperative Values (V^O)			
Mean	0.005	0.033	-0.005
Std. Deviation	1.007	0.995	0.991
Skewness	-0.236	-0.246	-0.259
Kurtosis	-0.565	-0.589	-0.432
Workgroup-level Work Performance (P^W)			
Mean	0.000	0.013	-0.004
Std. Deviation	1.002	1.009	0.996
Skewness	-0.521	-0.514	-0.625
Kurtosis	-0.446	-0.431	-0.156

5.5 Data aggregation

In order to develop the values for the organization-level factors, data aggregation is required. However, before averaging the workgroup responses for the organization-level factors an assessment of workgroup consistency within each organization was required. If the workgroups were not deemed consistent,

then aggregation would not be empirically justified. Three indices were used to assess for consistency: within-group reliability $r_{WG(j)}$ (James, Demaree, and Wolf, 1984), intraclass correlation (ICC)(1) and a reliability of means index denoted ICC(2) (Bliese, 2000). An $r_{WG(j)}$ estimate was made for each organization. The values were found to range from 0.798 to 0.939 for Q^O and 0.815 to 0.939 for V^O. This showed a high consistency among workgroups within organizations (James, Demaree, and Wolf, 1993). Next, the ICC (1) coefficient with unequal sample sizes were computed based upon ANOVA mean squares. The ICC(1) value represents the proportion of variance that is accounted for at the organization level and represents the degree of reliability with a single workgroup's assessment of an organization-level factor. The results of 0.023 for Q^O and 0.021 for V^O revealed that a relatively small proportion of Q^O and V^O variance exists between organizations. These values show the importance of gathering many respondents within each organization. For the reliability of means ICC (2) calculation high values are preferred. According to James (1982, p. 222), ICC(2) may be interpreted as follows: "If another sample of n_j individuals were sampled randomly from each of the same j organizations, then the correlation between the two sets of means would be approximately equal to ICC(2)." Computing ICC (2) with unequal sample sizes (Bliese, 2000) resulted in values of 0.867 for Q^O and 0.855 for V^O. These results justified data aggregation (i.e., averaging) of Q^O and V^O for each organization when it was deemed appropriate in the subsequent HLM process. Table 5-10 depicts the means for Q^O and V^O for each organization

over the three years. The mean values for the workgroup-level factors Q^W and P^W are also shown for informative purposes.

Table 5-2: Agency Means per Year

Agency		1998	1999	2000
National Partnership for Reinventing Government	N	32	No data	
	Q^O	0.601		
	Q^W	0.653		
	V^O	0.797		
	P^W	0.381		
Department of the Air Force	N	167	189	541
	Q^O	0.089	0.048	0.108
	Q^W	0.094	0.067	0.104
	V^O	0.053	0.050	0.101
	P^W	-0.064	-0.079	0.055
Department of the Army	N	218	234	326
	Q^O	0.014	-0.064	0.060
	Q^W	-0.037	-0.101	0.036
	V^O	-0.036	-0.102	0.023
	P^W	-0.078	-0.119	-0.096
Department of the Navy	N	184	193	331
	Q^O	-0.045	-0.165	0.167
	Q^W	-0.063	-0.185	0.130
	V^O	-0.090	-0.159	0.138
	P^W	-0.102	-0.111	0.091
Defense Logistics Agency	N	243	289	270
	Q^O	0.015	0.018	-0.081
	Q^W	-0.017	0.019	-0.098
	V^O	0.016	0.050	-0.090
	P^W	-0.016	-0.085	-0.204
Forest Service	N	273	274	329
	Q^O	0.045	0.056	0.034
	Q^W	-0.027	0.020	-0.066
	V^O	-0.012	-0.018	-0.046
	P^W	-0.033	-0.029	-0.079
Food Safety and Inspection Service	N	295	286	5730
	Q^O	-0.134	-0.173	-0.309
	Q^W	-0.113	-0.111	-0.242
	V^O	-0.085	-0.137	-0.240
	P^W	-0.214	-0.215	-0.304

Table 5-3: Agency Means per Year (continued)				
Animal and Plant Health Inspection Service	N	318	290	302
	Q^O	0.053	0.028	0.049
	Q^W	0.033	0.015	0.041
	V^O	0.048	0.033	0.030
	P^W	0.002	0.002	-0.110
Food and Consumer Services	N	326	236	193
	Q^O	-0.115	0.017	-0.165
	Q^W	-0.077	0.082	-0.070
	V^O	-0.067	0.098	-0.079
	P^W	-0.087	0.051	-0.057
Nat Oceanic & Atmospheric Admin	N	341	310	424
	Q^O	0.110	0.274	0.076
	Q^W	0.124	0.347	0.122
	V^O	0.102	0.319	0.131
	P^W	0.139	0.212	0.072
Patent and Trademark Office	N	203	195	3889
	Q^O	0.008	0.215	0.089
	Q^W	0.043	0.197	0.106
	V^O	0.063	0.210	0.062
	P^W	0.059	0.128	0.171
Bureau of the Census	N	342	333	5458
	Q^O	0.181	0.363	0.117
	Q^W	0.150	0.315	0.061
	V^O	0.143	0.292	0.082
	P^W	0.183	0.269	0.171
International Trade Administration	N	301	249	288
	Q^O	0.055	0.065	0.009
	Q^W	0.035	0.067	0.012
	V^O	0.024	0.077	0.032
	P^W	0.123	0.089	0.067
Student Financial Assistance	N			363
	Q^O			0.099
	Q^W	No data		0.115
	V^O			0.142
	P^W			0.127
Office of Post Secondary Education	N	312	108	33
	Q^O	-0.100	-0.115	-0.348
	Q^W	-0.089	-0.060	-0.170
	V^O	-0.060	-0.063	-0.360
	P^W	-0.100	-0.088	-0.190

Table 5-4: Agency Means per Year (continued)				
Department of Energy	N	364	262	430
	Q^O	0.071	0.029	0.095
	Q^W	0.041	-0.029	0.044
	V^O	0.025	-0.056	0.035
	P^W	0.036	-0.042	-0.016
Food and Drug Administration	N	296	263	468
	Q^O	0.067	0.188	0.215
	Q^W	0.042	0.149	0.180
	V^O	0.037	0.166	0.184
	P^W	0.008	0.049	0.082
Health Care Financing Administration	N	308	382	319
	Q^O	-0.335	-0.105	-0.118
	Q^W	-0.311	-0.075	-0.086
	V^O	-0.330	-0.105	-0.113
	P^W	-0.178	-0.073	-0.083
Administration for Children and Families	N	305	266	534
	Q^O	-0.108	-0.063	0.012
	Q^W	-0.083	-0.019	0.002
	V^O	-0.067	-0.029	0.015
	P^W	-0.054	-0.009	-0.037
Department of Housing & Urban Development	N	204	357	401
	Q^O	-0.039	0.076	-0.031
	Q^W	0.002	0.188	0.034
	V^O	0.082	0.163	0.021
	P^W	-0.020	0.100	0.024
Dept of Interior Bureau of Land Management	N			289
	Q^O			-0.038
	Q^W	No data		-0.093
	V^O			-0.123
	P^W			-0.182
National Park Service	N	358	306	319
	Q^O	-0.019	0.003	-0.045
	Q^W	-0.038	0.003	-0.088
	V^O	-0.030	-0.037	-0.103
	P^W	-0.049	-0.072	-0.167
Immigration and Naturalization Service	N	212	310	204
	Q^O	-0.415	-0.326	-0.407
	Q^W	-0.408	-0.288	-0.350
	V^O	-0.441	-0.319	-0.406
	P^W	-0.219	-0.201	-0.159

