Deming Management Method: Subjecting Theory to Moderating and Contextual Effects

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W. Edwards Deming's ideas on quality management, expressed in hypothetico-deductive theoretical form by Anderson, Rungtusanatham, and Schroeder (1994), have been empirically tested at the organizational level in the manufacturing and service sectors in a handful of Western countries and Japan. These studies show generally good empirical support for the theory, thus providing a plausible "road map" on how organizations succeed through quality management. The authors' study seeks to improve the validity and applicability of the theory. They used a standard measurement instrument to collect data from 367 civil servants from five public-sector organizations in Singapore. Using structural equation modeling data analysis technique, they established that these organizations generally appear to act in a manner consistent with the theory, but the patterns of relationships as predicted by the theory are not completely similar across these organizations. Also, individual-level factors (positional authority and length of tenure) have an impact on how well the theory holds. Further, since the study was in a new industry sector (public sector) and country context (Singapore), the generally positive results enable the authors to tentatively conclude that the theory applies to these contexts.

Key words: Deming, moderator, quality management, public sector, Singapore, structural equation modeling, theory

INTRODUCTION

A key objective of many organizations in both public and private sectors is to systematically and sustainably improve the quality of their product or service offerings. Several studies over time have shown that implementation of quality management (QM) enables organizations to achieve this outcome (Womack, Jones, and Roos 1990; Bowles and Hammond 1991; U.S. General Accounting Office 1991; American Quality Foundation and Ernst & Young 1993; Ahire, Landeros and Golhar 1995; Powell 1995; Hendricks and Singhal 1996; Easton and Jarrell 1998). Over time, a number of specific QM frameworks and programs have been proposed to achieve this objective. These can broadly be classified into three groups: 1) formal and quasi standards such as ISO 9000, and quality and business excellence awards; 2) academic-research-based empirically validated models; and 3) road maps proposed by prominent gurus such as W. Edwards Deming, Joseph Juran, and Philip Crosby. In this paper, the authors focus on the third group and specifically target the seminal works of W. Edwards Deming, widely regarded as the preeminent personality of the QM movement (Anderson, Rungtusanatham, and Schroeder 1994; Rungtusanatham et al. 1998; Kleiner 2008).

Deming's ideas, garnered over a long consulting career in Japan and elsewhere, were consolidated into a list that he labeled "14 Points of Management" (Deming 1986). A number of higher-order themes that he strongly advocated can be found in these points. These include the need for systems thinking, developing "profound knowledge," ensuring management takes due responsibility for failures, and "unshackling" employees so they

can be more effective in their workplaces (Edgeman and Fraley 2008). Together, these are referred to as the Deming Management Method (DMM) (Walton 1986).

Deming's ideas, particularly the 14 points, were appealing to many practitioners in manufacturing organizations in the United States and other Western countries, who, in the 1980s, had difficulties responding to competitive challenges from companies from Japan and some newly industrialized countries (El Shenawy, Baker, and Lemak 2007; Knouse et al. 2009). Many manufacturing companies used Deming's ideas to respond to these challenges (Walton 1986; Gabor 1990; Yoshida 1995; Kleiner 2008). Subsequently, many service organizations and government departments have also attempted to use these ideas (Little 1994; Kidder and Ryan 1996; Gustafsson, Nilsson, and Johnson 2003; Taveira et al. 2003; Gupta, McDaniel, and Herath 2005; Hales and Chakravorty 2006; Tang 2008).

Despite the popularity of Deming's ideas, evidence of their efficacy has been lacking. A number of researchers have attempted to provide a more rigorous and systematic assessment of the DMM by analyzing the theoretical bases of Deming's ideas (Anderson, Dooley, and MIsterek 1992). Subsequently, a formal theory, research propositions, conceptual diagram (Anderson, Rungtusanatham, and Schroeder 1994), path analytical diagram (Anderson et al. 1995), and testable hypotheses (Rungtusanatham et al. 1998) were proposed. This theoretical model has been tested in a variety of domains using different data analysis methodologies (Anderson et al. 1995; Rungtusanatham et al. 1998; Douglas and Fredendall 2004; Fisher, Barfield, and Li 2005; Rungtusanatham et al. 2005). The evidence to date shows that the theory has some level of empirical support.

Notwithstanding these efforts, several important research questions remain. One such question relates to the impact of factors that operate at different levels. The theory has been tested at the organizational level, with the implicit assumption that it only operates at this level. The impact of individual-level factors on the applicability of the theory to organizations is unclear, with none of the studies mentioned previously involving empirical validation of the DMM theory checking for moderating influences of these factors. This is important, as studies have shown that the application of many management

theories and concepts is affected by both individual- and nonindividual-level factors (Klein, Dansereau, and Hall 1994; Yammarino and Dansereau 2002; Dansereau, Cho, and Yammarino 2006). In fact, several studies that have tested some of Deming's ideas for internal organizational effects (Taveira et al. 2003; Hales and Chakravorty 2006) have suggested (without testing) the presence of within-organization variance. Therefore, the impact of individual-level factors requires closer scrutiny.

Another research issue that requires further examination is industry sector effects. Studies to date have focused on the applicability of the theory to private for-profit organizations, mostly from the manufacturing sector (for example, Walton 1986; Gabor 1990; Yoshida 1995; Kleiner 2008), and some service industry organizations (for example, Gustafsson, Nilsson, and Johnson 2003; Gupta, McDaniel, and Herath 2005; Hales and Chakravorty 2006; Tang 2008). The theory has not been thoroughly and rigorously tested in the public sector context. As more and more public, nonprofit organizations are embracing quality management ideas (McAdam, Reid, and Saulters 2002), it is important to investigate how the ideas embodied within the theory will apply to public sector organizations.

Country context is another important research issue. The theory has been tested with data from organizations located in only a handful of developed countries from North America, Europe, and Japan. It remains unclear whether the theory is robustly applicable across different cultural and national contexts.

Finally, from a methodological perspective, previous studies have used composite measures for constructs, averaged responses from multiple respondents to arrive at a single score for the organizations, or used single respondents to represent organizations. While these are widely used practices in empirical studies, nonetheless, the methodology literature does note their limitations (see, for example, Hair Jr. et al. 2006; Podsakoff and Dalton 1987; Podsakoff et al. 2003). In previous DMM studies, these methodological limitations have reduced detail and specificity, and could have introduced biases, thereby reducing the reliability and validity of the findings.

In this paper, the authors address the aforementioned research gaps and issues through an empirical study where the DMM theory was tested with data from

367 individual employees from five public sector organizations in Singapore. A modified version of the measurement instrument from Anderson et al. (1995) was used for data collection, and multivariate analysis of variance (MANOVA) and structural equation modeling (SEM) techniques were used for data analyses.

This paper makes several contributions. First, it serves as a replication and validation study on the constructs and relationships as depicted in the DMM theory across organizations. Thus, the authors' findings will add to the literature and provide additional clarity on claims relating to the operation of the theory at the organizational level. Second, the authors address a gap in the literature by assessing the theory for individual-level effects. Third, the authors attempt to expand the domain range for the applicability of the theory in two important contextual directions: new industry sector (that is, the public sector) and new country (that is, Singapore). This aspect contributes toward the understanding of how a managerial system developed in one industry sector or country applies to other industry and country contexts. Collectively, the authors' theory-testing efforts contribute to theory building and assist in knowledge consolidation of ideas that have been widely acknowledged as having had profound impact on many organizations. As highlighted in Anderson, Rungtusanatham, and Schroeder (1994), there is a need to test the DMM theory more rigorously and widely to establish its generalizability and applicability across sectors, countries, industries, employee groups, and time periods.

LITERATURE REVIEW AND HYPOTHESES

Deming's 14 Points and the DMM Theory

From a theory perspective, Deming's 14 points, summarized in Figure 1a, have been criticized for their prescriptive form (Anderson, Rungtusanatham, and Schroeder 1994). In essence, the 14 points do not describe, explain, and predict the effects of adopting the DMM. The statements are not in hypothetico-deductive form, making empirical testing difficult. Anderson, Rungtusanatham,

and Schroeder (1994) addressed the shortcomings of the 14 points by proposing a formal theory to conceptualize and consolidate Deming's philosophies, using the Delphi method that involved a panel of seven experts on Deming's ideas. In its final form, the theory is stated as:

> "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" (Anderson, Rungtusanatham, and Schroeder 1994, 479-480).

This theory comprises seven constructs. Figure 1b lists these and their definitions. Anderson, Rungtusanatham, and Schroeder (1994) identified four propositions that explain the causal relationships among the seven constructs (see Figure 1c). From these propositions, Rungtusanatham et al. (1998) developed eight testable hypotheses (see Figure 1d). Figure 1e (Rungtusanatham et al. 1998) depicts a path diagram that summarizes the theory by identifying the propositions, constructs, and hypotheses.

Empirical Validation of the DMM Theory

Several empirical studies tested and validated the Deming-based theory (see Table 1). These studies have a number of commonalities. First, these studies are consistent in the use of the DMM theory and the accompanying model as described in Anderson et al. (1995). Second, similar measurement items and scales were used to operationalize the constructs, with most making minor changes to the original instrument used in Anderson et al. (1995) to suit national and industry contexts. (The exception is Douglas and Fredendall [2004] where the customer satisfaction construct was broadened to include financial performance and a hospital audit score, with the final outcome construct labeled as "business performance.")

Figure 1 Elements of the Deming Management Method theory.

(a) Deming's 14 Points (Deming 1986, 23-24)

1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on mass inspection.
4. End the practice of awarding business on the basis of price tag alone.
5. Improve constantly and forever the system of production and service.
6. Institute training.
7. Adopt and institute leadership.
8. Drive out fear.
9. Break down the barriers between staff areas.
10. Eliminate slogans, exhortations, and arbitrary targets for the workforce.
11. Eliminate numerical quotas for the workforce and numerical goals for management.
12. Remove barriers that rob people of pride of workmanship.
13. Institute a vigorous program of education and self-improvement for everyone.
14. Make everyone in the firm take action to accomplish the transformation.

(b) Constructs and nominal definitions (Anderson, Rungtusanatham, and Schroeder 1994, 480)

Visionary leadership: The ability of management to establish, practice, and lead a long-term vision for the organization, driven by changing customer requirements, as opposed to an internal management control role.

Internal and external cooperation: The propensity of the organization to engage in noncompetitive activities internally among employees and externally with respect to suppliers.

Learning: The organizational capability to recognize and nurture the development of its skills, abilities, and knowledge bases.

Process management: The set of methodological and behavioral practices emphasizing the management of process, or means of actions, rather than results.

Continuous improvement: The propensity of the organization to pursue incremental and innovative improvements of its processes, products, and services.

Employee fulfillment: The degree to which employees of an organization feel that the organization continually satisfies their needs.

Customer satisfaction: The degree to which an organization's customers continually perceive that their needs are being met by the organization's products and services.

(c) Propositions (Anderson, Rungtusanatham, and Schroeder 1994, 492-495)

Proposition 1: Visionary leadership enables the simultaneous creation of a cooperative and learning organization.

Proposition 2: An organization that simultaneously fosters cooperation and learning facilitates the implementation of process management practices.

Proposition 3: Process management practices simultaneously result in continuous improvement of quality and employee fulfillment.

