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The Influence of Managerial Metacognition on Quality Management Practices and a Firm's Sustainable Competitive Advantages

Young Sik Cho
Jackson State University
Email: young_sik.cho@jsums.edu

ABSTRACT

The purpose of this study is to explore how managerial metacognition has an influence on a firm's QM practices and their sustainable competitive advantages. A survey method was used to collect a primary data, and a total of 235 viable samples were obtained from senior-level quality managers working in the U.S.-based firms. Structural equation modeling was adopted to test the hypothesized research model of this study. The test results demonstrated that there was a positive synergy effect of metacognition and QM practices on the creation of a firm's sustainable competitive advantages.

KEYWORDS: Metacognition, Quality management, Sustainable competitive advantage, Structural equation modeling, Survey research

INTRODUCTION

Metacognition can generally be defined as a higher-order process reflecting one's awareness and control over the knowledge structure used by people in making an assessment or a decision (Haynie et al., 2010). Specifically, in the context of quality management, a firm's managerial metacognition can be defined as a higher-order psychological mechanism actually possessed by a firm through which it is able to develop a new knowledge structure in order to realize more effective implementation of its lower-order technical mechanisms (i.e., quality management practices) based on a keen understanding of its motivations, assumptions, strengths, and weaknesses (Flavell, 1987; Haynie, 2005; Choo et al., 2007; Haynie and Shepherd, 2009; Haynie et al., 2010). In the literature, it is recognized that quality management (QM) practices and metacognition inherently have the following strong functional similarities. Both mechanisms mainly: (i) focus on process effectiveness (e.g., Berardi-Coletta et al., 1995; Silver, 2004; Kaynak & Hartley, 2008); (ii) emphasize a learning-by-doing approach (e.g., Paris & Winograd, 1990; Hayes et al., 2005); and (iii) pursue continuous improvement by an ongoing knowledge creation process (e.g., Kluwe, 1982; Linderman et al., 2004). Taking these similarities into consideration, it is rationally anticipated that a functional relationship exists between the two mechanisms. However, there is a little insight into the relationship between the "technical mechanism" (i.e., QM practices) and the "psychological mechanism" (i.e., managerial metacognition) (Choo et al., 2007, p. 437) in the operations management literature. In addition, the psychological mechanism has been actively studied for a long time at the higher-order level in many other disciplines such as education (e.g., Schoenfeld, 1987; Borkowski and Muthukrishna, 1992), psychology (e.g., Flavell, 1976; Davidson et al., 1994), entrepreneurship (e.g., Haynie, 2005; Haynie et al., 2012; Cho and Jung, 2014), and international management (e.g., Ang et al., 2007; Kim and Van Dyne, 2012). To date, psychological mechanism-related research in operations management has only been conducted at the cognitive level. However, metacognition is considered as the higher-order process which controls the existing knowledge structure while cognition is regarded as the existing knowledge structure used by people in

making an assessment or a decision. Accordingly, it is anticipated that the functional role of such a higher-order process (i.e., metacognition) on QM practices may be quite different from the role of a lower-order process (i.e., cognition) on them. Thus, this study attempts to explore how a quality manager's higher-order psychological process, metacognition, affects their lower-order technical process, QM practices. Specifically, the following research questions have been examined through this study:

(1) What is the role of managerial metacognition on the effective implementation of QM? In other words, is managerial metacognition related to the effective implementation of QM practices?

(2) If so, how does the synergy of managerial metacognition and QM practices influence the creation of a firm's sustainable competitive advantage?

THEORY AND HYPOTHESES

The Relationship between Metacognition and QM practices

Metacognition is typically illustrated as "thinking about thinking" and "cognition about cognition" (Flavell, 1979, 1987). The study of Haynie et al. (2010) more specifically defined metacognition as "the control that the individual has over their own cognitions as a function of a differing ability to consider alternative cognitive strategies in light of a changing environment" (p.219). Cognition is the knowledge structure used by people in making a decision; whereas, metacognition is a higher-order process controlling over the knowledge structure (Mitchell, Busenitz, Lant, McDougall, Morse, and Smith, 2002; Cho and Jung, 2014). Metacognition is also understood as the process of formulating strategies in order to select from a set of possible cognitive mechanisms (Flavell, 1987; Haynie, 2005; Haynie et al., 2010). Further, many studies indicate that the metacognitive abilities of people can be improved by appropriate training and practices, which is intrinsically different from the intelligence quotient (IQ) of people (Mevarech, 1999; Nietfeld & Schraw, 2002; Schmidt & Ford, 2003; Haynie et al., 2010). Furthermore, in terms of neuroscience, metacognition is known as a function of the prefrontal cortex in human brain which is generally regarded as one of the few distinctions from other primates (Fleming, Weil, Nagy, Dolan, and Rees, 2010; Baird, Smallwood, Gorgolewski, and Margulies, 2013).

Although metacognition can be slightly differently classified into sub-dimensions (Flavell, 1979, 1987; Griffin and Ross, 1991; Nelson, 1996), Haynie and Shepherd (2009) conceptualized metacognition as the following five dimensions: goal orientation, metacognitive knowledge, metacognitive experience, metacognitive strategy (or metacognitive choice), and monitoring. This study basically adopted the Haynie and Shepherd's (2009) "Measure of Adaptive Cognition (MAC)" to measure a managerial metacognition after slightly revising the items to reflect the purpose of this study. Thus, this study employs Haynie and Shepherd's (2009) the original definitions for each metacognition dimension. In the context of metacognition literature, goal orientation can be defined to be "the extent to which the individual interprets environmental variations in light of a wide variety of personal, social, and organizational goals" (Haynie and Shepherd, 2009, p.699). Metacognitive knowledge can be described as "the extent to which the individual relies on what is already known about oneself, other people, tasks, and strategy when engaging in the process of generating multiple decision frameworks focused on interpreting, planning, and implementing goals to manage a changing environment" (Haynie and Shepherd, p.699). Metacognitive experience can be illustrated as "the extent to which the individual relies on idiosyncratic experiences, emotions, and intuitions when engaging in the process of generating multiple decision frameworks focused on interpreting, planning, and implementing goals to manage a changing environment" (p.699). Metacognitive choice (also called as