Table 5-5: Agency Means per Year (continued)				
Occupational Safety & Health Administration	N	314	864	468
	Q^O	-0.132	-0.204	-0.088
	Q^W	-0.147	-0.227	-0.104
	V^O	-0.111	-0.210	-0.113
	P^W	-0.172	-0.214	-0.200
Bureau of Consular Affairs	N	243	224	260
	Q^O	0.174	0.299	0.268
	Q^W	0.176	0.282	0.213
	V^O	0.181	0.306	0.276
	P^W	0.142	0.294	0.174
Federal Aviation Administration	N	276	284	359
	Q^O	-0.288	-0.226	-0.351
	Q^W	-0.352	-0.216	-0.400
	V^O	-0.348	-0.274	-0.397
	P^W	-0.269	-0.072	-0.321
Internal Revenue Service	N	266	327	414
	Q^O	-0.195	0.002	-0.051
	Q^W	-0.151	0.068	0.005
	V^O	-0.107	0.050	-0.020
	P^W	-0.006	0.033	-0.068
U.S. Customs Service	N	260	258	334
	Q^O	-0.143	-0.306	-0.177
	Q^W	-0.128	-0.282	-0.166
	V^O	-0.140	-0.328	-0.196
	P^W	-0.146	-0.321	-0.205
Financial Management Service	N	219	226	440
	Q^O	-0.026	0.071	0.180
	Q^W	-0.042	0.016	0.131
	V^O	0.000	0.071	0.217
	P^W	-0.053	-0.012	0.129
Veterans Health Administration	N	187	169	319
	Q^O	-0.042	-0.140	-0.065
	Q^W	-0.078	-0.158	-0.148
	V^O	-0.026	-0.194	-0.125
	P^W	-0.030	-0.123	-0.139
Veterans Benefits Administration	N	318	237	440
	Q^O	-0.106	-0.088	0.031
	Q^W	-0.064	-0.028	0.057
	V^O	-0.018	-0.045	0.087
	P^W	-0.035	0.011	0.010

Table 5-6: Agency Means per Year (continued)				
Environmental Protection Agency	N	309	308	407
	Q^O	0.224	0.289	0.143
	Q^W	0.218	0.297	0.110
	V^O	0.204	0.281	0.092
	P^W	0.190	0.335	0.102
Equal Employment Opportunity Commission	N	277	235	519
	Q^O	-0.177	-0.055	-0.004
	Q^W	-0.192	-0.090	0.042
	V^O	-0.173	-0.062	0.020
	P^W	-0.011	0.050	0.180
Federal Emergency Management Agency	N	379	300	346
	Q^O	-0.074	-0.046	-0.028
	Q^W	-0.042	-0.007	0.012
	V^O	-0.037	-0.020	0.023
	P^W	-0.058	-0.079	-0.041
General Service Administration	N	257	256	456
	Q^O	0.156	0.257	0.305
	Q^W	0.181	0.311	0.307
	V^O	0.170	0.293	0.332
	P^W	0.110	0.209	0.204
National Aeronautics & Space Administration	N	385	316	443
	Q^O	0.518	0.632	0.576
	Q^W	0.476	0.571	0.507
	V^O	0.474	0.583	0.491
	P^W	0.435	0.404	0.317
Small Business Administration	N	358	397	350
	Q^O	0.035	0.089	0.015
	Q^W	0.107	0.182	0.104
	V^O	0.121	0.227	0.148
	P^W	0.059	0.190	0.136
Social Security Administration	N	273	282	327
	Q^O	0.053	-0.086	-0.061
	Q^W	0.047	-0.108	-0.076
	V^O	0.025	-0.075	-0.039
	P^W	-0.045	-0.146	-0.145
U.S. Office of Personnel Management	N	297	328	379
	Q^O	0.219	0.306	0.230
	Q^W	0.184	0.266	0.206
	V^O	0.212	0.292	0.252
	P^W	0.177	0.259	0.181

The information in Table 5-10 demonstrates the variability in sample size between organizations and year over year. For example, the Patent and Trademark Office ranged in sample size from 203 in 1998 to 3,889 in 2000. There was also variation between organizations as demonstrated in 2000 between the Forest Service (n=329) and the Food Safety and Inspection Service (n=5,730). Such widely unbalanced data provides another justification for using HLM because it does not assume sample size equality. Once singular organization-level factor values were computed for each organization, HLM data analysis was possible and is presented next.

5.6 Hierarchical Linear Model Results

In order to prepare the data for HLM analysis, two databases were constructed for each year. The first database is termed level-one data. This data set included workgroup-level values Q^{W}_{ij} and P^{W}_{ij}, as well as V^{O}_{ij} responses for workgroup *i* in organization *j*. The second database included the aggregated organization-level values Q^{O}_{j} and V^{O}_{j}. Both databases were related through the organization code and all "other" organization codes were removed. Multivariate data matrices (MDM) were created from these databases in HLM 6.02 software (Raudenbush, Bryk, Cheong, Congdon, and du Toit, 2004). To assess the specified models 1, 2 and 3, first an empty model was tested, and then the hypothesized model was tested. An empty model, also known as a *random effects analysis of variance model*, contains only random groups and random

variation within groups (Snijders et al., 1999). An empty model is used to create a base case to which the hypothesized model can be compared. Two r^2 values (one for each level) were computed based upon the change in σ^2 and τ^2 values from the empty model (Snijders et al., 1999).

The HLM analysis also included a test for homogeneity of level-1 variance among the organizations. The assumption of homogenous level-1 variance is often made in multilevel modeling; however, because of the endogenous V^O and Q^W factors some degree of heterogeneity was expected (Raudenbush et al., 2002). The Bartlett and Kendall (1946) test statistic used by the HLM software did detected heterogeneous variance among organizations. In order to control for these, the main effects in each model were specified to explain the log of level-one error variance. For example, in model 1 the log of σ^2 was specified to be predicted by Q^O. This is the default approach used in HLM and assures the estimates are consistent with only positive values of σ^2. Besides aiding with model fit, specifying sources of heterogeneity added insights – this will be discussed in subsequent sections. Because of this heterogeneity and the underlying likert-based responses, robust estimation procedures standard in HLM 6.02 were used for hypothesis testing.

5.6.1 Results for 1998

The results from 1998 are shown in Table 5-11. Model 1 is depicted in the first two columns with first the "empty" model and then the hypothesized model.

The estimated organization-level effect of Q^O on V^O, γ_1^V, was 0.930 (p<.001). Since only a level-2 main effect is considered for model 1, the level-2 r^2 is of

Table 5-7: Results from HLM analysis for NPR - 1998

Outcome Variable	Model 1 V_{ij}^O		Model 2 Q_{ij}^W		Model 3 P_{ij}^W	
Parameters	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]
γ_0^V	0.007 (0.029) [0.245]	0.011 (.006) [1.632]				
γ_1^V (H1)		0.930 *** (.035) [26.232]				
γ_0^Q			-0.003 (.028) [-0.119]	0.005 (.002) [1.944]		
γ_1^Q (H2)				0.392 *** (.066) [5.890]		
γ_2^Q (H3)				0.594 *** (.074) [7.982]		
γ_{00}^P					-0.004 (.023) [-0.188]	0.007 (.009) [0.741]
γ_{01}^P (H4)						0.466 * (.192) [2.427]
γ_{02}^P (H5)						0.244 (.183) [1.330]
γ_{10}^P (H6) ††††						0.793 *** (.006) [126.543]
Deviance	28959	28837	28874	28745	28926	17046
$\Delta\chi^2(df)$ †††		122 (3) ††		129 (5)††		11880 (7) ††
Level 1 R^2		0.030		0.030		0.664
Level 2 R^2		0.884		0.886		0.812

* p < .05
** p < .01
*** p < .001
† Robust estimation results, †† Includes heterogenous sigma-sq explanatory variables , ††† df is the difference in no. of parameters, †††† β_1 held constant across organizations – post hoc relaxation yields low reliability (.08) meaning little organizational variation

interest and was computed to be 0.844. These results provided support for hypothesis 1, which posited that organization-level quality management practices would influence the emergence of organization-level cooperative cultural values.