Proposition 4: An organization's simultaneous efforts continuously to improve its quality and to fulfill its employees lead to higher customer satisfaction.

(d) Hypotheses (Rungtusanatham et al. 1998, 83-84)

H1: Visionary leadership is not positively related to internal and external cooperation.

H2: Visionary leadership is not positively related to learning.

H3: Internal and external cooperation is not positively related to process management.

H4: Learning is not positively related to process management.

H5: Process management is not positively related to continuous improvement.

H6: Process management is not positively related to employee fulfillment.

H7: Continuous improvement is not positively related to customer satisfaction.

H8: Employee fulfillment is not positively related to customer satisfaction.

(e) A path model of the Deming Management Model (Rungtusanatham et al. 1998, 84)

The psychometric properties of items and constructs covered in the measurement instruments in the respective studies were at generally acceptable levels. Third, the data analysis techniques (path analysis, SEM, multiple regression analysis) all produced results in the form of standardized regression coefficients and R-squared values to measure the strength of the hypothesized relationships between constructs. As a result, it is possible to compare the outcomes of these studies.

Table 1 Empirical studies on Deming Management Method theory.					
Study	**Anderson et al. (1995)**	**Rungtusanatham et al. (1998)**	**Douglas and Fredendall (2004)**	**Fisher, Barfield, and Li (2005)**	**Rungtusanatham et al. (2005)**
Domain					
Country setting	United States	Italy	United States	United States and Canada	Germany, Italy, Japan, and United States
Industry setting	Manufacturing: American and Japanese owned electronics, machinery, and transportation component (WCM research project—Round I)	Manufacturing: Italian and overseas owned machine tool, electronics, and transportation-related (part of WCM research project—Round II)	Service (healthcare)	Manufacturing and service	Manufacturing: local and overseas owned electronics, machinery, and transportation-related (WCM research project—Round II)
Sample size (response rate)	41 (60%)	43 (51%)	193 (38%)	101 (66%)	143
Study participants	Multiple individuals	Multiple individuals	CEO and director of quality	Individual executives	Multiple individuals
Level of analysis	Plant (>100 employees)	Plant	Hospital	Companies (of various sizes)	Plant
Measurement Instrument					
Constructs as defined in Anderson et al. (1994)	Unchanged	Unchanged	One major change—Customer satisfaction to business performance	Unchanged	
Items	33 items in total	33 items in total from Anderson et al. (1995)—some modified, new items added, and several dropped	44 items in total obtained from QM literature	33 items in total from Anderson et al. (1995)—some modified	21 items in total, subset of Rungtusanatham et al. (1998)
Reliability	Cronbach's alpha coefficients > 0.6 for all constructs	Cronbach's alpha coefficients > 0.6 for all constructs	Cronbach's alpha coefficients > 0.6 for all constructs	Cronbach's alpha coefficients > 0.6 for all constructs	Cronbach's alpha coefficients > 0.6 for all constructs
Validity	Exploratory factor analysis showed that items were unidimensional for all constructs.	Principal components factor analysis showed one factor extracted for each construct.	Not discussed	Exploratory factor analysis showed that items were unidimensional for five constructs.	Principal components factor analysis showed one factor extracted for each construct
Data Analysis					
Procedure used to test relationships	Path analysis	Path analysis	Structural equation modeling	Path analysis	MANOVA and regression analysis
Relationships					
Visionary leadership → Internal external cooperation	Strong	Strong	Strong	Strong	Strong for all countries
Visionary leadership → Learning	Strong	Weak	Strong	Strong	Strong for all countries

Table 1	Empirical studies on Deming Management Method theory (continued).				
Study	Anderson et al. (1995)	Rungtusanatham et al. (1998)	Douglas and Fredendall (2004)	Fisher, Barfield, and Li (2005)	Rungtusanatham et al. (2005)
Internal and external cooperation → Process management	Strong	Strong	Moderate	Strong	Strong for all countries
Learning → Process management	None	None	Moderate	Strong	Strong for all countries
Process management → Continuous improvement	Moderate	Strong	Strong	Strong	Strong for all countries
Process management → Employee fulfillment	Moderate	None	Strong	None	None for Germany and Italy. Strong for Japan and United States.
Continuous improvement → Customer satisfaction	None	Weak	None	Strong	Strong for all countries
Employee fulfillment → Customer satisfaction	Strong	None	Moderate	None	None for Germany and Italy. Strong for Japan and United States.
Overall Conclusion					
	Qualitative assessment: Reasonable support for theory	Qualitative assessment: Mixed support for theory	Quantitative assessment: Reasonably good support for theory	Qualitative assessment: Generally good support for theory. Employee fulfillment "troublesome" construct.	Qualitative assessment: Generally good support for theory. More similarities between countries than differences

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Comparing DMM Across Organizations

So far, the interpretations of Deming's work (Anderson, Dooley, and Misterek 1992; Anderson, Rungtusanatham, and Schroeder 1994; Rungtusanatham et al. 1998) have largely assumed that the DMM theory operates at the organizational level. A majority of the empirical studies (Anderson et al. 1995; Rungtusanatham et al. 1998; Lee et al. 1999; Douglas and Fredendall 2004; Fisher, Barfield, and Li 2005; Rungtusanatham et al. 2005) have also

made this assumption. This assumption means that there is within-organization homogeneity and across-organization heterogeneity with respect to the DMM.

At the organizational level, the results of the empirical studies are remarkably similar in terms of the relationships between constructs in the model (Anderson et al. 1995; Rungtusanatham et al. 1998; Lee et al. 1999; Douglas and Fredendall 2004; Fisher et al. 2005; Rungtusanatham et al. 2005). Table 1 shows that, in most cases, the pattern of hypothesized relationships among the seven constructs are as predicted by the theory. Most relationships are moderate to strong in magnitude

and positive in direction. Only one construct, employee fulfillment, seems to lack empirical support; the prior and posterior relationships of this construct with other constructs are statistically insignificant in most cases. Overall, the similarities in results lend tentative support to claims of universal applicability of the theory across the domains and contexts in which it has been tested.

From a theoretical viewpoint, the institutional theory (Meyer and Rowan 1977; DiMaggio and Powell 1983; Powell and DiMaggio 1991; Selznick 1996) perspective is popular in understanding how QM programs such as the DMM manifest themselves in organizations. The view purports that organizations are consensual, homogenous, and mechanistic, and become isomorphically similar through externally imposed mimetic, normative, and coercive forces. Less popular is the critical theory (Clegg 1975; Burrell and Morgan 1979; Alverson and Willmott 1992; Parker 1995) view that treats the DMM not as a monolithic system that is applied mechanistically, but as a socially constructed management system that people adopt, reinterpret, and apply, depending on the contingent situation of the organization. Considered together, these theories reinforce the notion of within-organization homogeneity and across-organization heterogeneity with respect to the DMM.

Based on strong theoretical justification (Anderson, Dooley, and Misterek 1992; Anderson, Rungtusanatham, and Schroeder 1994; Rungtusanatham et al. 1998) and empirical support to date (Anderson et al. 1995; Rungtusanatham et al. 1998; Douglas and Fredendall 2004; Fisher, Barfield, and Li 2005; Rungtusanatham et al. 2005), it is hypothesized that:

- *Hypothesis 1: A similar pattern of relationships between constructs in the Deming Management Method theory holds across different organizations.*

Moderating Influence of Individual-Level Factors on the DMM

As discussed earlier, it has generally been assumed that the DMM is an organization-level theory, and by implication, other levels such as individual-level factors do not influence its application. However, social science researchers in various fields have long acknowledged that many management concepts and theories operate or are affected by factors at the individual, group, organization, industry, national, and other levels (Rousseau 1985; Klein, Dansereau, and Hall 1994; Yammarino and Dansereau 2002; Dansereau, Cho, and Yammarino 2006). More specifically, DMM-related research that has focused on internal organizational effects shows that there is a presence of within-organization variance (Taveira et al. 2003; Hales and Chakravorty 2006). Thus, the assumption of within-organization homogeneity with respect to the DMM could be limiting its utility at best, or at worst, could be contributing to incomplete theorizing, conceptualizing, and analysis of issues related to the theory.

In this study, the authors reassessed this assumption of within-organization homogeneity by testing for the moderating influence of two key individual-level factors on the DMM. These factors are positional authority of individuals and the length of tenure in their organizations. They selected these because research in the organizational studies area shows that these factors have a strong influence on the success of management programs. However, there are no studies to date that have examined their influence on QM programs such as the DMM.

Positional authority of individuals

While the DMM addresses both managers and operational employees, the emphasis is on managers (Douglas and Fredendall 2004). Deming (1986) made it a manager's responsibility for creating the workplace system that reflects his ideas. As such, in organizations where the DMM is implemented (consciously or otherwise), one would expect that managers not only act and behave in a manner consistent with the features of the theory, but also proactively create the system that bears the characteristics of the theory (Taveira et al. 2003; Hales and Chakravorty 2006), as is generally the case in QM (Taylor 1997). This would require them to take the necessary steps to install and maintain the system. Further, they would monitor the system and be affected or guided by it. For operational-level employees, however, the level of engagement would be much less than managers—employees would act within the designed system in a manner consistent with theory (Taveira et al. 2003; Hales

and Chakravorty 2006). Hence, the span of activities covered by the theory would be more expansive for managers than it would be for employees.

There could also be a perceptual gap between the two groups. Research has shown that managers frequently present an overly positive view of QM implementation, which might not be matched by the real experience of others in the organization, leading to the "rhetoric versus reality gap" (Zbaracki 1998). If this gap is large (QM being high on rhetoric and less prevalent in reality), one could conclude that managers' views are formed for external reasons, as predicted by institutional theory (DiMaggio and Powell 1983; Powell and DiMaggio 1991). Even if this gap is small, managers generally would still prefer to exercise a more optimistic view, as research shows that senior management has a strong influence on the implementation of QM initiatives (Yeung, Lee, and Chan 2003; Soltani 2005; Soltani, Lai, and Gharneh 2005; Chowdhury, Paul, and Das 2007).

Another key difference relates to knowledge of Deming's ideas for the two groups. Managers would be expected to be more knowledgeable about Deming's ideas and QM in general (Taylor and Wright 2003). Experienced managers would have attended training courses and workshops in the 1980s and 1990s, and many may have formally studied these quality ideas in university or college. On the other hand, lower-level employees may not have had as much educational and experiential exposure to these concepts. Given the strategic and philosophical nature of some of the practices, it is more likely that managers would be more informed about and aware of these than their nonmanagerial colleagues.

An additional insight can be obtained from a traditional view of change management, which suggests that managers, as change agents, are likely to view management programs such as the DMM more favorably than nonmanagers. These managers are likely to think they are doing the right things while workers as change recipients throw up unreasonable obstacles or barriers intent on disrupting the change (Dent and Goldberg 1999; Ford, Ford, and D'ameio 2008).