metacognitive strategy) can be conceptualized to be "the extent to which the individual engages in the active process of selecting from multiple decision frameworks the one that best interprets, plans, and implements a response for the purpose of managing a changing environment" (p.700). Finally, metacognitive monitoring can be defined as "seeking and using feedback to reevaluate goal orientation, metacognitive knowledge, metacognitive experience, and metacognitive choice for the purposes of managing a changing environment" (p.700). While the metacognitive mechanism has not yet been examined in operations literature, the metacognition has been actively studied for a long time in many other disciplines such as education (e.g., Schoenfeld, 1987; Borkowski and Muthukrishna, 1992), psychology (e.g., Flavell, 1976; Davidson et al., 1994), entrepreneurship (e.g., Haynie, 2005; Haynie, Shepherd, and Patzelt, 2012; Cho and Jung, 2014) and international management (e.g., Ang, Van Dyne, Koh, Ng, Templer, Tay, and Chandraseka, 2007; Kim and Van Dyne, 2012). Table 1 summarizes the major metacognition-related studies in management literature.

As depicted in Fig. 1, QM practices and metacognition inherently have strong functional similarities. Above all, both QM and metacognition mainly pursue process effectiveness (e.g., Berardi-Coletta et al., 1995; Silver, 2004). Also, both mechanisms heavily rely on a learning-by-doing approach, that is, learning how to perform the activity better by actually doing it (e.g., Paris and Winograd, 1990; Hayes et al., 2005). Besides, both strongly emphasize continuous improvement by an ongoing knowledge creation process (e.g., Kluwe, 1982; Linderman et al., 2004). Taking these similarities into consideration, it is rationally anticipated that a strong positive interaction exists between the two mechanisms. Thus, the following hypothesis is suggested:

Hypothesis 1. Managerial metacognition is positively related to a firm's quality management practices.

Figure 1: A comparison of QM and metacognition

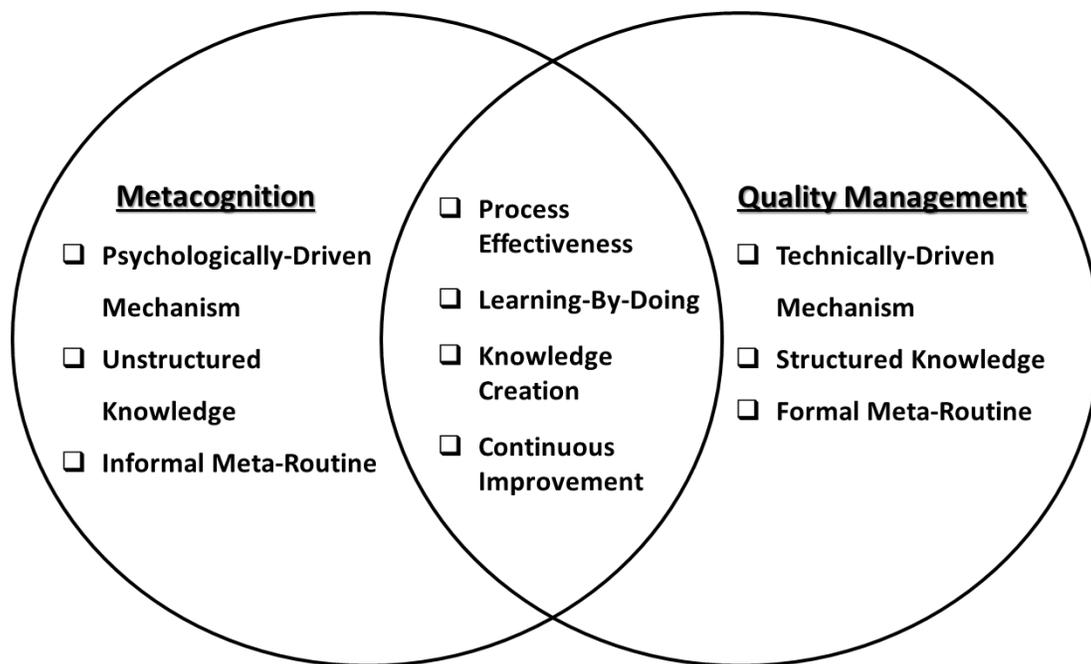


Table 1: Major Metacognition Studies in Management Literature

Study	Purpose	Discipline & Research Type	Sample	Key Finding
Haynie (2005)	To explore how metacognition affects 'cognitive adaptability' in the context of an entrepreneurial task.	Entrepreneurship/ Empirical	Entrepreneurs in the US (N = 73)	Metacognitive awareness relates positively to cognitive adaptability at entrepreneurial tasks; the enhanced cognitive adaptability contributes to improving entrepreneurial task performance.
Ang, Van Dyne, Koh, Ng, Templer, Tay, and Chandraseka (2007)	To explore the relationship between cultural intelligence (CQ) and intercultural effectiveness outcome.	International management/ Empirical	Undergraduate students in the US (N = 235) and Singapore (N = 358); international managers (N = 98); foreign professionals (N = 103)	Metacognitive CQ has a significantly positive effect on both cultural judgment and decision making (CJDM) effectiveness and task performance, while cognitive CQ has a significantly positive effect on CJDM, but not on task performance.
Haynie and Shepherd (2009)	To develop an instrument to assess metacognitive awareness in an entrepreneurial context.	Entrepreneurship/ Empirical	Undergraduate business students in the US (N = 432)	36 measure items were constructed to be used for assessing the five dimensions of metacognitive awareness such as metacognitive experience, knowledge, monitoring, choice, and goal orientation.
Haynie, Shepherd, Mosakowski, and Earley (2010)	To conceptualize a situated metacognitive model of an entrepreneurial mindset.	Entrepreneurship/ Conceptual	Not applicable	The study proposed a metacognitive process model that is able to elucidate how entrepreneurial metacognition affects entrepreneurial task and consequently, entrepreneurial outcome.
Chua, Morris, and Mor (2012)	To investigate how individual variation in terms of cultural metacognition impacts success in intercultural creative collaboration.	Organizational behavior/ Empirical	Middle-level managers (N = 43) and managers attending an executive MBA course in the US (N = 60); university	The study result indicates that individuals with higher metacognitive CQ are more positively associated with intercultural creative collaborations.