Model 2 is depicted in the third and fourth column, with the estimated cross-level effects of Q^O and V^O on Q^W (i.e., γ_1^Q and γ_2^Q) being 0.392 (p<.001) and 0.592 (p<.001) respectively. Again the level-2 r^2 was of interest and it was computed to be 0.866. Therefore it was concluded that hypothesis 2 was supported, which posited that organization-level quality management practices would influence workgroup-level quality management practices. In addition, hypothesis 3, which posited that organization-level cooperative cultural values would influence workgroup-level quality management practices, was also supported. It should be noted that the effect of V^O was estimated to be higher than the effect of Q^O.

Finally, model 3 is shown in the last two columns. The organization-level effects of Q^O and V^O on P^W (i.e., γ_{01}^P and γ_{02}^P) are estimated at 0.466 (p<.05) and 0.244 (not significant), while the workgroup-level effect of Q^W on P^W (γ_{10}^P) is estimated at 0.793 (p<.001). The level-1 r^2 0.664 while the level-2 r^2 was 0.812. These results support the hypothesized effects of both organization-level and workgroup-level quality management practices (i.e., H4 and H6), but fail to support the hypothesized effects of organization-level cooperative cultural values on workgroup-level performance (i.e., H5).

As was stated, variance controls were included for each model. In each model the logarithm of level-1 variance is predicted by an intercept and the main

effects in the model (e.g.,, $\log(\sigma^2)=\alpha_0+\alpha_1 Q^O_j$), of which the α_1 value is of interest. A $\Delta\chi^2$ is computed to assess if variance control is warranted. For model 1, α_1 had a significant value of -0.346 and a significant $\Delta\chi^2$ of 17.9, revealing that higher Q^O values are associated with less V^O error variance. For model 2, Q^O and V^O had insignificant alpha values of 0.192 and -0.469 respectively, but a significant $\Delta\chi^2$ of 11.4, revealing only marginal variance control. For model 3, Q^O, V^O and Q^W had alpha values of -0.503, 0.039 and -0.441 respectively, of which only Q^W's alpha was significant. The $\Delta\chi^2$ for model 3 variance control was significant at 774.7. For all three models the variance controls in the HLM analyses revealed insights that are developed in Chapter 6.

As was noted in Chapter 4, the level-1 coefficient β_1 was held constant across organizations. This assumed that the effect of workgroup-level quality management practices was the same across organizations. Organizations likely implement quality management practices differently, and as such, this assumption could be questioned. Therefore, to assess this assumption, the error term u_j in (7) was unconstrained and the model was reanalyzed. A reliability estimate (Raudenbush et al., 2004) of 0.08 was computed indicating nearly no organizational variation in the effect of Q^W on P^W. This inferred a high consistency in the effectiveness of workgroup-level quality management practices.

5.6.2 Results of 1999

The results from 1999 are shown in Table 5-12. The estimated organization-level effect γ_1^V is 0.975 (p<.001), with a level-2 r^2 of 0.919. Both of these are increases from 1998 and provide further support for hypothesis 1. Model 2 had estimated cross-level effects γ_1^Q and γ_2^Q to be 0.166 (insignificant) and 0.802 (p<.001) respectively, with a level-2 r^2 of 0.912. Interestingly, H2 was not supported for 1999 (different than 1998) but H3 was. Finally, model 3's organization-level effects γ_{01}^P and γ_{02}^P were estimated at 0.188 (insignificant) and 0.596 (p<.001), showing a reversal in hypothesis support from 1998 – that is H5 is accepted for 1999 while H4 is not. The workgroup-level effect γ_{10}^P is estimated at 0.803 (p<.001), thereby further supporting H6. In this final model, the level-1 r^2 was 0.670 while the level-2 r^2 was 0.866.

In regard to variance control, model 1's alpha had a significant value of -0.321 and a significant $\Delta\chi^2$ of 22.1, again revealing that higher Q^O values are associated with less V^O error variance. The model 2 variance control had similar results to 1998 with Q^O and V^O having insignificant alpha values of -0.243 and -0.023 respectively, and a small but significant $\Delta\chi^2$ of 15.4. For model 3, Q^O, V^O and Q^W had alpha values of 0.155 (insignificant), -0.698 (p<.05) and -0.433 (p<.001) respectively. These results are different than 1998 in that V^O had become significant and negatively related to P^W error variance. The $\Delta\chi^2$ for model 3 variance control was significant at 770.0. The post-hoc test for β_1 reliability was 0.24, which is an increase from 1998 but still a low value.

Table 5-8: Results from HLM analysis for NPR - 1999

Outcome Variable	Model 1 V_{ij}^{O}		Model 2 Q_{ij}^{W}		Model 3 P_{ij}^{W}	
Parameters	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]
γ_0^V	0.037 (.033) [1.112]	0.037 *** (.008) [4.454]				
γ_1^V (H1)		0.975 *** (.031) [30.502]				
γ_0^Q			0.041 (.032) [1.288]	0.040 *** (.004) [8.744]		
γ_1^Q (H2)				0.166 (.082) [2.007]		
γ_2^Q (H3)				0.802 *** (.089) [8.958]		
γ_{00}^P					0.017 (.028) [0.615]	0.021 * (.010) [2.112]
γ_{01}^P (H4)						0.188 (.136) [1.381]
γ_{02}^P (H5)						0.596 *** (.145) [4.112]
γ_{10}^P (H6) ††††						0.803 *** (.006) [124.666]
Deviance	28916	28788	29123	28987	29327	17201
$\Delta\chi^2(df)$ †††		128 (3) ††		136 (5) ††		12126 (7) ††
Level 1 R^2		0.039		0.037		0.670
Level 2 R^2		0.919		0.912		0.866

* p < .05
** p < .01
*** p < .001

† Robust estimation results, †† Includes heterogenous sigma-sq explanatory variables , ††† *df* is the difference in no. of parameters, †††† β_1 held constant across organizations – post hoc relaxation yields low reliability (.24) meaning little organizational variation

Table 5-9: Results from HLM analysis for NPR - 2000

Outcome Variable	Model 1 V_{ij}^{O}		Model 2 Q_{ij}^{W}		Model 3 P_{ij}^{W}	
Parameters	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]	Empty Est. (std.error) [t-value]	Full † Est. (std.error) [t-value]
γ_0^V	0.018 (.029) [0.624]	0.014 (.007) [1.897]				
γ_1^V (H1)		0.888 *** (.044) [20.133]				
γ_0^Q			0.017 (.027) [0.643]	0.012 (.007) [1.504]		
γ_1^Q (H2)				0.221 * (.106) [2.072]		
γ_2^Q (H3)				0.715 *** (.111) [6.399]		
γ_{00}^P					-0.009 (.025) [-0.373]	-0.004 (.015) [-0.265]
γ_{01}^P (H4)						-0.044 (.166) [-0.269]
γ_{02}^P (H5)						0.761 *** (.154) [4.938]
γ_{10}^P (H6) ††††						0.769 *** (.013) [58.317]
Deviance	77420	77317	77318	77198	77413	46779
$\Delta\chi^2(df)$ †††		103 (3) ††		120 (5) ††		30634 (7) ††
Level 1 R^2		.031		0.027		0.644
Level 2 R^2		.943		0.945		0.765