Given the different roles of managers and nonmanagers under the DMM, the differences in perception, and the level of familiarity of the two groups with Deming's ideas, it is posited that:

- *Hypothesis 2a: The pattern of relationships between constructs in the Deming Management Method theory holds more strongly for individuals with high positional authority than those with low positional authority.*

Length of tenure

Another individual-level moderating factor that could affect the way in which the theory applies is the time period that an employee has spent within an organization. Employees who have been with their organizations for long periods of time tend to have a better understanding of their jobs (Cohen 1991; Cohen 1993; Sturman 2003). Assuming the ideas embodied within the DMM offer positive organizational outcomes, and that these individuals act rationally, then these individuals with more experience would act in ways that are in accordance with the theory more than would individuals who have less experience. Similarly, the emerging view from the change management literature supports the notion that more experienced employees are likely to be more proactive in embracing change in the form of the DMM. Ford, Ford, and D'ameio (2008) and Dent and Goldberg (1999) argue that a more balanced view of resistance to change involves the realization that much of the resistance to change is not real and only attributable to change recipients, but is usually a creation and perception of change agents. As such, when the DMM ideas are first implemented (say, as part of a culture change program (Snee 2008)), these should not be too difficult to implement. Further, the more experienced employees, if adaptable, could make quicker change transitions because of their greater role and organizational familiarity. However, in some organizations, long-serving employees tend to loathe change. In these cases, newer employees might possess less resistance to embracing change. But in industry sectors such as the public sector, industrial relations arrangements are such that the flexibility to recruit new workers is limited, forcing organizations to deal with existing employees (Foster, Howard, and Shannon 2002). Even if new employees can be recruited, it usually takes time for them to learn and become effective contributors. As a result, it would appear that employees with longer tenure would have greater understanding and appreciation for the need to implement ideas such as

those contained within the DMM than those with shorter tenure. To test this, it is posited that:

- *Hypothesis 2b: The pattern of relationships between constructs in the Deming Management Method theory holds more strongly for individuals with relatively longer length of tenure than those with shorter length of tenure.*

The DMM in Public Sector Organizations

Deming (1986) claimed that "… the 14 points apply to a service organization with little modification" (p. 199) where "service industries include government service" (p. xi). However, there is a paucity of research that has sought to verify this claim. Some empirical studies on the DMM that included public sector organizations (Douglas and Fredendall 2004; Fisher, Barfield, and Li 2005) in their sample did not test for partial industry sector effects. Thus, it is not possible to differentiate how the theory relates to government sector organizations.

In recent times, the adoption of QM concepts has been accorded high priority in public sector organizations due to pressure to increase stakeholder satisfaction, reduce costs, and enhance performance (McAdam, Reid, and Saulters 2002). The proclamation that QM programs are key to driving public organizational transformations (Redman et al. 1995), and the ongoing debate about the effectiveness of quality practices in public organizations (Speller and Ghobadian 1993; Marcus 2008) further reinforces the need to test Deming's ideas in the public sector context.

Another reason to test the DMM theory within the public sector is that there are significant differences between public and private sector organizations. Compared to the private sector, the public sector appears to adopt QM across a much wider scope because of the sector's diverse nature, and in terms of the "range of services provided, statutory duties and responsibilities, area-wide responsibilities, accountabilities, financial arrangements, nature of management, and political control of imposed centrality" (Speller and Ghobadian 1993, 30). Another major difference is customers (Dewhurst, Martinez-Lorente, and Dale

1999). Instead of individual consumers or businesses, the public sector views the whole of society as their customers who pay for the public organizations' budgets to satisfy society's needs. This could result in a motivation to reduce costs and conform to technical requirements rather than to improve customer satisfaction.

Although these differences may hinder implementation of QM practices and achievement of outcomes, public sector organizations generally pay greater attention to training, empowerment, and teamwork because of the motivation to change the organizations' behavior and the way they are perceived (Dewhurst, Martinez-Lorente, and Dale 1999). Further, CEOs and consultants from public sector organizations have proclaimed that QM programs are a key factor in driving for success of organizational transformations (Redman et al. 1995).

The aforementioned points suggest that the DMM could be the practical solution for public sector organizations to develop QM capabilities. Based on evidence to date, the authors hypothesize that:

- *Hypothesis 3: The Deming Management Method theory holds in public sector organizations.*

The DMM in Different Country Contexts

The literature on international diffusion of QM does not provide a clear answer as to whether the DMM applies across countries without modification (Sila and Ebrahimpour 2003). Studies show that there are country-specific differences in terms of the QM elements that are emphasized (Baba 1999).

Similar doubts have been expressed about the DMM. Anderson et al. (1995, 640-1) state: "… the Deming Management Method has been implemented worldwide … suggesting an ease of transferability of the prescriptions in the 14 points, as well as the constructs and relationships proposed in the path diagram …. Conversely, others … have argued that there may be cultural constraints on the applicability of the Deming Management Method across different national cultures." The DMM has been shown to vary in applicability among countries, although these differences do not bear any strong and consistent pattern (Rungtusanatham et al.

1998; Rungtusanatham et al. 2005). Formal validation of the theory in the United States, Canada, Italy, Germany, and Japan have shown significant similarities in the patterns of relationships that are supported vis-à-vis those that are not. This led Rungtusanatham et al. (2005) to conclude in favor of the convergence hypothesis ahead of national specificity arguments. However, these empirical tests have been restricted to countries that have similar social, political, economic, and, to some extent, national cultural characteristics. As a result, it is not clear if the DMM theory has characteristics that are generic to individuals and organizations and are unaffected by national characteristics. To show convincingly that the DMM is truly universal in application, it is necessary to test the theory in country contexts that are different.

The country context for the authors' study is Singapore. While Singapore is similar to other countries where this type of study has been conducted, it is unique in some ways, especially compared to Japan. Unlike Japan, which is a mature industrialized nation and largely monocultural and hierarchical in tradition, Singapore is a multicultural Asian country that is relatively newly industrialized and less hierarchical.

Singapore was primarily chosen because of its aggressive efforts in promoting QM. A number of studies show that QM has been implemented in Singapore in a range of industry sectors, and most of these implementations have been successful (Ghosh and Ling 1994; Ghosh and Hua 1996; Leong and Lee-Patridge 1997; Quazi and Padibjo 1998; Brah, Wang, and Rao 2000; Woon 2000b; Woon 2000a; Chung 2001; Yong and Wilkinson 2001; Brah, Tee, and Rao 2002; Yong and Wilkinson 2003; Yong and Pheng 2008). QM has also been promoted in the Singaporean public sector. This makes Singapore an ideal research setting for studying the efficacy of various quality ideas such as Deming's. In May 1995, the Singapore Public Service Commission (a government body) embarked on a concerted movement called "Public Service for the 21st Century." This program has two basic objectives: 1) to nurture an attitude of service excellence in meeting the needs of the public with high standards of quality, courtesy, and responsiveness; and 2) to foster an environment that induces and welcomes continuous changes for greater efficiency and effectiveness by employing modern management tools and techniques, while

paying attention to the morale and welfare of public officers (Singapore Government 2006) As part of meeting these objectives, a set of processes, systems, and standards was developed for the public agencies to adopt so as to create a national quality infrastructure. These included organizational excellence tools such as ISO standards, "People Developer" standard, Singapore Quality Award/ Singapore Quality Class, Singapore Service Class, balanced scorecard, benchmarking, and a platform for sharing best practices on quality and risk management. A quality service committee was also set up comprising quality service managers from the ministries and the 12 largest "customer-facing" statutory boards and public organizations to promote quality customer service in the public sector as well as citizen engagement practices (for example, public consultation).

Based primarily on Rungtusanatham et al.'s (2005) findings in favor of universal applicability of QM, one would expect that it is suited to country contexts outside those where it has been tested, such as Singapore. In order to test this, it is hypothesized that:

• *Hypothesis 4: The Deming Management Method theory holds in organizations based in Singapore.*

RESEARCH METHOD
Data Collection

Employees working in statutory boards in Singapore were selected as the target population to test the theory. Statutory boards are organizations that have been created and tasked by the government to autonomously perform certain operational functions. Examples include the Economic Development Board and Civil Aviation Authority of Singapore. The heads of 23 statutory boards were approached to allow their employees to take part in the authors' study. Out of the 16 boards that agreed to participate, 11 had received the Singapore Quality Class, within which three were also winners of the more prestigious Singapore Quality Award. The data were collected via a survey administered through a website and hardcopy questionnaires. A total of 2,097 invitations were sent out to individual employees; 528 completed surveys were returned. Since the authors were interested in conducting individual-level analysis, they removed organizations

where the numbers of respondents were less than 40 individuals. This was to ensure that there were sufficient numbers of cases to perform multivariate statistical analysis for detecting individual-level effects. Further, respondents who did not provide their positional authority or duration of tenure were eliminated from further analysis.

The final dataset consisted of 367 individuals from five organizations. This represented an overall response rate of 17.5 percent. Among the respondents, 52.6 percent held managerial positions and 58 percent had been in their current positions for more than four years. National census data of Singapore show that close to 45 percent of the workforce has less than three years of length of service (Lee 2001). As public sector organizations have systems and processes that tend to be more hierarchical and bureaucratic compared to private sector organizations, workers would require a slightly longer period of time to become familiar with these systems. Thus, the authors decided to use four years as a demarcation point between short and long tenure. Table 2 provides a profile of the respondents.

The Spearman's rho correlation coefficient between positional authority and length of tenure was 0.193. While significant at the 0.01 level, the magnitude is not strong. This is not surprising, as the Singapore civil service has had a recruitment and promotions policy based on meritocracy. This means managers are promoted based on their qualifications, skills, and abilities. While temporal experience is useful, it is not a guarantee for promotion.

Measurement Items of the Theoretical Constructs

The measurement items in the instrument were extracted from previous studies, particularly from Anderson et al. (1995). Several items were modified to suit the nature of the public sector. Table 3 provides

Table 2 Number of study participants categorized in terms of organization, positional authority, and length of tenure.

Positional authority	Length of tenure	Organization					Subtotal	TOTAL
		1	2	3	4	5		
Nonmanager	≤ 4years	14	16	19	29	15	93	
	> 4 years	17	12	11	32	9	81	
	Subtotal	31	28	30	61	24		174
Manager	≤ 4 years	7	7	5	33	9	61	
	> 4 years	15	29	20	59	9	132	
	Subtotal	22	36	25	92	18		193
	TOTAL	53	64	55	153	42		367

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descriptions of these items. As can be seen, there are a few questions on past practices that might be a bit challenging for employees with tenure of less than four years to respond to. However, most of the questions do not deal with detailed technical matters that require deep insights into the organization. Rather, these questions are fairly general and most employees can be expected to provide reasonably accurate perceptual responses.

Data Analysis Procedure

Survey data of the type collected in this study can be analyzed using either "exploratory" or "confirmatory" approaches (Malhotra and Grover 1998). Since the authors' study involved testing prespecified relationships between constructs that have already been proposed formally in the DMM theory and this model has been tested for validity in several contexts, the confirmatory approach was adopted. To test the hypothesized relationships in the theoretical model (see Figure 1), they used the SEM data analysis procedure. This technique is suited to the authors' purpose for several reasons (Hair Jr. et al. 2006). First, SEM estimates multiple and interrelated dependence relationships; there are eight such relationships in the DMM model. Second, SEM is able to represent unobserved concepts (that is, constructs) in these relationships and account for measurement error in the estimation process; seven such constructs are presented in the DMM model.