			students in the US (N = 236)	
Van Dyne, Ang, Ng, Rockstuhl, Tan, and Koh (2012)	To conceptualize sub-dimensions for each of the four CQ factors.	International management/ Conceptual	Not applicable	The study conceptualized the sub-dimensions of metacognitive CQ as follows: planning, awareness, and checking.
Haynie, Shepherd, and Patzelt (2012)	To explore the role of metacognitive ability and feedback on the cognitive adaptability of naive entrepreneurs.	Entrepreneurship/ Empirical	Undergraduate business students in the US (N = 217)	The study result demonstrates that the benefits of cognitive-based feedback are greater for the naive entrepreneurs with higher metacognitive knowledge.
Kim and Van Dyne (2012)	To examine the relationships between prior intercultural contact, cultural intelligence, and international leadership potential.	International management/ Empirical	Working adults in the US (N = 441); employees (N = 181) and their observers in the US (N = 708)	Cultural intelligence has a mediating effect on the relationship between prior intercultural contact and international leadership potential.
Cho and Jung (2014)	To investigate the relationships between a metacognitive ability, entrepreneurial orientation, and firm performance.	Entrepreneurship/ Empirical	Entrepreneurs in the US (N = 190)	The study has found that an entrepreneurial metacognitive ability is significantly associated with entrepreneurial orientation (EO). Further, the study result demonstrates that EO mediates the effects of entrepreneurial metacognition on entrepreneurial task performance.

The Synergy of Metacognition and QM on a Firm's Sustainable Competitive Advantages

Numerous studies present that the elements of quality management (QM) framework can be clustered by two sub-constructs: human behavior-oriented quality practices and technology-oriented quality practices (Flynn, Schroeder, and Sakakibara, 1995; Anderson, Rungtusanatham, Schroeder, and Devaraj, 1995; Powell, 1995; Dow, Samson, and Ford, 1999; Rahman and Bullock, 2005; Naor, Goldstein, Linderman, and Schroeder, 2008; Jung and Hong, 2008; Gadenne and Sharma 2009; Zu, 2009). For example, quality management (QM) practices such as top management support, employee empowerment, customer focus, supplier relationship are intrinsically classified as the behavioral QM practices. On the other hand, QM practices such as process management, product and service design, strategic planning, quality information are typically clustered as the technical QM. Those studies, as shown in Table 2, also demonstrate that behavioral QM is characterized by features such as human-oriented, intangible, and relationship-driven practices, whereas technical QM can be distinguished by attributes such as mechanical-oriented, tangible, and technology-driven practices (Powell, 1995; Dow et al., 1999; Jun et al., 2006; Naor et al., 2008). Table 3 summarizes the major studies on the relationships between behavioral QM, technical QM, and organizational performance. Ironically most of the studies over the past two decades have maintained that only behavioral-related quality practices (e.g., top management support, employee involvement, supplier involvement, and customer involvement) positively relate to the competitive advantage of a firm, while technical QM practices (e.g., quality information, product design, and process management) do not directly affect the generation of a firm's competitive advantage (Naor et al., 2008; Powell, 1995; Jung and Hong, 2008).

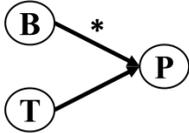
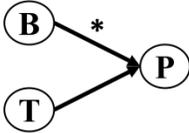
Table 2: A Comparison between Behavioral vs. Technical QM Practices			
	Behavioral QM	Technical QM	References
Perspective	Relationship-driven	Technology-driven	Flynn et al., 1995; Anderson, Rungtusanatham, Schroeder, and Devaraj, 1995; Powell, 1995; Dow et al., 1999; Rahman and Bullock, 2005; Jun et al., 2006; Naor et al., 2008; Jung and Hong, 2008; Gadenne and Sharma 2009; Zu, 2009.
Type of Resource	Intangible	Tangible	
Primary Functional Concern	How to do	What to do	
Locus of Managerial Efforts	Leading	Controlling	
Key Practices	Top management support, Employee involvement, Customer involvement, Supplier involvement	Process management, Strategic planning, Product/service design, Quality information	

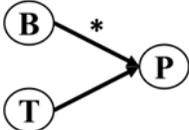
With respect to QM practices, there is a strong tendency across QM-embedded firms to simply adopt or mimic the most popular QM framework that has been successfully implemented by their leading competitors; this so-called isomorphic nature of QM practices can be explained by institutional theory (Selznick, 1996; Hendricks and Singhal, 1997; Dahlgaard et al., 1998; Jun et al., 2006). However, numerous studies have argued that successful QM implementation is not

accomplished equally by every QM-embedded firm (Powell, 1995; Beer, 2003; Jun et al., 2006); for example, one survey study indicated that only approximately one-third of all QM efforts have been successful (Hayes, Pisano, Upton, and Wheelwright, 2005). Therefore, this study presumes that the isomorphism of QM practices acts as one of the primary sources of the failure of QM implementation. Based on this argument, this study postulates that managerial metacognition can help the firm to better understand and control the problems generated through mimicking other firms' QM practices. In turn, these metacognitive findings can help the firm to develop a more effective QM framework in accordance with their operation systems' characteristics, eventually contributing to their sustainable competitive advantages. Namely, it is assumed that there is a positive synergy effect of metacognition and QM practices on the creation of a firm's sustainable competitive advantage. Therefore, the following hypotheses are suggested to explore the relationships:

Hypothesis 2. Managerial metacognition has a positive influence on the relationship between QM practices and a firm's sustainable competitive advantage.