* p < .05
** p < .01
*** p < .001

† Robust estimation results, †† Includes heterogenous sigma-sq explanatory variables , ††† *df* is the difference in no. of parameters, †††† β_1 held constant across organizations – post hoc relaxation yields moderate reliability (.49) showing some true organizational variation

5.6.3 Results of 2000

The results from 2000 are shown in Table 5-13. The estimated organization-level effect γ_1^V is 0.888 (p<.001), which is a decrease from 1999 but with an increased level-2 r^2 of 0.943. Therefore for 2000 H1 remains supported. Model 2 had estimated an increased γ_1^Q cross-level effect of 0.221 (p<.05), but a decreased γ_2^Q of 0.715 (p<.001). The level-2 r^2 increased to 0.945, therefore both H2 and H3 are supported for 2000 (similar to 1998). Finally, model 3's organization-level effects γ_{01}^P and γ_{02}^P were estimated at -0.044 (insignificant) and 0.761 (p<.001), furthering the trend started in 1999 that did not support H4 but did support H5. The workgroup-level effect γ_{10}^P decreased from 1999 to 0.769 (p<.001) but still supported H6. Model 3 had a computed level-1 r^2 of 0.644 and a level-2 r^2 of 0.866 – both a decrease from 1999.

Regarding the year 2000 variance control, for the first time model 1's alpha was not significant with an estimate of just -0.045 and a non-significant $\Delta\chi^2$ of 1.1, which revealed that higher Q^O values no longer lessen V^O error variance. The model 2 variance control was similarly unsuccessful in predicting error variance with Q^O and V^O having insignificant alpha values of -0.026 and 0.078 respectively, and an insignificant $\Delta\chi^2$ of 0.9. However model 3's variance control was slightly more successful. The main effects Q^O, V^O and Q^W had alpha values of -0.374 (insignificant), -0.210 (insignificant) and -0.444 (p<.001) respectively. These results show a diminished ability of the organization-level effects to predict P^W error variance. The $\Delta\chi^2$ for model 3 variance control was much higher than

both 1998 and 1999 at 2195.5, revealing this final control to be the most successful. The post-hoc test for 2000 β_1 reliability was 0.49, which continues the increasing trend from 1999 and shows that organizations were differentiating on the effect of Q^W on P^W. Reviewing the results from each year reveals substantial support for the proposed multilevel model. However, as was noted earlier, the sociotechnical effects of quality management practices are dynamic. Therefore, year-over-year comparisons were made and are presented next.

5.7 Parameter stability

The effects of a quality initiative were expected to change over time. Not only is this caused by the diffusion process noted in the literature (Ahire et al., 2001), but also because of the organizational and environmental dynamics associated with quality management (Narasimhan et al., 2001). Moreover, the sociotechnical effects of introducing a new management technology such as quality management should effect changes in the theorized model. This is particularly expected in the case of cooperative cultural values. Being able to detect significant changes in the strength of relationships over time will add insight into the process of quality initiatives and, more generally, of sociotechnical systems.

The assessment of parameter stability was accomplished through year-over-year *t*-tests of coefficient equivalence. Because no unique respondent information was available and the surveys were randomly administered, each year was treated as an independent sample. Also, because it was discovered

that error variances were susceptible to main effect changes (see section 5.6) and that organizational main effect values shifted year over year (see Table 5-10) it was assumed that variances were not equal between years. Because of these assumptions of independence and unequal variances, a one-tailed Welch *t*-test based comparison was made between years (Welch, 1947). Equation 8 shows the test statistic calculation while equation 9 shows the computed degrees of freedom that is rounded down to give a bias to the null hypothesis (Aczel and Sounderpandian, 2005). A 0.10 threshold was chosen for significance because of the relatively small number of organizations.

$$t = \frac{\left|\theta^k_{y+1} - \theta^k_y\right|}{\sqrt{\left(e^k_{y+1}\right)^2 + \left(e^k_y\right)^2}} \tag{8}$$

$$df = \left\lfloor \frac{\left[\left(e^k_{y+1}\right)^2 + \left(e^k_y\right)^2\right]^2}{\left(e^k_{y+1}\right)^4 / \left(n_{y+1} - 1\right) + \left(e^k_y\right)^4 / \left(n_y - 1\right)} \right\rfloor \tag{9}$$

Where, θ^k_y represents the coefficient *k* in year *y* and e^k_y is the standard error of θ^k_y, which is determined by $\sigma_{\gamma_y} / \sqrt{n_y}$.

θ^k_y, which is determined by $\sigma_{\gamma_y} / \sqrt{n_y}$. The results of the test between 1998 and 1999 are shown in Table 5-14 and the results between 1999 and 2000 are presented in 5-15. With respect to H7, it was expected that the effects of Q^O would negatively change from 1998 to 1999 and from 1999 to 2000. As can be seen only one significant change was observed from 1998 to 1999 – that is $\Delta\gamma_1^Q$ was -0.226, which was in the direction

expected. Subsequently, from 1999 to 2000 only one significant change occurred in the effect of Q^O – that is $\Delta\gamma_1^V$ was -0.087, which again was in the direction expected. Interestingly, the general trend of the other changes was also negative, albeit only significant when 1998 was compared to 2000, such as with γ_{01}^P. Therefore, it was concluded that H7 was supported by the multiyear results.

Table 5-10: Structural change from 1998 to 1999

		1998		1999					
Number of level 1 units		10220		10343					
Number of level 2 units		37		36					
		Estimate	Std.Err	Estimate	Std.Err	Δ		*t*-value	df
H7	γ_1^V $(Q^O \rightarrow V^O)$	0.930	0.035	0.975	0.031	0.045		0.96	70
	γ_1^Q $(Q^O \rightarrow Q^W)$	0.392	0.066	0.166	0.082	-0.226	**	2.15	67
	γ_{01}^P $(Q^O \rightarrow P^W)$	0.466	0.192	0.188	0.136	-0.278		1.18	64
H8	γ_2^Q $(V^O \rightarrow Q^W)$	0.594	0.074	0.802	0.089	0.208	**	1.80	68
	γ_{02}^P $(V^O \rightarrow P^W)$	0.244	0.183	0.596	0.145	0.352	*	1.51	67
H9	γ_{10}^P $(Q^W \rightarrow P^W)$	0.793	0.006	0.803	0.006	0.010		1.18	70

* p<0.10, ** p<0.05

Table 5-11: Structural change from 1999 to 2000

		1999		2000					
Number of level 1 units		10343		27702					
Number of level 2 units		36		38					
		Estimate	Std.Err	Estimate	Std.Err	Δ		*t*-value	Df
H7	γ_1^V $(Q^O \rightarrow V^O)$	0.975	0.031	0.888	0.044	-0.087	*	1.62	65
	γ_1^Q $(Q^O \rightarrow Q^W)$	0.166	0.082	0.221	0.106	0.055		0.41	68
	γ_{01}^P $(Q^O \rightarrow P^W)$	0.188	0.136	-0.044	0.166	-0.232		1.08	70
H8	γ_2^Q $(V^O \rightarrow Q^W)$	0.802	0.089	0.715	0.111	-0.087		0.61	69
	γ_{02}^P $(V^O \rightarrow P^W)$	0.596	0.145	0.761	0.154	0.165		0.78	71
H9	γ_{10}^P $(Q^W \rightarrow P^W)$	0.803	0.006	0.769	0.013	-0.034	**	2.37	51

* p<0.10, ** p<0.05

With respect to H8 regarding the effects of V^O, it was expected that negative changes would be observed between 1998 and 1999 and between 1999 and 2000. As can be seen in Table 5-14, $\Delta\gamma_2^Q$ and $\Delta\gamma_{02}^P$ were 0.208 (p<.05) and 0.352 (p<.10), which was unexpected. In Table 5-15 it is shown that $\Delta\gamma_2^Q$ and $\Delta\gamma_{02}^P$ were insignificant, which also was unexpected. Therefore, it was concluded that H8 was not supported because the direction of change was in the opposite expected direction. The implications of this finding are detailed more extensively in Chapter 6, but the results implied that the causal mechanisms differ substantially between organization-level quality management practices and cooperative cultural values.