Construct	Item label and description*
Table 3 Constructs and items of Deming Management Method theoretical model.	
1. Visionary leadership	VL1: All major department heads within our organization accept their responsibility for quality. VL2: The management provides personal leadership for quality services and quality improvement. VL3: Our top management strongly encourages employee involvement in the work process. VL4: In our organization, goals, objectives, and strategies are communicated to me. VL5**: Short-term plans affect our decision making, but are less important than pursuing long-term goals. (Reverse coded)
2. Internal and external cooperation	CO1: Generally speaking, everyone in the organization works well together. CO2: Departments in the organization communicate frequently with each other. CO3: Departments within the organization seem to be in constant conflict. (Reverse coded) CO4: Management works together well on all important decisions. CO5: During problem-solving sessions, we make an effort to get all team members' opinions and ideas before making a decision. CO6**: Problems are usually solved by supervisors. (Reverse coded)
3. Learning	L1: Employees receive training to perform multiple tasks. L2: Employees are rewarded for learning new skills. L3: Information technology competence is high in this organization. L4: The longer an employee has been in this organization, the more tasks or jobs he (she) learns to perform. L5: Employees receive training and development in work-place skills on a regular basis. L6: Employees are crossed-trained in the organization so that they can fill in for others if necessary. L7: Employees learn how to perform a variety of tasks/jobs. L8**: In this organization, employees only learn how to do one job/task. (Reverse coded)
4. Process management	PM1: We have standardized process instructions that are given to personnel. PM2: We use statistical methods to recognize the source of problem. PM3: We use charts to determine whether our processes are in control. PM4: Information on quality performance is readily available to employees.
5. Continuous improvement	CI1: All employees believe that it is their responsibility to improve quality in the organization. CI2: Continuous improvement of quality is stressed in all work processes throughout our organization.
6. Employee fulfillment	EF1: I would feel unhappy if I could not take pride in my work. EF2: Doing a good job should mean as much to a worker as a good paycheck. EF3: I like to feel a sense of pride in my work.
7. Customer satisfaction	SC1: In general, our organization's level of quality performance over the past three years or at least during the period since I worked here has been low, relative to industry norms. (Reverse coded) CS2: Our customers have been well satisfied with the quality of our services over the past three years or at least during the period since I worked here. CS3: How does your organization compare to the other statutory boards in the public sector in terms of customer relations? (Customer could mean internal customer within the organization or public sector, whom your output will affect their satisfaction) CS4: How does your organization compare to the private sector in terms of customer relations?

* Survey respondents were asked to express their agreement with statements, on a five-point Likert scale with 1 representing "strongly disagree" and 5 representing "strongly agree." For CS3 and CS4, survey respondents were asked to express their agreement with these statements on a five-point scale with 1 = "poor or low end of the industry," 2 = "below average," 3 = "average or equal to competition," 4 = "better than average" and 5 = "superior or better than average."

** These items were removed from the final version of the constructs and not used in the testing of the revised CFA and hypothesized models.

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Third, SEM allows for multigroup tests; this would be useful for testing the moderation and contextual effects that have been hypothesized. The authors used the AMOS® 5.0 software package for SEM analysis, and applied the maximum likelihood (ML) technique to estimate parameters.

There are several studies that have used SEM data analysis procedure to analyze data in the QM area.

For example, Ahire, Golhar, and Waller (1996) have used the SEM analysis procedure to validate a set of QM implementation constructs.

RESULTS
Distributional Properties, Correlations, and Missing Data Analysis

The distributional properties (mean, standard deviation, skewness, and kurtosis) for all of the items are shown in Table 4. Non-normal distribution could result in lower standard error estimates. This would result in an inflated number of statistically significant parameters (Muthen and Kaplan 1985; Byrne 1994). All of the univariate statistics suggested that there were no significant departures from normality based on threshold values suggested by Chou and Bentler (1995). As for multivariate normality, the Mardia's (1970) coefficient of multivariate kurtosis was 195.1, which is above the threshold value of 10.0 (Ory and Mokhtarian 2009), suggesting multivariate non-normality. However, a number of studies have shown that ML is reasonably robust to multivariate non-normality (Hu and Bentler 1995; Ory and Mokhtarian 2009). As such, the departure from multivariate normality was not regarded as a serious issue in the authors' study.

For outliers, since all variables were measured on a five-point Likert scale, the dataset was carefully reviewed to ensure that there were no data-entry related errors present. Also, Mahalanobis d-squared distance measures did not suggest that any of the cases were significant multivariate outliers.

Also shown in Table 4 are the Pearson correlation coefficients between the 32 items. These coefficients are small to moderate in magnitude. If inter-item correlations are greater than 0.9, the possibility that multicollinearity (that is, the two items are essentially measuring the same entity) could be existing is high (Hair Jr. et al. 2006). As none of the correlation coefficients is greater than 0.9, multicollinearity did not appear to be present.

The level of missing data ranged between zero and 1.9 percent for the items. These missing data were replaced with values obtained through the "expectation-maximization" iterative algorithm (Hair Jr. et al. 2006), since this method has been shown to be better than other substitution and elimination techniques (Jamshidian and Bentler 1999).

Psychometric Properties of the Constructs

Face validity

Since this was a confirmatory study, the constructs and items were selected from relevant previous studies. Specifically, the items were from Anderson et al. (1995), but modified to suit the public sector. Anderson et al. (1995) provide extensive literature support for these constructs and items. Subsequent studies (Rungtusanatham et al. 1998; Douglas and Fredendall 2004; Fisher, Barfield, and Li 2005) also use constructs and items from Anderson et al. (1995), and provide further literature-based justifications for these items and constructs. As a result, the constructs and their associated items used in the authors' study had good grounding in the literature and possessed face validity.

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was performed to assess how well the items listed in Table 3 estimated the seven constructs of the DMM. The CFA model is a structural equation model where the constructs are all co-varied with each other. This analysis involving all 32 items in Table 3 showed that three items had standardized factor loadings of less than 0.5. These were LV5, CO6, and L8. Since the standardized loadings were less than 0.5, the constructs associated with these items were accounting for less than 25 percent of the variance in these items. The authors decided to exclude these three items from all further analysis.

In assessing the goodness-of-fit of the CFA model with data involving the 29 items, various fit indices suggested an adequate level of fit. The $\chi^2_{(df = 356)}$ value was 727 with p-value = 0.000. The general recommendation is that the p-value should be greater than 0.05 for good fit. Based on this, it would appear that the fit is poor. However, this fit measure has a tendency to produce negative results with sample sizes greater

Table 4 Descriptive statistics and inter-item Pearson correlation coefficients for items.

Construct	Item	VL1	VL2	VL3	VL4	CO1	CO2	CO3r	CO4	CO5	L1	L2	L3	L4	L5
Descriptive statistics															
Mean		3.91	3.71	3.86	3.95	3.44	3.3	3.34	3.61	3.56	3.42	2.75	3.5	3.48	3.69
Standard deviation		0.858	0.825	0.792	0.81	0.933	0.914	0.872	0.784	0.875	0.896	0.849	0.858	0.96	0.805
Skewness		-1.19	-0.63	-0.8	-0.938	-0.689	-0.397	-0.241	-0.738	-0.758	-0.568	0.088	-0.478	-0.453	-0.859
Kurtosis		2.008	0.403	0.913	1.31	-0.161	-0.625	-0.373	0.686	0.075	-0.347	-0.308	-0.267	-0.514	0.537
Correlation coefficients															
Visionary leadership	VL1	1													
	VL2	.583**	1												
	VL3	0.480**	0.581**	1											
	VL4	0.442**	0.508**	0.514**	1										
Internal and external cooperation	CO1	0.407**	0.524**	0.501**	0.457**	1									
	CO2	0.386**	0.445**	0.506**	0.488**	0.538**	1								
	CO3r	0.273**	0.359**	0.312**	0.355**	0.500**	0.444**	1							
	CO4	0.405**	0.454**	0.438**	0.354**	0.512**	0.435**	0.428**	1						
	CO5	0.356**	0.415**	0.448**	0.387**	0.468**	0.461**	0.311**	0.391**	1					
Learning	L1	0.183**	0.364**	0.279**	0.306**	0.311**	0.318**	0.261**	0.331**	0.305**	1				
	L2	0.184**	0.305**	0.297**	0.281**	0.331**	0.328**	0.182**	0.276**	0.313**	0.507**	1			
	L3	0.286**	0.349**	0.287**	0.340**	0.269**	0.347**	0.209**	0.393**	0.236**	0.344**	0.326**	1		
	L4	0.250**	0.329**	0.249**	0.288**	0.317**	0.236**	0.233**	0.294**	0.269**	0.247**	0.319**	0.309**	1	
	L5	0.273**	0.297**	0.306**	0.393**	0.375**	0.375**	0.194**	0.262**	0.366**	0.522**	0.403**	0.377**	0.269**	1
	L6	0.324**	0.413**	0.349**	0.296**	0.324**	0.363**	0.201**	0.342**	0.297**	0.346**	0.345**	0.405**	0.346**	0.322**
	L7	0.224**	0.287**	0.270**	0.249**	0.259**	0.184**	0.081	0.193**	0.246**	0.301**	0.230**	0.231**	0.276**	0.342**
Process management	PM1	0.297**	0.342**	0.261**	0.314**	0.339**	0.372**	0.304**	0.359**	0.206**	0.242**	0.247**	0.271**	0.176**	0.249**
	PM2	0.248**	0.290**	0.265**	0.245**	0.340**	0.317**	0.164**	0.340**	0.242**	0.270**	0.310**	0.408**	0.215**	0.243**
	PM3	0.316**	0.292**	0.281**	0.256**	0.299**	0.336**	0.193**	0.335**	0.262**	0.280**	0.280**	0.360**	0.288**	0.281**
	PM4	0.342**	0.374**	0.318**	0.375**	0.331**	0.414**	0.226**	0.416**	0.316**	0.304**	0.284**	0.315**	0.240**	0.268**
Continuous improvement	CI1	0.428**	0.480**	0.386**	0.368**	0.352**	0.370**	0.273**	0.437**	0.330**	0.333**	0.264**	0.384**	0.267**	0.296**
	CI2	0.392**	0.429**	0.296**	0.326**	0.290**	0.333**	0.203**	0.366**	0.348**	0.296**	0.180**	0.362**	0.213**	0.279**
Employee fulfillment	EF1	0.142**	0.136**	0.205**	0.156**	0.168**	0.062	0.090	0.122*	0.200**	0.165**	0.075	0.141**	0.138**	0.145**
	EF2	0.118*	0.101	0.119*	0.078	0.087	0.066	0.108*	0.110*	0.154**	0.093	0.082	0.124*	0.090	0.087
	EF3	0.299**	0.260**	0.250**	0.206**	0.187**	0.147**	0.101	0.133*	0.199**	0.164**	0.108*	0.169**	0.113*	0.226**
Customer satisfaction	SC1r	0.262**	0.289**	0.303**	0.317**	0.365**	0.330**	0.538**	0.317**	0.213**	0.203**	0.138**	0.240**	0.183**	0.229**
	CS2	0.361**	0.402**	0.327**	0.422**	0.408**	0.327**	0.356**	0.412**	0.352**	0.297**	0.229**	0.343**	0.283**	0.314**
	CS3	0.338**	0.407**	0.372**	0.382**	0.384**	0.394**	0.346**	0.407**	0.312**	0.265**	0.244**	0.424**	0.282**	0.318**
	CS4	0.376**	0.427**	0.375**	0.381**	0.394**	0.428**	0.344**	0.356**	0.352**	0.265**	0.255**	0.425**	0.336**	0.311**