Table 3: Key studies on the relationships between behavioral QM, technical QM, and organizational performance

Study	Objective	Type & Sample	Simplified Model & Results	Key Findings
Powell (1995)	To examine QM as a potential source of sustainable competitive advantage.	Empirical / 54 US-based firms, employing 50 or more workers.		Intangible QM practices such as employee empowerment, executive commitment, and open culture significantly contribute to firm's competitive advantage, while tangible QM techniques such as process improvement, benchmarking, quality training do not generally relate to competitive advantage.
Dow, Samson, and Ford (1999)	To identify the core dimensions of quality management practices and investigate how these practices contribute to superior quality outcomes.	Empirical / 698 manufacturing plants located in Australia and New Zealand.		Only three of the nine quality practice constructs such as employee commitment, shared vision, and customer focus have a significant positive association with superior quality performance.
Jun, Cai, and Shin (2006)	To identify critical elements of QM practices that would contribute to the enhancement of employee satisfaction and loyalty.	Empirical / 407 employees of two Maquiladora-based firms in Mexico.		HR-focused QM practices such as teamwork, employee compensation, and employee empowerment have a significantly positive effect on employee satisfaction. In turn, the reinforced employee satisfaction contributes to a higher level of employee loyalty.
Naor, Goldstein, Linderman, and Schroeder (2008)	To investigate the relationship among organizational culture, infrastructure and core quality practices, and manufacturing	Empirical / 189 manufacturing plants located in six countries including the U.S., Japan,		Organizational culture more significantly impacts on infrastructure quality management practices than on core quality management practices, regardless of where the manufacturing plant is located in six countries. Besides, infrastructure quality practices have a positive and significant effect on

	performance.	Sweden, Finland, Germany, and South Korea.		manufacturing performance while core quality practices have no significant effect on it both in the Eastern and the Western countries.
Abdullah, Uli, and Tari (2008)	To examine the impact of soft factors of QM practices on quality improvement and organizational performance.	Empirical / 255 managers of electronics firms located in Malaysia.		Soft QM factors such as management commitment, employee involvement, customer focus, reward, and training are significantly associated with quality improvement. Some soft factors such as management commitment, employee involvement, and customer focus are also significantly associated with organizational performance.
Jung and Hong (2008)	To investigate the relationships among the organizational citizenship behavioral (OCB), soft QM, hard QM, and firm performance.	Empirical / 230 Maquiladora firms located at the border between Texas in the U.S. and Mexico.		Soft QM factor which consists of leadership, people management, and customer focus shows a strong positive effect on firm performance, while hard QM factor which contains strategic planning, process management, and information analysis does not represent any significant impact on firm performance.

Note: * Significant positive effect; B = behavioral-related quality practices; T = technical-related quality practices; P = performance-related variables.

RESEARCH METHODS

Sample and Data Collection

A survey research method was used to collect a primary data for this study. Initially CEOs was considered as the most ideal target population of this study because CEOs are generally regarded to have a ability to access their organization's comprehensive information and knowledge such as their managerial capabilities, competitive advantages, and firm performances (Miller & Toulouse, 1986; Zahra & Covin, 1993). However, it is a reality that in many cases CEOs are not available for a survey in many cases and moreover, a major part of the survey is directly related to a firm's quality management practices so we extended our target population to Quality Managers as well as senior-level Managers of participating firms. In order to obtain more reliable sample data, we also developed the following criteria for selecting appropriate respondents: (i) Survey respondents must be in an active position in U.S. firms; (ii) Survey respondents must be deeply knowledgeable about their managerial capabilities as well as quality management practices; (iii) Survey respondents must be at least 21 years old to participate; (iv) Survey respondents must be a single respondent of each participating firm; if there is more than one respondent from the same firm, the target respondent will be chosen based on the position in their firm, preferably the highest rank among the respondents.

Survey Procedure

Online survey research was designed to collect a primary sample data for this study, referring to the studies of Dillman, Smyth, and Christian (2008) and Dillman et al. (2014). Survey participants were recruited online through invitation emails. In particular, the email lists of quality managers (N = 2,000) and senior business managers (N = 52,576) were purchased from both Dun & Bradstreet, Inc. and Specialdatabases.com. The target sample size for this study was initially set at 200 respondents and a response rate of the online-based survey was normally expected less than 3%. Hence, after scrutinizing the whole email databases based on the selecting criteria developed in this study, a total of 12,000 email lists were finally prepared for the survey research. This survey study was approved by the Institutional Review Board for Human Subjects Protection (IRB).

Measures

The managerial metacognition-related measure items were adapted from the study of Haynie and Shepherd (2009) but, some items were slightly revised to reflect the purpose of this study, referring to the studies of Haynie (2005) and Haynie et al. (2010). According to the Haynie and Shepherd's (2009) study, the survey was designed to measure the five different metacognitive dimensions such as metacognitive knowledge, metacognitive experience, metacognitive goal-orientation, metacognitive strategy, and metacognitive monitoring. The QM-related measures were developed based on a variety of sources such as Powell (1995), Flynn, Schroeder, and Sakakibara (1995), Samson and Terziovski (1999), Flynn and Saladin (2006), Jun, Cai, and Shin (2006), Naor, Goldstein, Linderman, and Schroeder (2008), Zu (2009), Zu, Robbins, and Fredendall (2010), and Baird, Jia Hu, and Reeve (2011). The resource-based view (RBV) (Barney, 1991) assumes that competing firms within an industry may control different bundles of resources and these resources may not be perfectly mobile across firms so firms' resource differences can be long lasting (Barney and Arkan, 2005). Barney (1991) illustrates four primary features of firm's resource to be sustained competitive advantage (SCA) as follows: valuable, rare, imperfectly imitable, and non-substitutable. Premised on the RBV, Weerawardena (2003) argues that the SCA construct can be operationalized as "whether it is possible for competitors

to duplicate the firm' competitive strategy (Barney, 1991; Grant, 1991) and distinctive capabilities on which advantages have been founded (Grant, 1991; Hall, 1993)" (p.21). However, with respect to a firm's sustainable competitive advantage (SCA), a widely recognized set of measures was not available so we needed to develop most of the measurement scales for this study based on the comprehensive literature review. Accordingly most of items used in this study were newly developed in this study, referring to Barney (1991), McEvily & Chakravarthy (2002), Wiggins & Ruefli (2002), Weerawardena (2003), Barney & Arian (2005), Barney & Hesterly (2006), and Hitt, Ireland, and Hoskisson (2011).