Finally, regarding the effects of Q^W, it was also expected that positive changes would be observed between 1998 and 1999 and between 1999 and 2000. Table 5-14 shows that $\Delta\gamma_{10}^P$ was insignificant between 1998 and 1999, but was an unexpected negative value (i.e., -0.034) between 1999 and 2000. These results give no support for H9, meaning that although the strength of workgroup-level quality management practices remained high, they changed very little throughout the years of the initiative.

5.8 Summary of Data Analysis

This chapter reviewed the data preparation and factor analysis processes necessary to find support for the proposed research framework. Results were

presented that validated the measurement model and factor scoring procedure utilized to construct an appropriate data set from the secondary data source. The results of the HLM analysis were presented in which general support for the research framework was found. In addition, the stability of parameter estimates were assessed, which will provide an understanding of the dynamics of quality management, cooperative values and workgroup performance. These results make epistemic and practical knowledge contributions, which are discussed in the next chapter.

CHAPTER 6: DISCUSSION

In this chapter, both the epistemic and practical insights gained from this research are discussed. The first two sections will review the contributions to quality management knowledge and sociotechnical systems theory. The third section discusses managerial insights pertaining to the relationships among quality management practices, cooperative cultural values and work performance. Contributions made by this dissertation are highlighted throughout each section.

6.1 Knowledge of Quality Management

This subsection reviews the insights to quality management knowledge. The first subsection will discuss the insights drawn from the single 1998 period, and the second subsection will discuss additions to knowledge based upon the year-over-year results.

6.1.1 Single Period Results (1998)

One of the fundamental premises of this dissertation was the conjecture that a difference exists between quality management practices at the organization level and the workgroup level. This was based in part on Juran's (1989) insight regarding the "big Q" and "little Q" differences in quality management. Through use of established concepts in the quality management

literature (Anderson et al., 1994; Douglas et al., 2004), discrimination was found in the 1998 archival data between organization-level and workgroup-level quality management practices. Moreover, these two discriminant concepts had different relationships with workgroup-level performance and cooperative cultural values, a concept known to be concomitant with quality management (Detert et al., 2003). The epistemic implication of this empirical confirmation of Juran's insight is that recognition of the multilevel nature of quality management practices should exist. That is, much of past research has treated quality management as a single level concept (Rungtusanatham et al., 1998; Zbaracki, 1998). Doing so could ignore important phenomena, such as the antecedent role organization-level quality management practices have to cooperative cultural values. Moreover, recognizing workgroup-level quality management practice as significantly influenced by both technical and social aspects of an organization will aid in understand variations in quality management implementation. Therefore, an important contribution of this dissertation is the empirical discrimination of the different levels of quality management practices in an organization.

Another issue underpinning this dissertation was the problem of explaining the relationship between quality management and cooperative values. Based upon Detert et al.'s (2000) research, organization-level cooperative cultural values were measured using the 1998 archival data and related to the different levels of quality management practices. Empirical evidence was found for cooperative cultural values to be a consequence of organization-level quality

management practices, but also an antecedent to workgroup-level quality management practices. Such an interrelationship explains why these cultural values are deemed essential to a quality initiative (Detert et al., 2000; Kujala et al., 2004). Moreover, the results imply organization-level quality management practices reduce the variability of cooperative cultural values. As such, these findings imply that more extensive quality management initiatives stabilize the level of cooperation in organizations. Such a discovery may not have been possible without the different relationships proposed in this research. Therefore, another important contribution of this dissertation is the empirical support for a richer conceptualization of how quality management relates to cooperative values.

An important component of a quality management initiative is its implementation at the workgroup level (Naveh et al., 2004; Soltani et al., 2004). This research conjectured that both organization-level quality management practices and cooperative cultural values should influence the occurrence of workgroup-level quality management practices. Evidence was found in the 1998 archival data that both organization-level concepts had the conjectured influence. However, the cross-level influence of cooperative values on workgroup-level quality management practices was significantly higher than the influence of organization-level quality management practices. This finding implies that informal processes are more influential at the workgroup level than formal processes. That is, the cooperative norms of behavior that likely emerge from an organization valuing cooperation become a strong enabler of workgroup-level

quality management practices. This does not remove the importance of organization-level quality management practices, as these were found to be a strong influence on cooperative values. This mediating role of cooperative values can be likened to Argyris and Shon's (1996) conception of double-loop learning, where only after organizational members change their mental models will the full effect of new technologies occur. The elucidation of the differential effects of the two organization-level concepts is another contribution of this dissertation.

6.1.2 Multi-period Results (1998-2000)

The literature on quality management has emphasized the importance of time in quality management initiatives (Narasimhan et al., 2001; Schroeder et al., 2005). This is true not only for the time to implement the practices but also for the effects of these practices to manifest. Two hypotheses related to the changing effects of quality management practices were given, of which only one was empirically supported – hypothesis 7. This hypothesis posited that the effects of organization-level quality management practices come from changes to organizational characteristics and structures. As these organizational aspects are changed, the potential for further influence diminishes and therefore the strength of effect should decrease. This hypothesis was supported by the comparison of year-over-year results. The strength of each relationship diminished within either one or two years. Such a finding implies that the immediate effects of organization-level quality management practices may not be

sustainable. In other words, practices like cross-functional teams and communicating customer needs have a more immediate than long-term impact. The long-term effects may emerge more from sustaining the cooperative values and workgroup-level practices than from organization-level quality management practices. It should be noted that diminished correlation between organization-level and workgroup-level quality management practices further supported the discrimination of these two constructs.

The other hypothesis relating to the changing effects of quality management was hypothesis 9, which posited an increasing impact of workgroup-level quality management practices. This hypothesis was based upon the idea that as more workgroups in an organization learn and adopt quality management practices, a stronger relationship with workgroup-level performance should emerge. This conjecture was not supported by the data analysis. An explanation for this is that the other significant predictor of work performance (i.e., cooperative values) began to differentiate high and low performing workgroups better than workgroup-level quality management practices. This would imply that informal processes (e.g.,, cooperative management-union relations and valuing differences among individuals) have a cross-level impact equivalent to the workgroup-level effects of job recognition and information access. Another explanation for the lack of empirical support for H9 comes from the recognition that although the strength of workgroup-level quality management practices decreased, the change was very small. This implies that once quality management practices are implemented at the workgroup level, the effects

remain relatively stable over time. Although more investigation is needed, this dissertation has made insights into the effects of quality management through the multiyear analysis used.

This research also posited that the effects of organization-level cooperative cultural values would diminish over time. Similar to hypothesis 7, hypothesis 8 was based on a conjecture that once organizational changes were made, the potential for more change diminishes. This hypothesis, however, was not supported, and, in fact, the strength of cooperative cultural values increased over time. This could be explained two ways. First, it is likely that the amount of organizational structures influenced by organizational values is much greater than the amount of structures influenced by management practices. That is, although quality management practices influence how problems are solved and direction is communicated, it may not influence the hiring practices, interpersonal relations and bargaining agreements that cooperative values may influence. These other processes are part of the routines of an organization (Feldman and Pentland, 2003; Ray, Barney, and Muhanna, 2004). Organizational values likely have a much stronger impact on these than quality management practices. This would imply that the amount of change possible caused by organizational value change is much larger than expected.