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Construct	Item	L6	L7	PM1	PM2	PM3	PM4	CI1	CI2	EF1	EF2	EF3	SC1r	CS2	CS3	CS4
Table 4 Descriptive statistics and inter-item Pearson correlation coefficients for items (continued).																
							Descriptive statistics									
Mean		2.97	3.72	3.62	3.04	3.13	3.31	3.54	3.8	4.31	4.08	4.41	3.53	3.7	3.53	3.29
Standard deviation		0.952	0.653	0.801	0.851	0.858	0.876	0.873	0.76	0.761	0.885	0.67	0.946	0.727	0.742	0.832
Skewness		0.065	-1.238	-0.671	-0.217	-0.359	-0.337	-0.517	-0.838	-1.479	-1.166	-1.349	-0.297	-0.539	0.092	-0.011
Kurtosis		-0.925	1.802	0.376	-0.385	-0.307	-0.653	-0.131	1.291	3.583	1.512	3.637	-0.368	0.939	-0.095	-0.305
							Correlation coefficients									
Visionary leadership	VL1															
	VL2															
	VL3															
	VL4															
Internal and external cooperation	CO1															
	CO2															
	CO3r															
	CO4															
	CO5															
Learning	L1															
	L2															
	L3															
	L4															
	L5															
	L6	1														
	L7	0.407**	1													
Process management	PM1	0.209**	0.211**	1												
	PM2	0.336**	0.273**	0.317**	1											
	PM3	0.293**	0.187**	0.336**	0.680**	1										
	PM4	0.333**	0.250**	0.363**	0.370**	0.392**	1									
Continuous improvement	CI1	0.412**	0.324**	0.317**	0.295**	0.281**	0.464**	1								
	CI2	0.312**	0.247**	0.283**	0.284**	0.309**	0.449**	0.607**	1							
Employee fulfillment	EF1	0.067	0.103*	0.069	0.047	0.059	0.076	0.107*	0.180**	1						
	EF2	0.123*	0.140**	0.073	0.064	0.133*	0.072	0.047	0.144**	0.379**	1					
	EF3	0.141**	0.136**	0.128*	0.146**	0.188**	0.136**	0.124*	0.265**	0.520**	0.476**	1				
Customer satisfaction	SC1r	0.213**	0.130*	0.197**	0.121*	0.197**	0.222**	0.223**	0.234**	0.073	0.133*	0.148**	1			
	CS2	0.238**	0.206**	0.316**	0.207**	0.265**	0.312**	0.370**	0.362**	0.218**	0.146**	0.297**	0.400**	1		
	CS3	0.415**	0.311**	0.327**	0.310**	0.334**	0.330**	0.387**	0.346**	0.153**	0.149**	0.240**	0.389**	0.493**	1	
	CS4	0.447**	0.300**	0.253**	0.306**	0.276**	0.374**	0.450**	0.374**	0.084	0.145**	0.191**	0.330**	0.443**	0.714**	1

** Correlation is significant at the 0.01 level 2-tailed
* Correlation is significant at the 0.05 level 2-tailed.

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Table 5 Reliability estimates, average variance extracted and inter-correlation coefficients.

Construct	Composite reliability coefficient	Average variance extracted (AVE)	Normed fit index (NFI)	Non-normed fit index (NNFI)	Inter-correlation coefficients						
					1.	2.	3.	4.	5.	6.	7.
1. Visionary leadership	0.799	55.5	0.983	0.989	1						
2. Internal and external cooperation	0.832	47.6	0.966	0.976	0.857	1					
3. Learning	0.874	37.0	0.902	0.920	0.697	0.720	1				
4. Process management	0.797	44.2	0.974	0.977	0.567	0.634	0.676	1			
5. Continuous improvement	0.667	63.2	0.892	0.898	0.693	0.626	0.657	0.572	1		
6. Employee fulfillment	0.748	47.3	1.000	1.000	0.380	0.272	0.309	0.237	0.253	1	
7. Customer satisfaction	0.796	52.4	0.972	0.975	0.679	0.720	0.689	0.545	0.624	0.334	1

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than 200, and so was disregarded since the sample size was 367. The χ^2/df was 2.043 (acceptable fit range is between 2 and 3) and the values for goodness-of-fit index (GFI) = 0.876; adjusted goodness-of-fit index (AGFI) = 0.849; Tucker-Lewis index (TLI) = 0.895; and comparative fit index (CFI) = 0.908. Following recommendations of Hu and Bentler (1999), it has been conventional to use 0.95 for indices such as GFI, AGFI, TLI, and CFI as cut-off values for acceptable fit. If these cut-off criteria are applied to the authors' CFA model results, then one would conclude that fit is poor. But the conventional cut-off criteria are considered to be excessively stringent (Schermelleh-Engel, Moosbrugger, and Muller 2003; Marsh, Hau, and Wen 2004; Sharma et al. 2005; Hair Jr. et al. 2006). Less stringent cut-off criteria where factors such as model complexity, sample size, and number of observed variables are taken into account have been proposed (Sharma et al. 2005; Hair Jr. et al. 2006). For example, Sharma et al. (2005, 941-942) suggest that for datasets with more than 24 items and a sample size of around 200, "more liberal" cutoff values (for example, 0.8) should be used for fit indices such as GFI and TLI. Applying these criteria to the CFA model, the authors believe an "adequate" overall level of model-data fit has been obtained. Finally, the root mean square residual (RMR) = 0.040, and root mean square error of approximation (RMSEA) = 0.053. Values below 0.08 are regarded as being acceptable fit. Their results and fit assessment are similar to many studies in the operations management area. For example, Hult, Ketchen, and Nichols (2002, 581) declared "moderate but acceptable model fit" based on CFI = 0.84, AGFI = 0.86, and RMSEA = 0.08.

Reliability

The composite reliability coefficients for all seven constructs are shown in Table 5. As this table shows, all except one (continuous improvement) had coefficients that exceeded the minimum threshold level of 0.7 for acceptable reliability of constructs (Nunnally 1978). The value for continuous improvement was 0.667, which is sufficiently close to the threshold value. Furthermore, this relatively low value could be due the fact that this construct has only two items. As this construct is an important element of the theoretical model, normal processes for construct refinement, such as dropping items that do not contribute significantly to the estimation of the construct, was not employed because this will result in a single-item construct, which is not a recommended practice from a psychometric perspective.

Convergent and discriminant validity

Convergent validity (that is, items assigned to a construct contribute roughly equally to the construct's measurement) and discriminant validity (that is, items only estimate the construct to which they are assigned to and not any others) were both assessed using the

CFA model testing approach. These validities were assessed in a number of ways.

The convergent validity of the constructs was generally supported: all factor loadings of items on constructs were significant (at p-value < 0.05), the signs were all positive, and all 29 standardized loadings were above 0.5. Further, from the squared multiple correlation values, the variances of the items explained by their constructs were reasonably high (with the average being 41 percent). Another way in which convergent validity was assessed was through testing each construct as a one-factor congeneric model (Joreskog 1971) and assessing the SEM goodness-of-fit measures of normed fit index (NFI) and non-normed fit index (NNFI) (Ahire, Golhar, and Waller 1996). These fit indices measure the proportion of improvement of the overall fit of the theoretical model relative to the null model. Table 5 shows that the NFI ranged between 0.892 and 1.000 and for NNFI it ranged between 0.898 to 1.000. These values suggest that the one-factor congeneric models were significantly better than their respective null models, therefore indicating adequate levels of convergent validity for all of the constructs.

As for discriminant validity, Kline (2005) suggests that this is present when the inter-correlations between constructs is below the threshold of 0.9. Since the correlations between the constructs were mostly moderate (see Table 5), this suggested that the items assigned to constructs were unidimensional (that is, these items collectively estimated one single construct). Hence, constructs possessed adequate levels of discriminant validity. Further evidence of discriminant validity was provided by the average variance extracted (AVE) values (see Table 5). These values are generally close to or higher than the square of the intercorrelation coefficients, again suggesting reasonable levels of discriminant validity.

Nomological validity

Nomological validity refers to the degree to which the constructs make accurate predictions of other concepts in a theoretically based model (Hair Jr. et al. 2006). The correlations between the constructs could be used to assess for this type of validity. Table 5 indicates that the correlations between exogenous and endogenous constructs are at statistically significant levels.

These provide nomological support for the theory-based development of the hypotheses presented earlier.

Common methods bias

Since all items were measured using a five-point Likert scale, common methods bias could be present. The authors performed Harmon's one-factor test (Podsakoff et al. 2003) using a confirmatory approach to test for this possibility. This involved testing a one-factor congeneric model (Joreskog 1971), where all 29 items loaded onto a single common-factor construct. The SEM results of this test indicated that common methods bias was unlikely to be present, with the goodness-of-fit indices for this model indicating poor fit with data. The indices for Harmon's one-factor congeneric model were: $\chi^2_{(df = 377)} = 1{,}395$, p-value = 0.000; $\chi^2/df = 3.701$; GFI = 0.780; AGFI = 0.746; TLI = 0.727; CFI = 0.747; RMR = 0.047; and, RMSEA = 0.086.

MANOVA Results: Preliminary Assessment of Moderating Effects

As stated in Hypotheses 1 to 4, the authors were interested in establishing if the DMM theory is affected by a range of organizational- and individual-level contextual and moderating factors. Preliminary assessment of these moderating effects was obtained through the MANOVA data analysis procedure. The MANOVA procedure compensates for variable intercorrelations and provides an omnibus test of any multivariate effect. In their case, a single MANOVA test was performed involving 5 (organization) x 2 (positional authority) x 2 (length of tenure) factorial design, and 29 DMM variables from Table 3 as dependent variables. This factorial design resulted in 20 (5 x 2 x 2) groups in total. With 367 cases (that is, study participants), this factorial design had a groups-to-cases ratio of 18.35, which is close to the recommended minimum ratio of 1:20 for MANOVA results to be stable (Hair Jr. et al. 2006).

Table 6 shows the average and standard deviation values for all 29 variables, with the total 367 study participants split into the three moderating factors. In essence, the authors were interested in establishing if the average values for each of the 29 variables were

significantly different among the five organizations, or the two levels of positional authority, or the two levels of length of tenure.

The four most commonly used multivariate tests within MANOVA (Pillai's criterion, Wilk's lambda, Hotelling's trace, and Roy's largest root) all indicated that there were statistically significant differences in the 29 variables collectively across the five organizations (for example, Wilk's lambda = 0.545; F = 1.81; df = 116, 1,270; sig. = 0.000), two positional authority groups (for example, Wilk's lambda = 0.844; F = 2.04; df = 29, 319; sig. = 0.002), and two length of tenure groups (for example, Wilk's lambda = 0.846; F = 2.00; df = 29, 319; sig. = 0.002). The MANOVA test results also showed that all the interaction effects between the three factors did not contribute to the model. Further, all three factors accounted for reasonable proportions of variance in the dependent measures (partial Eta squared = 0.141, 0.156, and 0.154 for organization, positional authority, and length of tenure, respectively).