The survey items were designed to estimate the degree to which the respondents agreed or disagreed with the given statement, based on a seven-point Likert scale, with 1 being strongly disagree and 7 being strongly agree. Before the actual survey, a pilot test was performed with MBA students (N = 24) to increase the reliability of scales. The measurement items and supporting literature are listed in Appendices A, B, and C.

DATA ANALYSIS AND FINDING

Sample Demographics

Email invitations with a web survey link were sent to a total of 12,000 target respondents in over 46 states of the U.S. We administered three rounds of survey invitations and obtained a total of 235 viable samples with a response rate of 1.95%. The χ^2 tests were conducted to examine whether a response bias exists among each round sample; any significant differences (at $p < 0.05$ level) were not reported between the samples (Zu, 2009). Of the whole sample, about 70% had more than 21 years business history as well as at least 100 employees. Of the sample, 31% was manufacturing firms and 66% was service firms. Of the respondents, 71% were more than 45 years old and 57% were male. A demographic profile of the sample is demonstrated in Table 4. The detailed industrial classifications and SIC codes of participating firms are also summarized in Table 5.

Category		Count	Proportion (%)
Firm's Age (Length of Time in Business)	Less than 5 years	7	3%
	5 ~ 10 years	16	7%
	11 ~ 20 years	30	13%
	21 ~ 30 years	48	20%
	31 ~ 50 years	46	20%
	51 ~ 100 years	55	23%
	More than 100 years	26	11%
	<i>Missing responses</i>	7	3%
Firm's Size (Number of Employees)	Less than 10 employees	20	9%
	11 ~ 50 employees	34	14%
	51 ~ 100 employees	14	6%
	101 ~ 500 employees	49	21%
	501 ~ 1,000 employees	21	9%
	1,001 ~ 10,000 employees	51	22%
	More than 10,000 employees	39	17%
	<i>Missing responses</i>	7	3%
Industry	Manufacturing	74	31%
	Service	154	66%

	<i>Missing responses</i>	7	3%
Age (Survey Respondents)	Less than 18	0	0%
	18 ~ 29	11	5%
	30 ~ 44	51	22%
	45 ~ 59	124	53%
	More than 59	42	18%
	<i>Missing responses</i>	7	3%
Gender (Survey Respondents)	Female	93	40%
	Male	135	57%
	<i>Missing responses</i>	7	3%

Table 5: Industrial Classification of the Sample		
Industrial Classification	Count	Proportion (%)
Agriculture, Forestry & Fishing [01-09] ^a	4	2%
Construction [15-17]	10	4%
Apparel & Fabricated Textile Products [23]	2	1%
Papers & Allied Products [26]	0	0%
Printing & Publishing [27]	5	2%
Pharmaceuticals [28]	10	4%
Chemical Products [28]	9	4%
Petroleum Refining [29]	3	1%
Semiconductors & Related Devices [36]	2	1%
Transportation Services [47]	10	4%
Communications Services [48]	8	3%
Wholesale Trade [50-51]	9	4%
Retail Trade [52-59]	12	5%
Financial Services [60-64]	13	6%
Hotels & Other Lodging Places [70]	2	1%
Prepackaged Software [73]	2	1%
Healthcare [80]	23	10%
Legal Services [81]	2	1%
Education [82]	11	5%
Accounting & Business Consulting Services [87]	4	2%
Others	84	36%
<i>Missing responses</i>	10	4%

Note: ^a Two-digit numbers represent the SIC codes.

Reliability of Scales

Reliability is defined as “the stability or consistency of an operational definition,” while validity means “the goodness-of-fit between an operational definition and the concept it is purported to measure” (Singleton and Straits, 2010: 146). In other words, a reliable measure may or may not be valid, whereas a valid measure is necessarily reliable (Singleton and Straits, 2010). Thus, we conducted several reliability and validity tests for the measures before testing the hypothesized

structural model. First the reliability of scales can be examined by calculating the value of Cronbach's alpha coefficient for each construct (Cronbach, 1951; Nunnally, 1967). The values of Cronbach's alpha for all scales exceeded the acceptable level point of 0.70, ranged from 0.75 for customer involvement to 0.94 for metacognitive strategy (Nunnally and Bernstein, 1994). In addition, Table 6 presents the descriptive statistics and correlations among all variables.

Convergent Validity

Convergent validity refers that all items consisting of a specific construct should share a high proportion of variance in common (Hair et al., 2010). The size of factor loading is considered as a criterion for identifying whether the scale items converge on their assigned latent construct. Thus, the factor loading for each item was computed to examine the convergent validity and the results showed that all items satisfied the suggested threshold of 0.50 factor loading (Hair et al., 2010). In particular, Table 7 shows the test results for the metacognition-related measure items, ranged between 0.84 and 0.93 factor loadings; Table 8 includes the description of each item and the test results of the confirmatory factor analysis (CFA) for the QM-related measures, ranged between 0.75 and 0.95 factor loadings;; Table 9 represents the test results for the items of both SCA and firm performance, ranged between 0.71 and 0.88 factor loadings.

Discriminant Validity

The values of the average variance extracted (AVE) were calculated to investigate the discriminant validity among factors. "Average Variance Extracted refers to the amount of variance that is captured by the latent variable in relation to the amount of variance due to the measurement error in the latent variable (Dillon and Goldstein 1984)" Akgün (2011: 201). The AVE of a value 50 percent or higher indicates discriminant validity among factors (Hair et al., 2010). In this study, the AVE estimate for each factor ranges between 60% for the factor of sustainable competitive advantage and 89% for the factor of supplier involvement, demonstrating that all factors satisfy the adequate level of discriminant validity.