A second explanation for why organization-level cooperative values increased in effect year over year may be in the characterization of organizational structures as barriers. That is, it may be that quality management removes those structures that are barriers to organizational effectiveness while

cooperative values add structures that are enablers to effectiveness. This differentiation is most evident in the changing influence on workgroup-level quality management practices. While organization-level quality management decreased, organization-level cooperative values increased. If workgroup-level practices like rewarding creativity and innovation are indicative of other effectiveness enablers, then it follows that a sustained presence of cooperative values may further differentiate high and low performing workgroups. Although more research is needed to support these conjectures, the use of multi-year data to explore the dynamics of the hypothesized model was critical to discovery. Not only did this research make epistemic contributions to quality management, but also towards sociotechnical systems theory, which is presented in the next section.

6.2 Knowledge of Sociotechnical System

This section will discuss the added epistemic insights to sociotechnical system theory resulting from this dissertation. The first subsection will discuss the insights drawn from the single 1998 period, and the second subsection will discuss additions to knowledge based upon the year-over-year results.

6.2.1 Single Period Results (1998)

The theoretical grounding for much of this dissertation has been based upon sociotechnical systems (STS) theory (Emery, 1959; Pasmore, 1988;

Pasmore et al., 1982; Seiler, 1967; Trist et al., 1951). This theory was utilized to explain how quality management and cooperative values were related from a meso-paradigm perspective and a dynamic perspective. Quality management practices were considered to be part of the technological systems used by the different organizational levels for environmental adaptation. Cooperative cultural values were considered to be part of the social systems in an organization functioning to satisfy the human needs for stability and priority. As STS theory views organizations as sociotechnical systems, a reciprocal relationship was expected between quality management practices and cooperative cultural values.

The first period results from this research provide support for the applicability of STS theory to the study of quality management practices and cooperative cultural values. Significant relationships existed among organization-level quality management practices, organization-level cooperative values and workgroup-level quality management practices. This support for the applicability of STS theory to quality management may be useful for future examinations into the antecedents and consequences of this management practice. For instance, the growth of Six Sigma as an important quality management tool could have an impact on the social values of an organization, such as attention to detail or a reluctance to take uninformed action. Moreover, STS theory has predominantly been applied to *physical* manufacturing technologies such as work cells and mass customization (Huber et al., 1991; Liu et al., 2006). However, this research found support for STS theory in a nonprofit

service context. As such, this dissertation could provide the justification to seek applicability of STS theory in other service setting with other management technologies, such as with warehouse management systems (WMS) within a logistics context.

A few empirical results, however, were not accounted for with STS theory and may be areas where the theory needs further development. One issue was in the lack of support in the first period for the relationship between cooperative cultural values and workgroup-level performance. STS theory implied that cooperative values should induce an organizational structure conducive to workgroup effectiveness, but because this was not supported, the theory should be questioned. It may be that cooperative cultural values do not change the structure as expected, or that these changes take longer than can be detected in a single period. These issues, along with other insights from the multiple period data analysis are developed in the next subsection.

6.2.2 Multi-period Results (1998-2000)

The insights for STS theory were enhanced from fitting the theoretical model across consecutive time periods. For instance, the lack of support in 1998 for hypothesis 5 relating cooperative values to workgroup-level performance was changed in 1999 and 2000 to full support. Such a result not only provides more confidence in STS theory, it also gives insight into the delayed influence of social values. It should be noted that each STS theory-based hypothesis was supported in at least one of the years, and that three (i.e., H1, H3 and H6) were

supported in all the years. Overall these results demonstrate the potential for STS theory in future studies.

However, STS theory was unsuccessful in predicting the year-over-year effects. This was evident in the lack of support for two of the three diffusion hypotheses. The STS literature has observed the biased preoccupation STS theorist have toward understanding the effects of technology on social systems (Fox, 1995). This bias can be explained by the field's motivation to find means to improve quality of work life (QWL) for employees (Griffith and Dougherty, 2001). Such a focus has served STS theory well with understanding the consequences of technical system change, but not in the consequences of social system change. As such, the lack of empirical support for most of the diffusion hypotheses may motivate future research into the dynamics of STS theory. This section has presented the epistemic contributions of this research, but practical insights have been made as well and these are presented next.

6.3 Managerial insights

In this section, suggestions for managers on how to use these research findings are presented. Insights are drawn from the single 1998 period results, where the multilevel nature of quality management was validated. This is followed by practical ideas gained from analyzing the multiple years of archival data and comparing year-over-year results.

6.3.1 Insights from a Single Period (1998)

The operations management literature has found that quality management is beneficial for both manufacturing and service operations (Douglas et al., 2004; Kathuria et al., 2001; Zhao et al., 2004). This dissertation, therefore, expected to find support for quality management influencing work performance. The uniqueness of this dissertation, however, is that quality management practices at two distinct organizational levels were tested in a nonprofit service context. Finding support for quality management in this context would broaden the applicability of such a management approach. Analyzing archival data from 1998, support was found for both organization-level and workgroup-level quality management practices influencing workgroup-level performance. This result supports the use of both organization-level practices (e.g.,, cross-functional teams, customer feedback systems, and vision communication) and workgroup-level practices (e.g.,, innovation rewards, employee involvement, and information access) to improve workgroup-level quality and productivity. Moreover, this result supports quality management even in a nonprofit environment where the "voice of the customer" may not be as strong.

Another important point is the high strength and significance of workgroup-level quality management practices. This research did not have an expectation as to which level of quality management would affect workgroup performance more. Because much of the literature on quality management extols the importance of top management support (Brah, Wong, and Rao, 2000; Flynn et al., 1995; Naveh et al., 2004), an argument could be made for organization-level

quality management practices to be most influential for work performance. However, the 1998 archival data show that workgroup-level practices were more influential. This result underscores the necessity for managers to implement change at the lower levels of the organization and to not be satisfied with organization-level change. In fact, subsection 6.3.2 reveals that the work performance impact of organization-level practices diminishes completely by the year 2000. This result provides further support for the importance of distinguishing and emphasizing both "big Q" and "little Q" practices in a quality initiative.

It should be noted that organization-level performance was not a construct measured in this dissertation. Because of this, the importance of organization-level quality management practice should not be diminished. Moreover, because of the cascading influence that organization-level quality management practices have throughout the organization (i.e., inducing cooperative cultural values and workgroup-level quality management practices), its work performance impact may still be strong but indirect. For these reasons, organization-level practices are likely still necessary for the successful quality initiatives but not sufficient.

A crucial decision that managers must make when embarking on a quality initiative is where to allocate resources. Should managers devote personnel time to training in quality practices, or should an organization-wide communication campaign begin the quality initiative? A common theme within the quality management literature is the importance of having a "quality" organizational culture prior to implementing quality management practices (Detert et al., 2000;

Kujala et al., 2004). This dissertation measured a significant portion of what characterizes a "quality" culture through the cooperative cultural values construct (V^O). This dissertation also found support for the hypothesis that organization-level quality management practices are antecedent to cooperative values. A conclusion could be made that resources should be devoted to organization-wide initiatives first and then the right "quality" culture will follow. Such a conclusion is premature. There are well known problems with definitive inferences regarding the direction of causality with cross-sectional data (Mitchell and James, 2001). Moreover, the theoretical model is by no means deterministic as Table 5-13 shows. An insight from this dissertation is the possibility that a simultaneous approach may be the most beneficial. That is, rather than embarking solely on an organization-wide culture change initiative that could have uncertain consequences (Harris et al., 2002), this research implies implementation of organization-level quality management practices simultaneously complements and aids the culture change process.