These results need to be considered cautiously, as tests showed that the critical assumption of homogeneity of variance-covariance matrices was not strongly supported. Both the multivariate Box's M test for equality of covariance matrices (Box's M = 1,778, F = 1.24, df = 870, 24,394, sig. = 0.000) and the univariate Levene's test of equality of error variances (the F-statistic had significance levels less than 0.05 for 15 out of the 29 dependent variables) showed that there were significant differences in variances and covariances across the 20 groups along the 29 dependent measures.

Given this situation, post hoc methods where equality of variance was not assumed were used for identifying the organizations that had significant differences in mean values for the 29 dependent variables. These methods (Tamhane's T2, Dunnett's T3, and Games-Howell) showed that while differences in the average scores for the variables existed between organizations, these were inconsistent and without any regular pattern.

Overall, the MANOVA test results indicated that the three factors of interest all acted as moderators. Further, these tests showed that the three factors did not interact. It was therefore possible to perform separate SEM analysis to understand their impact in more detail.

SEM Analysis Results: Comparing the DMM Across Organizations

To assess organizational-level effects on the pattern of relationships among constructs of the DMM theory, the theoretical model was subjected to a two-stage multigroup analysis (MGA) (Bollen 1989; Sauer and Dick 1993; Joreskog 1998; Rigdon, Schumacker, and Wothke 1998). In the first stage, the hypothesized DMM model was tested in which all of the structural model parameters were freely estimated for the five organizational groups. The second step was to determine if there was significant change in fit when the structural parameters being influenced by the moderator were constrained to be equal across the five organizations. If a significant change in fit occurred, this would suggest that the moderator was acting.

The first stage of the MGA exhibited adequate model-data fit ($\chi^2_{(df = 1,846)}$ = 3,115, p-value = 0.000; χ^2/df = 1.687; GFI = 0.668; AGFI = 0.609; TLI = 0.708; CFI = 0.735; RMR = 0.070; and RMSEA = 0.044). The second stage also showed adequate fit ($\chi^2_{(df = 1,906)}$ = 3,217, p-value = 0.000; χ^2/df = 1.688; GFI = 0.660; AGFI = 0.612; TLI = 0.708; CFI = 0.735; RMR = 0.083; and RMSEA = 0.044). The inflation in χ^2 statistic is 102 with 60 degrees of freedom. The p-value associated with this is 0.001. Applying the conventional cut-off value of 0.05, this indicated that the constraints imposed in stage two did significantly change the overall model-data fit. Therefore, the model showed structural variance (Bollen 1989), that is, the pattern of structural relationships in existence for the five groups and magnitudes of the hypothesized relationships were significantly different among the groups. In essence, relationships in the hypothesized theoretical model are sensitive to the moderating impact of organization. This would lead one to tentatively conclude that Hypothesis 1 was not supported.

A closer examination of the individual relationships of the theoretical model for the five organizations in Figure 2 suggest that results are more complex than what the SEM output indicates. Looking at each organization in isolation, it appears that the pattern of relationships predicted by the theory holds in all of them since a clear majority of the relationships are supported

Variable	Moderating factors								
	Organization					Positional authority		Length of tenure	
	1	2	3	4	5	Nonmanager	Manager	≤ 4 years	> 4 years
n	53	64	55	153	42	174	193	154	213
VL1	4.08 (0.70)	4.14 (0.61)	3.98 (0.87)	3.73 (0.99)	3.95 (0.70)	3.84 (0.80)	3.97 (0.90)	3.83 (0.82)	3.97 (0.88)
VL2	3.77 (0.70)	3.94 (0.71)	3.82 (0.82)	3.59 (0.91)	3.62 (0.73)	3.67 (0.76)	3.76 (0.88)	3.58 (0.84)	3.81 (0.80)
VL3	3.98 (0.70)	4.14 (0.69)	3.87 (0.86)	3.73 (0.83)	3.71 (0.86)	3.75 (0.75)	3.95 (0.82)	3.73 (0.81)	3.94 (0.77)
VL4	4.09 (0.70)	4.06 (0.75)	3.98 (0.78)	3.92 (0.84)	3.69 (0.92)	3.83 (0.82)	4.06 (0.79)	3.79 (0.88)	4.07 (0.74)
CO1	3.62 (0.66)	3.59 (0.90)	3.51 (0.96)	3.35 (0.98)	3.26 (1.01)	3.36 (0.98)	3.52 (0.88)	3.34 (0.95)	3.52 (0.92)
CO2	3.64 (0.71)	3.30 (0.97)	3.27 (0.89)	3.20 (0.94)	3.29 (0.92)	3.30 (0.88)	3.31 (0.95)	3.12 (0.92)	3.43 (0.89)
CO3r	3.55 (0.85)	3.39 (0.87)	3.45 (0.98)	3.27 (0.83)	3.07 (0.87)	3.19 (0.84)	3.47 (0.88)	3.14 (0.82)	3.48 (0.88)
CO4	3.77 (0.54)	3.81 (0.81)	3.64 (0.93)	3.45 (0.79)	3.67 (0.65)	3.56 (0.76)	3.66 (0.81)	3.52 (0.79)	3.68 (0.78)
CO5	3.47 (0.75)	3.67 (0.78)	3.62 (0.91)	3.52 (0.93)	3.57 (0.94)	3.52 (0.85)	3.60 (0.90)	3.57 (0.91)	3.55 (0.85)
L1	3.45 (0.82)	3.56 (0.89)	3.49 (0.86)	3.44 (0.87)	3.00 (1.06)	3.35 (0.89)	3.49 (0.90)	3.27 (1.01)	3.53 (0.79)
L2	2.81 (0.81)	2.73 (0.90)	2.93 (0.90)	2.76 (0.84)	2.48 (0.77)	2.77 (0.84)	2.74 (0.86)	2.69 (0.86)	2.80 (0.84)
L3	3.79 (0.53)	3.67 (0.87)	3.69 (0.81)	3.26 (0.90)	3.48 (0.86)	3.49 (0.77)	3.51 (0.93)	3.34 (0.93)	3.61 (0.79)
L4	3.51 (0.78)	3.55 (0.87)	3.60 (0.97)	3.37 (1.04)	3.57 (0.97)	3.41 (0.92)	3.54 (0.99)	3.33 (1.00)	3.59 (0.92)
L5	3.77 (0.54)	3.78 (0.92)	3.71 (0.76)	3.68 (0.82)	3.43 (0.89)	3.60 (0.82)	3.76 (0.79)	3.64 (0.86)	3.72 (0.76)
L6	3.06 (0.84)	3.33 (0.99)	3.22 (0.92)	2.75 (0.93)	2.76 (0.93)	2.98 (0.92)	2.96 (0.98)	2.87 (0.96)	3.04 (0.94)
L7	3.58 (0.69)	3.83 (0.61)	3.82 (0.58)	3.71 (0.68)	3.64 (0.66)	3.75 (0.59)	3.69 (0.70)	3.73 (0.67)	3.71 (0.64)
PM1	3.72 (0.72)	3.64 (0.74)	3.42 (0.85)	3.64 (0.85)	3.62 (0.73)	3.60 (0.79)	3.63 (0.81)	3.50 (0.80)	3.70 (0.79)
PM2	3.17 (0.73)	3.23 (0.85)	3.11 (0.83)	2.88 (0.87)	3.10 (0.91)	3.16 (0.77)	2.94 (0.91)	2.98 (0.85)	3.09 (0.85)
PM3	3.38 (0.69)	3.31 (0.81)	3.07 (0.88)	2.94 (0.90)	3.31 (0.78)	3.20 (0.78)	3.07 (0.92)	2.99 (0.86)	3.23 (0.85)
PM4	3.53 (0.78)	3.22 (0.92)	3.29 (0.85)	3.26 (0.92)	3.40 (0.80)	3.32 (0.84)	3.31 (0.91)	3.11 (0.92)	3.46 (0.82)
CI1	3.55 (0.75)	3.72 (0.84)	3.56 (0.88)	3.52 (0.90)	3.31 (0.95)	3.52 (0.81)	3.56 (0.93)	3.35 (0.91)	3.68 (0.82)
CI2	3.94 (0.60)	3.83 (0.72)	3.69 (0.72)	3.77 (0.82)	3.79 (0.81)	3.72 (0.76)	3.87 (0.75)	3.68 (0.82)	3.88 (0.70)
EF1	4.17 (0.55)	4.42 (0.69)	4.31 (0.69)	4.34 (0.87)	4.19 (0.74)	4.17 (0.76)	4.43 (0.74)	4.25 (0.82)	4.35 (0.72)
EF2	4.00 (0.78)	4.17 (0.81)	4.13 (0.77)	4.03 (1.03)	4.19 (0.67)	4.05 (0.76)	4.12 (0.98)	4.10 (0.89)	4.07 (0.88)
EF3	4.28 (0.63)	4.55 (0.50)	4.44 (0.63)	4.42 (0.76)	4.24 (0.62)	4.32 (0.58)	4.49 (0.74)	4.34 (0.73)	4.45 (0.63)
SC1r	3.70 (0.87)	3.67 (1.01)	3.67 (0.96)	3.35 (0.91)	3.57 (0.97)	3.30 (0.92)	3.73 (0.93)	3.29 (0.88)	3.70 (0.96)
CS2	3.58 (0.66)	3.77 (0.77)	3.69 (0.86)	3.67 (0.68)	3.83 (0.73)	3.56 (0.70)	3.82 (0.73)	3.53 (0.71)	3.82 (0.72)
CS3	3.55 (0.61)	3.69 (0.79)	3.49 (0.77)	3.39 (0.72)	3.79 (0.78)	3.47 (0.74)	3.58 (0.74)	3.34 (0.74)	3.66 (0.72)
CS4	3.21 (0.66)	3.44 (0.91)	3.25 (0.87)	3.18 (0.79)	3.62 (0.94)	3.31 (0.84)	3.27 (0.83)	3.18 (0.89)	3.37 (0.78)

Table 6 Mean (standard deviation) values for all variables with respect to three moderating factors.

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and the models explain substantial proportions of variance in the endogenous construct in each organization. However, Figure 2 shows that there are also differences in these patterns of relationships: only one organization (No. 4) has all relationships that are significant and in the directions hypothesized; one organization (No. 2) has one nonsignificant relationship; two organizations (No. 3 and No. 5) have two relationships that are nonsignificant; and one organization (No. 1) has three nonsignificant relationships. Also, the specific relationships that are not significant are more different than similar for the organizations. This explains why the SEM analysis results suggest that organization is a significant moderator. Essentially, the authors conclude that while organizations bear the general features of the DMM, their patterns of relationships are quite different. Balancing these somewhat contradicting findings, the authors conclude that H1 is only partially supported.