Unidimensionality

Unidimensional measures are described as "a set of measured variables (indicators) can be explained by only one underlying construct" (Hair et al., 2010, p. 674). With respect to the CFA, a comparative fit index (CFI) of above 0.90 suggests statistical evidence of unidimensionality (Bentler, 1992; Al-Hawari, Hartley, and Ward, 2005; Zu, 2009). As shown in Table 10, all the CFI indices for the measurements are higher than 0.90, indicating acceptable unidimensionality..

Table 6: Descriptive Statistics and Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Mean	S.D.
1. Firm's Age ^a																	4.662	1.566
2. Firm's Size ^b	.440**																4.429	1.950
3. Firm's Industry ^c	-.108	-.126															1.675	.469
4. Metacognitive Knowledge	-.078	-.104	-.034														4.842	1.504
5. Metacognitive Experience	-.060	-.034	-.060	.847**													4.774	1.531
6. Metacognitive Goal-Orientation	-.048	.011	-.015	.755**	.769**												4.802	1.626
7. Metacognitive Strategy	-.053	-.055	-.056	.838**	.894**	.794**											4.514	1.611
8. Metacognitive Monitoring	-.024	-.051	-.013	.816**	.856**	.787**	.921**										4.527	1.499
9. Process Management	.048	.061	-.111	.737**	.712**	.652**	.747**	.720**									4.342	1.595
10. Product/Service Design	-.024	.075	-.076	.736**	.719**	.659**	.710**	.719**	.708**								4.491	1.525
11. Quality Information	-.023	.073	-.142*	.704**	.713**	.663**	.736**	.727**	.772**	.726**							4.473	1.658
12. Top Management Support	-.076	-.042	-.069	.725**	.724**	.679**	.745**	.713**	.703**	.674**	.713**						4.702	1.750
13. Employee Involvement	-.079	-.029	-.064	.701**	.697**	.632**	.710**	.687**	.758**	.708**	.744**	.792**					4.200	1.692
14. Customer Involvement	-.059	-.053	-.141*	.668**	.603**	.559**	.587**	.584**	.604**	.598**	.654**	.578**	.554**				5.063	1.441
15. Supplier Involvement	-.056	.066	-.174**	.571**	.571**	.569**	.576**	.564**	.605**	.614**	.634**	.616**	.598**	.652**			4.544	1.559
16. Sustainable Competitive Advantage	-.033	.101	-.124	.627**	.608**	.575**	.610**	.628**	.582**	.667**	.608**	.630**	.623**	.523**	.554**		4.323	1.307

Note: N = 235; Pearson correlation coefficients; ** Correlation is significant at $p < .01$ level (two-tailed); * Correlation is significant at $p < 0.05$ level (2-tailed). ^a The Length of Time in Business; ^b The Number of Employees; ^c "Manufacturing" = 1, "Service" = 2.

Table 7: CFA Test Results of Metacognition Measures				
Factors and Underlying Variables	Loading ^a	S.E. ^b	C.R. ^c	AVE ^d
Metacognitive Knowledge ($\alpha^e = .801$)				
We think of several ways to solve a problem and choose the best one.	.892***	n/a ^f	n/a	.679
We try to use strategies that have worked in the past.	.750***	.054	14.535	(68%)
Metacognitive Experience ($\alpha = .899$)				
We know what kind of information is most important to consider when faced with a problem.	.909***	n/a	n/a	.816
We consciously focus our attention on important business information.	.898***	.045	21.919	(82%)
Metacognitive Goal-Orientation ($\alpha = .927$)				
We often define goals for ourselves.	.928***	n/a	n/a	.865
We set specific goals before we begin a task.	.932***	.044	23.350	(87%)
Metacognitive Strategy ($\alpha = .939$)				
We ask ourselves if we have considered all the options when solving a problem.	.934***	n/a	n/a	.839
We re-evaluate our assumptions when we get confused.	.914***	.037	25.575	(84%)
We ask ourselves if we have learned as much as we could have when we finished the task.	.899***	.040	24.281	
Metacognitive Monitoring ($\alpha = .908$)				
We stop and go back over information that is not clear.	.928***	n/a	n/a	.762
We find ourselves analyzing the usefulness of a given strategy while engaged in a given task.	.846***	.043	19.923	(76%)
We find ourselves pausing regularly to check our comprehension of the problem or situation at hand.	.842***	.043	19.758	

Note: N = 235; ^a Standardized factor loading; ^b Standard error; ^c Critical ratio (*t*-value); ^d Average Variance Extracted; ^e Cronbach's alpha; ^f Not applicable (not estimated when loading set to fixed value: i.e., 1.000); *** $p < 0.001$.

Table 8: CFA Test Results of QM Measures				
Factors and Underlying Variables	Loading^a	S.E.^b	C.R.^c	AVE^d
Technical QM Measures				
Process Management ($\alpha = .789$)				
Clear work or process instructions are given to employees	.834***	n/a	n/a	.654
We make extensive use of statistical techniques to reduce variance in processes	.782***	.070	13.208	(65%)
Product/Service Design ($\alpha = .772$)				
We thoroughly review new product/service design before the product/service is produced.	.811***	n/a	n/a	.630
We work in teams, with members from a variety of areas (marketing, purchasing, manufacturing, etc.) to introduce new products/services.	.776***	.082	12.080	(63%)
Quality Information ($\alpha = .919$)				
Information on quality performance is readily available to employees.	.830***	n/a	n/a	.802
Our quality data (error rates, defect rates, scrap, etc.) are accurate and reliable.	.900***	.060	17.564	(80%)
Quality data are timely.	.952***	.059	18.962	
Behavioral QM Measures				
Top Management Support ($\alpha^e = .932$)				
Our top management provides personal leadership for quality products and quality improvement.	.941***	n/a ^f	n/a	.872
Our top management creates and communicates a vision focused on quality improvement.	.927***	.041	23.868	(87%)
Employee Involvement ($\alpha = .840$)				
Employees receive quality-related training.	.854***	n/a	n/a	.725
Employees are recognized and rewarded for superior quality improvement.	.849***	.068	15.416	(73%)
Customer Involvement ($\alpha = .745$)				
Customer complaints are used as a method to initiate improvements in our current processes.	.809***	n/a	n/a	.597
Our customers give us feedback on our quality and delivery performance.	.735***	.081	10.202	(60%)
Supplier Involvement ($\alpha = .939$)				
We actively engage suppliers in our quality improvement efforts.	.938***	n/a	n/a	.885

We maintain close communication with suppliers about quality considerations and design changes.	.944***	.044	22.256	(89%)
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Note: N = 235; ^a Standardized factor loading; ^b Standard error; ^c Critical ratio (*t*-value); ^d Average Variance Extracted; ^e Cronbach's alpha; ^f Not applicable (not estimated when loading set to fixed value: i.e., 1.000); *** *p* < 0.001.