6.3.2 Multi-period Results (98-00)

An important question faced by managers is the stability of effects that can be expected throughout the years of a quality initiative. That is, the impact of organization-level and workgroup-level quality management practices may diminish from their initial effects. If this is so, managers must be aware of changes that may ensue. This is one of the motivations for the longitudinal design employed by this dissertation.

A review of the year-over-year comparisons made in Tables 5-16 and 5-17 revealed two relationships that appeared relatively unchanged from 1998 to 2000. These relationships were between 1) organization-level quality management practices (Q^O) and organization-level cooperative cultural values (V^O); and 2) workgroup-level quality management (Q^W) practices and workgroup-level performance (P^W). It should be noted that these were the only same-level relationships posited in the theoretical model. The relative stability of the Q^O-V^O relationship implies that these two concepts are tightly coupled. In addition, the managerial insight is that a sustained effort at implementation of organization-level quality management practices should have a marked effect on the values of the organization. The other stable relationship (i.e., between Q^W and P^W) has quite similar implications and should lend support to managerial convictions that workgroup-level quality management practices will make a difference.

The unexpected result found in the rising influence of organization-level cooperative cultural values should be brought to the attention of managers who are narrowly focused on the technical aspects of a quality initiative. From the initial non-significant relationship between cooperative values and work performance in 1998 to highly influential impact in 2000, the growing influence of this organization-level construct is remarkable. The managerial insight is that highly performing workgroups will be differentiated based in part by the level at which that workgroup's organization values cooperation. The expectation was that organizations with both *formal* Q^O characteristics and *informal* V^O characteristics will aid in workgroup-level performance. What is instead implied

is that the *formal* characteristics have only short-term workgroup benefits and that the truly long-term gains are realized by the more *informal* characteristics. Therefore, attention to organization-level cooperative cultural values and their ilk is likely necessary.

A final unstable relationship that managers should take note of is the decreasing impact of organization-level quality management practices on workgroup-level performance. In a general sense, while organization-level cooperative values rose in prominence, the organization-level quality management practice declined. It should be noted that a decline in influence was expected because of the diminishing number of potential removable barriers to work performance. However, an important causal chain from organization-level quality management practices to workgroup-level performance remained in effect throughout the quality initiative. That is the following process: $Q^O \rightarrow V^O \rightarrow Q^W \rightarrow P^W$. In each year this connection remained strong and in place. The managerial insight is that perhaps this should be the mental model of why organization-level quality management practices matter to an organization. That is, although a direct Q^O-P^W relationship is temporary, a stable indirect relationship should be maintained in order to reap the full benefits of a quality initiative.

6.4 Summary of Discussion

This chapter discussed how the findings from this research have made substantial contributions to study of quality management and its interaction with organizational values and workgroup performance. The validated multilevel

perspective of quality management practices helped explain a theoretical paradox unresolved in the current literature. Moreover, the longitudinal analysis, which is uncommon in the quality management literature, helped develop insights into the sociotechnical changes during a quality initiative. In addition, managerial suggestions were provided regarding why to take a simultaneous approach towards instituting both cooperative cultural values and quality management practices. The next chapter will draw final conclusions regarding this dissertation research, present insights from quality managers regarding the results, discuss research limitations and propose directions for future research.

CHAPTER 7: CONCLUSION

In this chapter, a summary of this dissertation is given that highlights the background, propositions, methods, findings and implications of this research. Following this summary is a review of the limitations of this study and potential avenues for future research.

7.1 Summary of Research

The lack of success of many quality management initiatives has perplexed researchers and managers alike (Choi et al., 1998). Extant literature has examined the various possible reasons for this lack of success (Schroeder et al., 2005). One prominent finding has been the association of quality management practices with cooperative cultural values (Detert et al., 2003; Detert et al., 2000). However, the question of how these values are associated with quality management has been unresolved; researches have adopted either an antecedent or consequent position but have not incorporated both. This research proposed a meso-paradigm model that sought resolution for the questions: what role do cooperative cultural values play in a quality initiative and what changes should be expected over time?

In order to develop the meso-paradigm model, literatures from different disciplines were required (see Figure 2-1). First, the quality management literature was utilized to distinguish between the multilevel and dynamic nature of

quality management practices (Juran, 1989; Narasimhan et al., 2001). Next the organization theory literature was examined to identify the types of cultural values that associate with quality management, as well as how these values may change over time (van Woerkom, 2004; Wagner, 1995). A review of empirical studies that investigated similar issues was conducted to determine where further research was required. Finally, a sociotechnical system theory-based set of single and multi-period hypotheses (see Figure 3-1) were proposed to seek resolution for the apparent epistemic paradox.

To find support for posited research framework the use of archival data was required and this was accomplished from a publicly available data source. A multiyear employee survey administered within the federal government during a portion of its seven year quality initiative was utilized (O.P.M., 2002). A measurement model based on extant literature in quality management and organization theory was tested and supported by the archival data. To avoid threats to validity, extensive measures were taken to maximize the use of information, control for underlying biases, and check for measurement adequacy. The multilevel model was then tested over three consecutive years and conclusions were drawn regarding the six single period hypotheses. In addition, year-over-year comparisons were made in order to find support for the three diffusion hypotheses.

The findings from this data analysis were original and valuable. First, it was confirmed that an empirical and causal discrimination exists between organization-level and workgroup-level quality management practice. The

implication was that researchers and managers should account for this difference when considering a quality initiative. Second, support was found for the posited relationship between cooperative cultural values and quality management practices. This result presented a possible resolution to the existing paradox in the literature and gave insight to managers for where to allocate resources in a quality initiative. Third, the multi-period benefits of quality management and cooperative cultural values in a governmental context were insightful. Such a finding supports the claim that quality management, and more generally operations management, has applicability in nonprofit service situations. Finally, the unexpected rise in prominence of cooperative cultural values during the quality initiative was remarkable. This finding motivated a reexamination of some STS theory premises and also called for managers to assure attention is given to cooperative values in a quality initiative.

7.2 Reactions from Managers

An important component of this research was the presentation of the findings to quality managers from several manufacturing facilities that had recently undergone quality initiatives. Three plant-level managers and one corporate-level manager were interviewed. Their titles are listed in the appendix (A.3). The managers were forwarded summary material in advance and then interviewed collectively via teleconference. This conference was recorded with the managers' consent and later transcribed for analysis. The managers

expressed agreement with some of the major findings but disagreement with others. In addition, the managers suggested areas of future research.

The quality managers unanimously agreed that cooperative cultural values should be highly influential in determining how permanent newly implemented quality management practices would be. One plant-level manager mentioned that "if (quality management) becomes part of the value system, then it'll maintain... managers will no longer need to be involved." The corporate-level manager interpreted the results to mean that "values replace practices because we believe in it, not because we say it." This same manager commented that he has observed the following: "a culture develops that won't let (quality management) die. If a leader changed the quality push, the people would revolt!" These comments show that one of the findings from this research resonates with quality managers.

There was also concurrence with the STS theory claim that cultural values can be influenced by management practice implementation. A plant-level manager told a story about multiple plants within his business unit;

> "Each had its own identity (and would not cooperate with each other). To counter act this, we changed the profit and loss reports to be at the business unit level, not the plant. This had a huge change, plants stopped being so individualistic. Another way was through process improvements – evaluating best practices at each plant and then duplicating efforts in other plants."