SEM Analysis Results: Moderating Influence of Individual-Level Factors on the DMM

Positional authority

The MGA procedure as described previously was used to test the moderating influence of positional authority on the DMM theory, with the two groups of individuals being managers and nonmanagers. Both steps of the MGA indicated adequate model fits (first stage: $\chi^2_{(df = 738)} = 1,236$, p-value = 0.000; $\chi^2/df = 1.675$; GFI = 0.820; AGFI = 0.788; TLI = 0.865; CFI = 0.877; RMR = 0.050; and RMSEA = 0.043; second stage: $\chi^2_{(df = 753)} = 1,434$, p-value = 0.000; $\chi^2/df = 1.904$; GFI = 0.801; AGFI = 0.770; TLI = 0.819; CFI = 0.832; RMR = 0.084; and RMSEA = 0.050). The inflation in χ^2 statistic is 198 with 15 degrees of freedom, and the p-value is 0.000. This implies that positional authority is a significant moderator.

Figure 3 shows that the pattern of relationships is stronger for managers than nonmanagers. Specifically, for managers, all relationships are significant and positive, whereas for nonmanagers, two relationships are not significant. Also, six out of eight relationships

are of higher magnitude for the managers group than the nonmanagers group. Further, the level of variance explained by the model is greater than nonmanagers. Therefore, the authors conclude that the model has greater saliency for the managers group than the nonmanagers group. Hypothesis 2a is therefore supported.

Length of tenure

The moderating influence of length of tenure of individuals on the DMM theory was also assessed using the MGA procedure. The two groups were individuals with less than four years of tenure, and those who had more than four years of tenure. The MGA results suggested that model-data fit were acceptable for both stages (first stage: $\chi^2_{(df = 738)} = 1,343$, p-value = 0.000; $\chi^2/df = 1.819$; GFI = 0.818; AGFI = 0.785; TLI = 0.848; CFI = 0.861; RMR = 0.054; and RMSEA = 0.045; second stage: $\chi^2_{(df = 753)} = 1,560$, p-value = 0.000; $\chi^2/df = 2.071$; GFI = 0.798; AGFI = 0.767; TLI = 0.801; CFI = 0.815; RMR = 0.086; and RMSEA = 0.052). The increase in χ^2 statistic is 217. With 15 degrees of freedom, the p-value is 0.000. This result suggests that the length of tenure is a significant moderator of relationships in the DMM theoretical model.

Figure 4 shows that while there is one nonsignificant relationship for the long tenure group (and none for the short tenure group), there are five out of eight possible relationships, which is stronger in magnitude for the long tenure group. On balance, the authors conclude that the DMM theory is more applicable to the long tenure group than the short tenure group. Hypothesis 2b is therefore supported.

# SEM Analysis Results: DMM in Public Sector Organizations in Singapore Country Context

No additional analysis was required to test Hypotheses 3 and 4; MGA SEM test results for organization-level analysis were sufficient for this purpose. As reported earlier, the fit indices suggested that organizations had different patterns of relationships. However, closer examination of individual relationships among constructs (see Figure 2) shows that the pattern of relationships is generally very

Figure 2 Hypothesized model, showing maximum likelihood parameter estimates for moderating effect of five organizations. Standardized regression coefficients on straight lines single-arrowheads, and squared multiple correlation coefficients on endogenous constructs.

Continuous line: p-value ≤0.05; Discontinuous line: p-value >0.05

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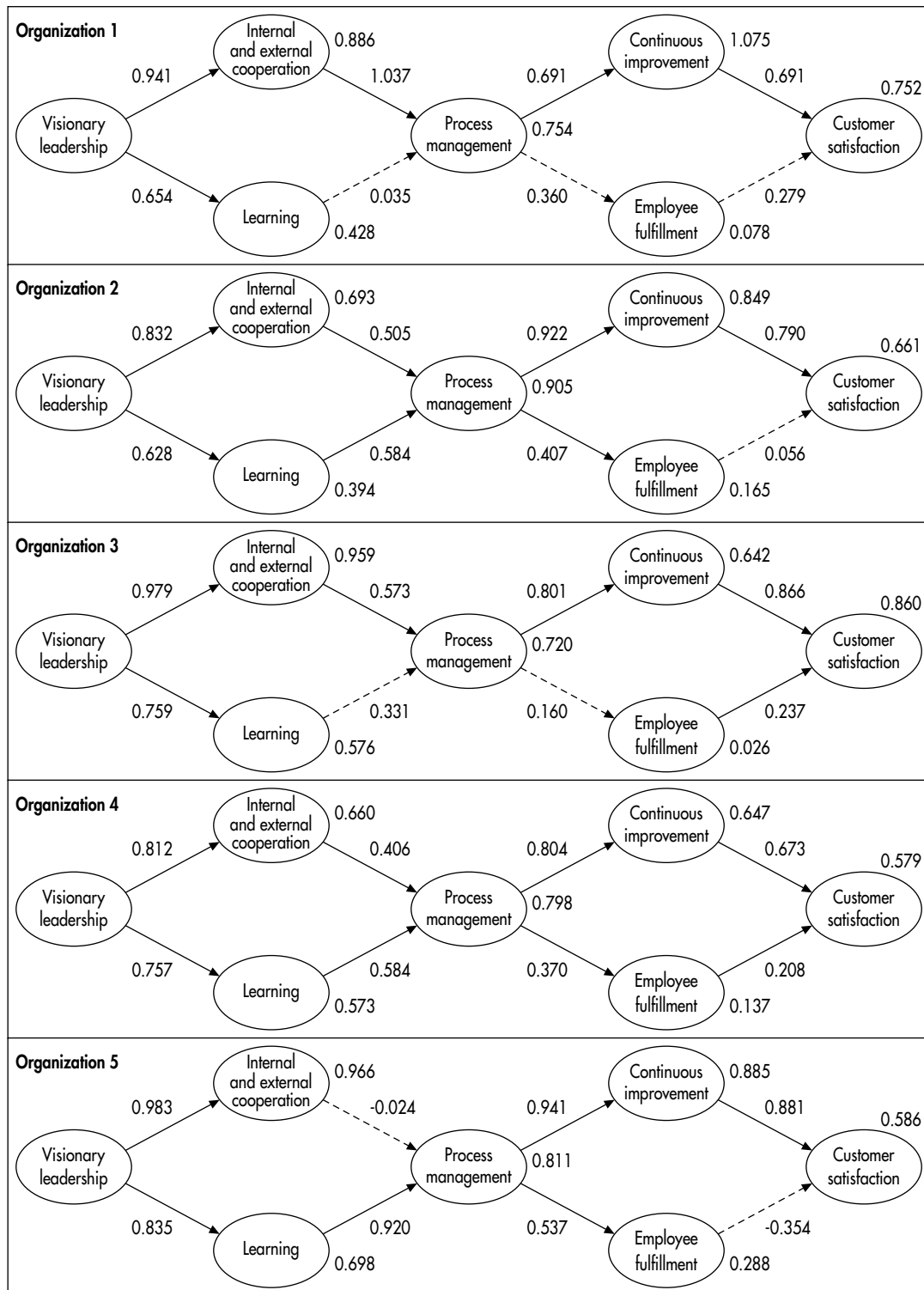
Figure 3 Hypothesized model, showing maximum likelihood parameter estimates for moderating effect of positional authority. Standardized regression coefficients on straight lines single-arrowheads, and squared multiple correlation coefficients on endogenous constructs.
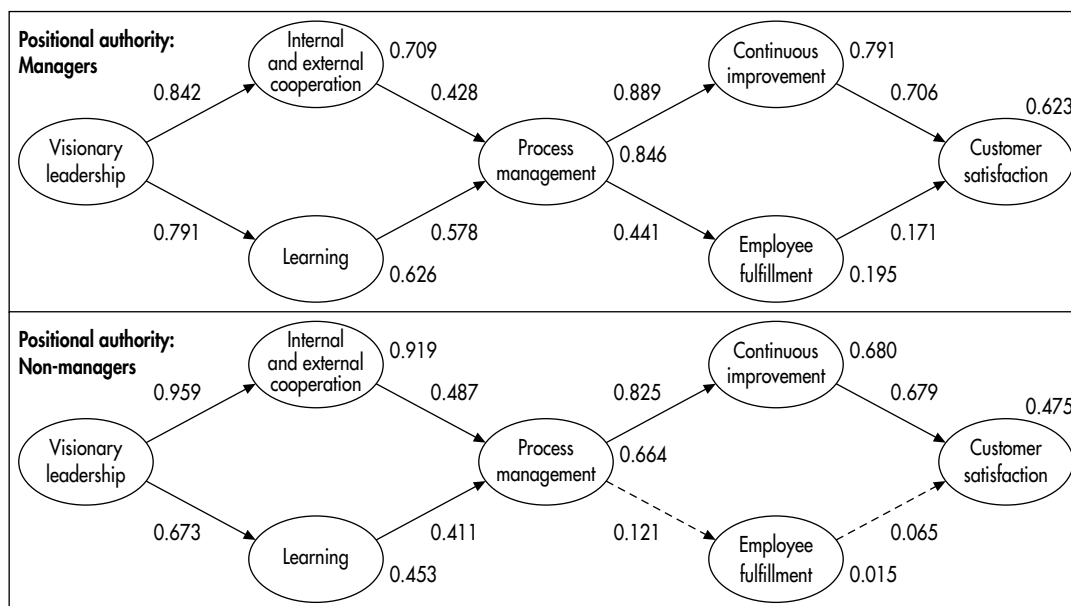
Continuous line: p-value ≤0.05; Discontinuous line: p-value >0.05

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similar to the patterns found in other empirical studies (see Table 1). Since the industry sector is public and the country sector is Singapore for this study, one can tentatively conclude that the DMM theory holds in these industry and country contexts. Therefore, Hypotheses 3 and 4 are both tentatively supported.

DISCUSSION

Comparing the DMM Across Organizations

Part of the authors' results suggest the theory applies to all five organizations. The number of relationships that are empirically supported outweigh the number of relationships that are not, supporting the point made by Rungtusanatham et al. (2005) that there are more similarities than differences across organizations. This conclusion is in line with the results of previous studies that have used SEM or path analysis, where the general conclusion is that the theory does appear to hold. However, because this study design is at multiple levels

(that is, individuals in organizations), this enables one to examine how the theory operates at multiple levels. The authors' results produced a more fine-grained understanding of the phenomena. This extra step, which is not covered in the studies to date, shows that the actual pattern of relationships predicted by the theory does not apply consistently across organizations. From Figure 2, it is evident that organizations are similar in relation to the theory, yet in terms of how the theory does not apply, there are subtle but perceptibly discernible differences among them.