Table 9: CFA Test Results of SCA Measures				
Factors and Underlying Variables	Loading ^a	S.E. ^b	C.R. ^c	AVE ^d
Sustainable Competitive Advantage ($\alpha = .884$)				
My company's resources or capabilities are so VALUABLE that they enable us to exploit opportunities or neutralize threats in our external environment.	.796***	n/a	n/a	
My company has COSTLY-TO-IMITATE resources or capabilities that our competitors cannot easily imitate or develop.	.712***	.077	11.535	.592
My company has DIFFICULT-TO-SUBSTITUTE resources or capabilities that cannot be easily substituted by those of our competitors.	.649***	.080	10.329	(60%)
My firm has mainly produced ABOVE average market return.	.840***	.069	14.243	
My company has shown PERSISTENT superior business performance to our competitors for a long time.	.832***	.069	14.074	

Note: N = 233 (2 missing values); ^a Standardized factor loading; ^b Standard error; ^c Critical ratio (*t*-value); ^d Average Variance Extracted; ^e Cronbach's alpha; ^f Not applicable (not estimated when loading set to fixed value: i.e., 1.000); *** *p* < 0.001.

Test Results

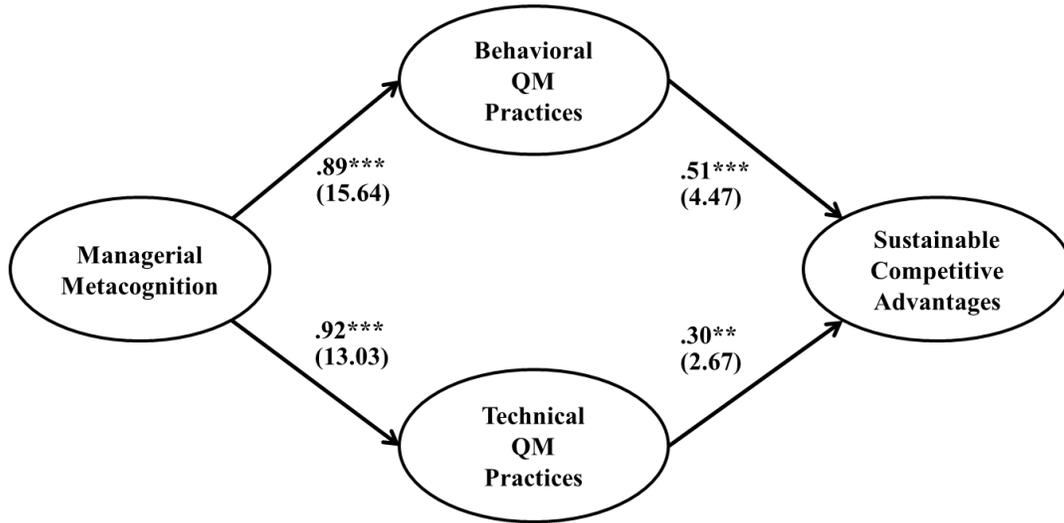
The structural equation modeling (SEM) analysis was used for testing the hypotheses of this study. First, we assessed the fit of the hypothesized model by several different fit indices such as the normed Chi-square ($X^2/d.f.$), the comparative fit index (CFI), the root mean square error of approximation (RMSEA), the RMSEA 90% confidence interval, the parsimony normed fit index (PNFI), and the Tucker-Lewis coefficient index (TLI) (Bentler and Bonett, 1980; Mulaik, James, Van Alstine, Bennett, Lind, and Stilwell, 1989; Bollen and Long, 1993; Byrne, 1998; Segars and Grover, 1998; Hair et al., 2010). As shown in Table 10, all the goodness-of-fit statistics for measure model met the desirable thresholds for each fit index. Further, all the statistics for the structural model were also within the recommended cutoff criteria.

Fit Index	Desirable Threshold	Measure Model	Structural Model
Chi-square (X^2)		973.72	1,051.44
Degree of Freedom (d.f.)		446	448
$X^2/d.f.$	< 3.00 ^e	2.18	2.34
CFI ^a	> 0.90 ^f	.93	.92
RMSEA ^b	< 0.08 ^g	.07	.07
RMSEA 90% Confidence Interval		.06 ~.07	.07 ~ .08
PNFI ^c	> 0.50 ^h	.74	.74
TLI ^d	Close to 1.00 ⁱ	.91	.90

Note: N = 235, ^a Comparative fit index, ^b Root mean square error of approximation, ^c Parsimony normed fit index, ^d Tucker-Lewis coefficient index, ^e Segars and Grover (1998), Hair et al. (2010), ^f Byrne (1998), ^g Bollen and Long (1993), ^h Mulaik, James, Van Alstine, Bennett, Lind, and Stilwell (1989), ⁱ Bentler and Bonett (1980).