These examples show how management practices can influence cultural values. The corporate-level manager summarized the process as follows: "as groups install quality practices, and once things get to some level of success, people transform into being believers."

Some lack of support was given by two plant-level managers as to the discrimination between organization-level quality management practices and organization-level cooperative values. "There isn't a distinction," was there primary comment. This shows how tightly coupled cooperative cultural values can be with quality management. In addition, one plant-level manager could not understand why organization-level quality practices diminished in their influence on workgroup-level practices. "I'd think the effects of organization-level quality would be increasing over time. Unless (organization-level quality) is continually reinforced, then workgroup-level performance dies." The effect this manager described could still occur through the $Q^O \rightarrow V^O \rightarrow Q^W \rightarrow P^W$ process discussed in section 6.3.2, but at least one plant-level manager firmly believed there was a direct effect.

The discussion of the research findings with quality managers provided richer insights into the multilevel relationships examined herein. Moreover, they suggested future research should account for the amount of leadership involvement and measure the depth of deployment of practices. As one manager put it, "it takes a while before the teams buy in, but with management support, they really start believing and doing things we wouldn't have thought of."

7.3 Limitations of study

There are some important limitations of this dissertation. The lack of detailed information on respondent characteristics prevented some issues to be examined. That is, a contrast could not be made between managers and non-

managers, nor between unionized and non-unionized employees. In addition, context-specific factors such as whether the workgroup served a front-line or support function were not accessible. Moreover, the tracking of unique workgroups within each organization from year to year prevented a more detailed dynamic analysis. Each of the above queries was prevented because of data inaccessibility and would have added more clarity to the research.

Another limitation to this research was the use of perceptual measures for the quality management and work performance constructs. This is a known issue for much survey research and the potential problems have been well documented elsewhere (Ketokivi and Schroeder, 2004). As such, the findings of this dissertation should be understood within the context of those limitations. It should be noted that direct measures of observable quality management practices at the organization and workgroup level were not available for consideration in the archival data. Moreover, objective measures of workgroup-level performance would have been difficult to attain given the lack of unique workgroup identification. This lack of data availability does not discount the research results given here but motivates the need for future research, discussed next.

7.4 Future research

Multiple avenues for future research should be pursued to further elucidate relationships among quality management practices, cooperative cultural values and work performance. Specifically, factors that may potentially

moderate the various relationships should be examined. For example, the effects of organizational size and employee turnover could significantly moderate the influence of organization-level quality management practices and cooperative cultural values. Moreover, the benefits of both organization and workgroup-level quality management practices may have changed depending upon the proximity each workgroup had to customers. Another moderator could be the variance in respondent measures of cultural values. Such variance could serve as a proxy for cultural strength; a strong culture could be harder to influence but at the same time be more influential. These and other moderators should be examined in future research.

The intent of this research was to assess the possibility of cross-level influences within multiple single periods. However, future research can be done investigating the viability of cross-period influences within a multilevel model. That is, further support for the direction of influence from organization-level quality management practices to organization-level cooperative cultural values if prior periods can predict future period outcomes (Mitchell et al., 2001). A dynamic econometric methodology is a choice for approaching issues of this manner (Hendry, 1995). This approach could also include objective organization-level measures obtainable from known public sources. Valuable insights may be gained from this dynamic examination of such a sociotechnical system.

An important finding of this dissertation is the stable causal sequence discussed in section 6.3.2. That is, the sequence characterized as

$Q^O \rightarrow V^O \rightarrow Q^W \rightarrow P^W$. This process of influence could well be explored through a case study methodology using the approach of narratives (Pentland, 1999). The case studies could utilize retrospective interviews (Cohen, Kasen, Bifulco, Andrews, and Gordon, 2005) to create generic narratives– i.e., a fabula (Langley, 1999) – that may explain the empirical observation of the aforementioned causal sequence. The outcome from such an investigation would be an even richer conceptualization of the relationships among quality management practices, cooperative cultural values and work performance.

7.5 Summary

This dissertation has suggested a resolution to a theoretical paradox previously unresolved by extant literature. Such a resolution was possible through a reconceputalization. That is, utilizing Juran's "big Q" and "little Q" quality management insight, support was found for a multilevel model explaining how quality management can be both an antecedent and a consequent of cooperative cultural values. However, this study does not conclude the search for clearer understandings on this issue. Rather, it inspires further attempts to clarify why quality management, cooperative values and workgroup performance relate as they do. Moreover, the benefits of acknowledging the multilevel nature of quality management should motivate researchers to explore how other practices may have similar effects. Only through improving our understanding of the management practices we use can we suggest new and better management methods in the future.

APPENDIX

A.1 Imputation

The overall difference between actual and imputed values is shown in Table A-1. The means demonstrated a median difference of less than 0.003 for each year, while the median correlation difference was less than 0.06 for each year. These differences were deemed not substantial to warrant concern and therefore analysis progressed to factor analysis.

Table A-1: Difference Statistics Between Actual and Imputed Values

	1998	1999	2000
Median absolute difference in mean	0.0007 (0.02%)	0.0021 (0.06%)	0.0029 (0.09%)
Median absolute difference in correlation	0.0005 (0.13%)	0.0201 (4.98%)	0.0507 (13.02%)

A.2 Factor Scoring

Grice (2001) assigned a value of 1/3 but described this as somewhat arbitrary. In this dissertation the goal was for the factor scores to closely replicate the CFA factor correlations. As such multiple iterations were conducted to adjust a until the score-based factor correlations were within .05 of the CFA factor correlations. The result of this procedure was a a of 1/4 and the subsequent weight matrix is shown in Table A-2. An important feature in recognizing factor obliqueness is that many items have multiple factors in which

they reflect. In addition, one item (Q26) is not used at all and one item (Q17) serves to decrease three factors.

Table A-2: Matrices from Factor Scoring Procedure on 1998 Data

	$\mathbf{S}_{vf}$: Structure Matrix				$\mathbf{W}^{U}_{vf}$: Unit Weight Matrix			
	Q^O	Q^W	V^O	P^W	Q^O	Q^W	V^O	P^W
Q2	0.634	0.562	0.589	0.494	1	1	1	0
Q3	0.770	0.682	0.714	0.600	1	1	1	0
Q4	0.653	0.675	0.668	0.839	0	1	1	1
Q9	0.568	0.503	0.527	0.442	1	0	0	0
Q11	0.685	0.773	0.710	0.622	0	1	1	0
Q13	0.587	0.521	0.545	0.458	1	0	0	0
Q14	0.564	0.558	0.608	0.484	1	0	1	0
Q16	0.592	0.586	0.637	0.508	0	0	1	0
Q17	0.463	0.479	0.474	0.595	-1	-1	-1	0
Q21	0.461	0.457	0.497	0.396	0	0	1	0
Q25	0.654	0.648	0.705	0.562	1	0	1	0
Q26	0.380	0.429	0.394	0.345	0	0	0	0
Q30	0.716	0.807	0.742	0.650	1	1	1	0
Q31	0.721	0.814	0.748	0.655	1	1	1	0
Q32	0.678	0.700	0.693	0.870	1	1	1	1
Q33	0.511	0.528	0.523	0.656	0	0	0	1

A.3 Titles of quality managers interviewed

Four quality managers were interviewed for their reaction to the findings of this research (as described in section 7.2). There were three plant-level managers and one corporate-level manager. The plant-level managers' titles were as follows: Business Excellence & Six-Sigma Manager, Director of Research and Development (with Malcohm Baldridge Award involvement since 1990), and Total Quality Manager. The corporate-level manager's title was Senior Consultant on Business Excellence.

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