In reconciling the contradictory findings of this study with that of previous studies, it is evident that most of these previous studies have taken an institutional theory (Meyer and Rowan 1977; DiMaggio and Powell 1983; Powell and DiMaggio 1991; Selznick 1996) perspective of organizations and the DMM. As such, organizations are regarded as being consensual, homogenous, and mechanistic, and similar to other quality management programs, Deming's ideas as rational and systematic management method whose goal is to improve the organizations' performance (Boiral 2003). The similarity among organizations thus reflects the manner in

Figure 4 Hypothesized model, showing maximum likelihood parameter estimates for moderating effect of length of tenure. Standardized regression coefficients on straight lines single-arrowheads, and squared multiple correlation coefficients on endogenous constructs.
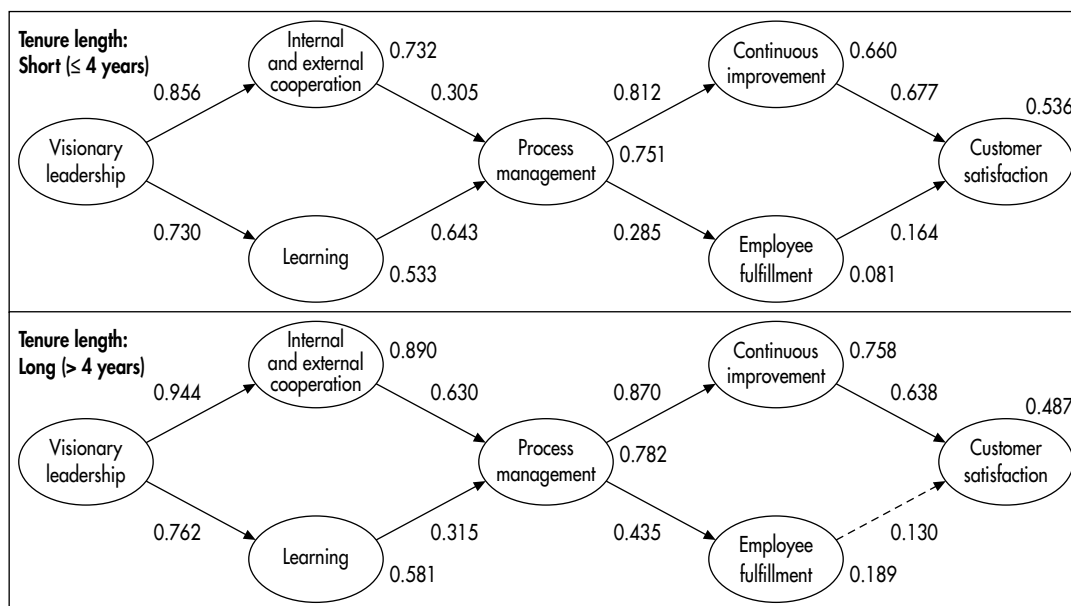
Continuous line: p-value ≤0.05; Discontinuous line: p-value >0.05

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which they use the DMM ideas in an attempt to isomorph through mimetic, normative, and coercive forces. But the authors' results show that this view is rather limited. In showing that patterns of relationships differ among organizations, the authors believe that they, reflecting critical theory (Clegg 1975; Burrell and Morgan 1979; Alverson and Willmott 1992; Parker 1995), could be treating the DMM not as a monolithic system that is applied mechanistically. Rather, it is a socially constructed management system that people adopt, reinterpret, and apply depending on the contingent situation of the organization. As such, the authors' results may have captured and demonstrated the inherent differences among organizations by virtue of the fact that they are different.

Moderating Influence of Individual-Level Factors on the DMM

Both individual-level factors, positional authority, and tenure length, were found to be significant moderators. Specifically, the authors found that the theory held better for managers and, to a slightly lesser extent, for those organizational members with longer length of service. This is a significant finding, as it suggests that behavior and actions in organizations when seen from the prism of the DMM theory are affected by individual characteristics of members.

The authors' results relating to employee position can be interpreted in several ways. At face level, the finding that the theory was more applicable to managers than to nonmanagers (in the form where some relationships were less relevant to the nonmanagers compared with managers) was not surprising. This is because the span of activities that managers are involved in is broadly covered by the theory, and so managers are more likely to be more closely aligned with the theory than nonmanagers. However, this face-level interpretation assumes that the differences between the groups are real. This may not necessarily be the case. As Zbaracki (1998) demonstrates, managers frequently engage in the "rhetoric of success" where an overly positive view of QM initiatives is presented, but this view is not shared by others in the organization. It could be that there are limited real differences between managers and nonmanagers relative to the DMM, and that the perceived

difference could be attributable to this "rhetoric versus reality" phenomenon. If the difference is indeed real, then the disconnect between managers and nonmanagers could account for the difficulties in implementation that is frequently associated with QM initiatives (Wilkinson et al. 1991; Choi and Behling 1997; Wilkinson, Godfrey, and Marchingto 1997; Waldman et al. 1998; Knights and McCabe 1999; Taylor and Wright 2003; Fuentes-Fuentes, Albacete-Saez, and Llorens-Montes 2004). Another reason for the difference between the two groups could be due to the ability of the respondents to accurately answer the questions in the study. Given the nature of the questions, managers—who tend to be more trained and educated—might be able to better understand and interpret the questions, and hence provide more precise and meaningful responses.

The results relating to the effect of tenure length can be interpreted in a similar manner. If it is really true that long-tenured employees find greater affinity to the principles embodied in the DMM theory than the short-tenured employees, then there are strong implications on how QM-type programs can be successfully implemented from the perspective of how long employees have been in the organization. The results of this study support the emerging view from the change management literature that resistance to programs such as DMM may not be as strong as generally thought, and that more experienced employees can be enthusiastic about the change that takes place if it is implemented well. It is also clear that newer employees would improve the chances of successful implementation of these programs since they are unlikely to be carrying the political baggage from their past. However, this interpretation needs to be made cautiously, as it is possible that newer employees are not fully aware of the relevant issues in the organization, and they could simply be consuming and repeating the overly positive rhetoric that managers frequently espouse (Zbaracki 1998).

The DMM in Public Sector and Singapore Country Contexts

The authors' results show that the DMM model is applicable to public sector organizations. Since their study explicitly tested the model in this "new" context, the positive outcome is an important extension of the

applicability of the DMM theory. The authors' results support the arguments of those who suggest that QM has ideas that are generic in nature that traverse the private-public industry divide (Little 1994; Kidder and Ryan 1996; Lai and Cheng 2003). The authors' results also provide clarity to Deming's claim that his ideas are generalizable to public sector organizations. These ideas include the influential role leadership plays, especially in the creation of a cooperative and learning organization, the implementation of process-management practices, and the generation of sustained employee fulfillment and continuous improvement of processes, products, and services, which support customer satisfaction and organizational survival. These ideas are encapsulated in the DMM theory and are based on the 14 points.

The evidence for the applicability of the model to Singapore, a non-Western country context, is another useful extension. The authors' results suggest that QM, as embodied by the DMM, is relatively unaffected by national cultural and political conditions and, similar to Rungtusanatham et al. (2005), it can be applied in a markedly different country context. This provides clarity to the debate on cross-country diffusion of QM (Sila and Ebrahimpour 2003).

Overall, the public sector and cross-country context applicability of the model favors the universalistic sentiments relating to QM. It would appear that this model has features that enable it to overcome the industry, social, political, and cultural differences. In doing so, it goes against much of the conventional management theory, which rejects notions of universalism (Dean Jr and Bowen 1994).

The significant presence of moderating factors means the model may not be viewed in a uniform and consistent manner within an organization. This is enigmatic. On the one hand, support for applicability of the theory across organizations in public sector and different country contexts indicates universalism. On the other hand, characteristics moderating the perceived applicability of the theory suggest that from a "micro" perspective, factors within organizations act against universalism. This "mixed" set of results suggests that the theory's applicability within organizations could be a lot more complex than currently perceived, and greater care must be taken if it is to be effectively implemented, an observation in

line with the wider QM (McAdam et al. 2008). To some extent, the authors' results explain the mixed empirical evidence reported in the literature on the utility of QM (Yong and Wilkinson 1999; Sousa and Voss 2002).

CONCLUSION

The authors' results provide a relatively positive appraisal of the DMM theory as it applies across organizations in new industry (public sector) and country (Singapore) contexts. However, in conjunction, they also found that some individual-level characteristics have a moderating influence on how the theory is perceived and operationalized in the workplace. Thus, a more nuanced understanding of the workings of the theory is obtained. For instance, the results show that claims of universal applicability are better directed at the "macro" or organization-industry-country level. Here, organization, industry, and country contexts do not appear to matter. However, at the "micro" or individual level, there is evidence to suggest that the theory permeates itself differently in organizations, and that internal stakeholders take different views of the concepts embodying the theory and how these concepts manifest themselves in organizations. Therefore, claims of universalism fail to apply at this level of analysis.

In addition to the aforementioned conceptual findings, the methodological approach of the authors' study enables it to make strong contributions to knowledge. A strictly confirmatory approach was adopted. This was made possible by the existence of a well-articulated theory and accompanying model, as well as a series of empirical studies that have attempted to test this. As a result, their study is able to build on these and focus on the higher-order theory testing and refinement tasks. Further, this study has a nonparochial ethnographic design, that is, testing a theory developed in one cultural setting in another (Adler 1983). It is also a replication study. These types of study designs are rare (Lindsay and Ehrenberg 1993). Therefore, the study makes a strong contribution to knowledge development in the QM area.

The authors' study also provides evidence of the continued relevance of QM. In not rejecting the various Deming-based QM models outright, their results suggest that QM has conceivably become embedded in the core practices of public sector organizations.

The findings of their study could have implications beyond the public sector organizations in Singapore. Based on the universal convergence hypothesis, the results of the study suggest that organizations in other countries could find the DMM model applicable to them. But these organizations would need to take care when implementing the DMM model because the study shows that individual-level contextual and moderating factors are significant in terms of the model's effectiveness and veracity. Specifically, the authors' study shows that positional authority and tenure length are important in terms of acceptance of some key elements of the model. These effects may not necessarily be as strong in organizations located in some Western countries where organizations have become less hierarchical and have flatter structures. Also, many of these Western organizations are more egalitarian than similar organizations in Eastern countries and emerging economies. Therefore, while the DMM model may apply in a large number of domains, care would need to be taken in terms of which contextual and moderating factors to manipulate in order to enhance their applicability and acceptance within organizations in other industry sectors and country contexts.

Future research could take several directions:

1. Future studies could focus more sharply on moderators. The authors' study examined two individual-level characteristics for their moderating influence on the applicability of the theory in five organizations. Positional authority, one of the two moderators considered in this study, could be studied for its influence in more detail, given the impact of senior management perspective on the effectiveness of QM implementation. Also, given the complexity of the theoretical model and constructs, future research could investigate other moderators such as age, education level, and technical background of individuals and their effects on the model in more organizations.

2. Future studies could test improvement possibilities to refine the model in order to develop a better understanding of how the theory operates, and include concepts such as ethics, safety, sustainability, and so on.

3. Since the authors' interest was in a replication study, they made minimal changes to the measurement instrument. But some questions required study

participants to reflect on the past three years of practices. Employees with short tenures could have had difficulties in providing accurate responses. Future studies could modify the measurement instrument to better reflect the demographic characteristics of the study participants.

4. This study is based in the public sector. Future studies could be based in other sectors where there is strong contemporary interest in QM, such as healthcare, large-scale services, and so on.

5. Four of the five organizations in this study had a relatively small sample size of study participants. This could have produced SEM parameter estimates that may not be stable. Also, five organizations may not be fully representative of the public sector in Singapore. Future studies could involve larger sample sizes of individuals from more organizations to improve the stability of the data analysis results and generalizability of the findings.

6. In terms of country domain, the authors' study in Singapore could be extended to other countries such as China and India where some really interesting developments are taking place.

7. Some aspects of their findings, such as the impact of the individual-level moderators, need greater levels of insight. Qualitative methods of enquiry would be particularly suitable for these.

All of these potential improvements would greatly improve the generalizability of their findings, and, at the same time, provide depth and rigor.

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