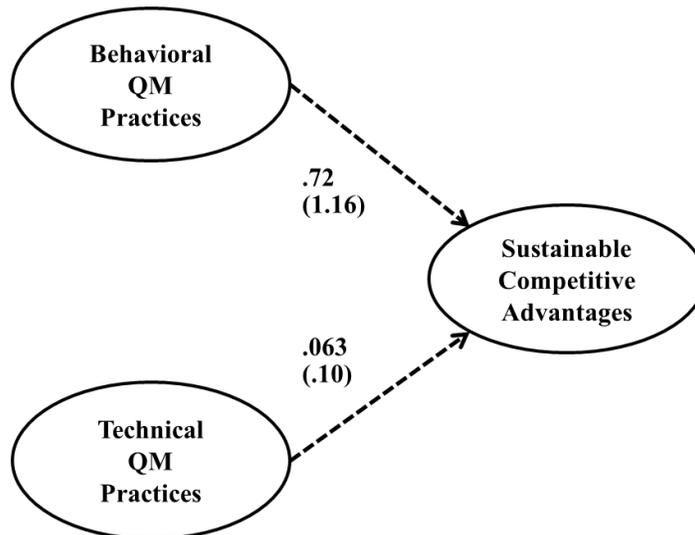
The SEM results of the hypothesized model are summarized in Fig. 2 Hypothesis 1 was supported in that managerial metacognition were positively related to both behavioral QM ($\beta = .89, p < .001$) and technical QM ($\beta = .92, p < .001$) practices. In addition, we developed the competing model (Fig. 3) to scrutinize the authentic effect of metacognition on the relationship between QM practices and a firm's SCAs. The results of the competing model demonstrated that QM practices were not significantly associated with a firm's SCAs. However, the results of the hypothesized model revealed that both behavioral QM ($\beta = .51, p < .001$) and technical QM ($\beta = .30, p < .01$) had a significantly positive effect on a firm's SCAs. Thus, hypothesis 2 was supported in that managerial metacognition positively influenced on the relationship between QM practices and a firm's SCAs. As a post-hoc study, the direct effect of managerial metacognition on a firm's SCAs was also examined (Fig. 4). The test results showed that metacognition were not directly associated with a firm's SCA ($\beta = -.09, p = -.38$). The theoretical and managerial implications of the test results were discussed in the next section.

Figure 2: SEM test results of the hypothesized model



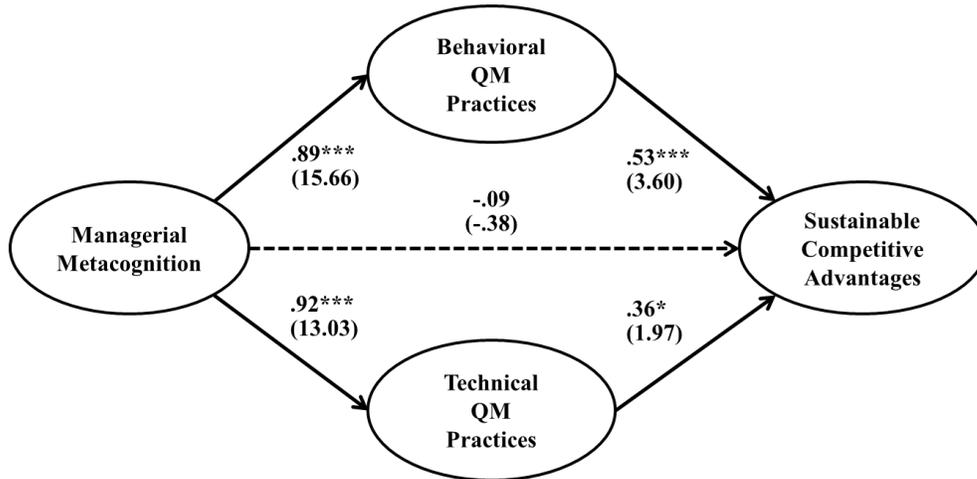
Note: N = 235; standardized path coefficients (β) are reported; the figure in the parenthesis represents the critical ratio (t value); * $p < .05$, ** $p < .01$, *** $p < .001$; $X^2/d.f. = 2.347$; CFI = .922; RMSEA = .076; TLI = .908; PNFI = .741.

Figure 3: SEM test results of the competing model



Note: N = 235; standardized path coefficients (β) are reported; the figure in the parenthesis represents the critical ratio (t value); dashed paths are not significant; $X^2/d.f. = 2.625$; CFI = .934; RMSEA = .083; TLI = .914; PNFI = .685.

Figure 4: The direct effect of managerial metacognition on a firm's SCAs



Note: N = 235; standardized path coefficients (β) are reported; the figure in the parenthesis represents the critical ratio (t value); dashed paths are not significant; * $p < .05$, ** $p < .01$, *** $p < .001$; $X^2/d.f. = 2.352$; CFI = .922; RMSEA = .076; TLI = .908; PNFI = .739.

DISCUSSION AND CONCLUSIONS

The study results present that there is a significantly positive association between managerial metacognition and a firm's quality practices, suggesting that better quality practices could eventuate in a firm when they have a higher level metacognitive ability. These findings are basically consistent with the Donaldson's (1987) structural adaptation to regain fit (SARFIT) model, which elucidates that an organizational structure should be continuously adapted to their contingencies for survival. That is, in terms of the contingency theory (Lawrence and Lorsch, 1967; Child, 1972; Donaldson, 1987), the study results imply that a firm's internal contingency factors (i.e., managerial metacognition) can result in the heterogeneous implementation of the firm's QM practices. Consequently, the findings in this study also weaken the 'universal applicability of QM practices' across organizational boundaries, based on institutional theory (Mitki and Shani 1995; Yavas 1995).

In addition, the metacognitive mechanism within organizational activities is typically too ambiguous for competitors to recognize; as a result, the mechanism cannot easily be imitated and substituted by competitors. In fact, the test results demonstrate that there is a positive synergy effect of metacognition and QM practices on the creation of a firm's SCAs. Hence, based on the premise of the resource-based view (Barney, 1991), the results also imply that a managerial metacognition might act as a source of a firm's SCAs.

In summary, this study found that managerial metacognition has a critical role in materializing the positive effect of a firm's QM practices on the creation of their SCAs. Thus, it is expected that the study findings can make some valuable contributions to the QM literature not only by expanding the research scope, but also by providing a new insight into the functional relationship between psychological and technical mechanisms.

REFERENCES

References available upon request.