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An Empirical Investigation in Sustaining High-Quality Performance

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ABSTRACT

Many organizations that were once quality leaders have had challenges sustaining high-quality performance. Although research has examined frameworks and concepts that lead to high-quality performance, few studies examine how to sustain high-quality performance. Sustaining performance may require additional capabilities from what it takes to achieve it. Drawing on quality management literature, organizational resilience literature, and the theory of dynamic capabilities in the strategy literature, this study empirically investigates the effects of four capabilities that help sustain high-quality performance. The analysis shows that capabilities in improvement, innovation, sensing weak signals, and responsiveness all help sustain high-quality performance. This suggests that what it takes to achieve high-quality performance is different, in part, from what it takes to sustain it. The data comes from a survey of 147 manufacturing business units. The analysis shows that the relative benefits of these capabilities may depend on the level of competitive intensity and environmental uncertainty. The findings provide empirical support for a theoretical model and practical guidance for sustaining quality performance. [Submitted: June 9, 2014. Revised: October 9, 2015. Accepted: October 15, 2015.]

Subject Areas: Quality management, Sustaining performance, Resilience, High reliability, and Dynamic capability.

INTRODUCTION

Organizations face an ongoing challenge of achieving and maintaining quality performance to satisfy and attract customers. Just because a firm has achieved a high level of quality performance relative to the competition does not guarantee that they can sustain it (Crockett & Reinhardt, 2003). High-quality performance takes firms years to achieve, but can be difficult to sustain in today's complex business environment. For example, even the long time quality leader Toyota recently experienced setbacks in their quality performance (Ohnsman et al., 2010), which

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illustrates the challenge of sustaining quality performance. Other companies with a strong track record in quality such as Sony and Mercedes-Benz have encountered similar problems in sustaining quality performance (Taylor, 2003; Fackler, 2006). A number of product recalls due to quality problems from various manufacturers including toys, drugs, medical devices, foods, electronic products, and vehicles (Fackler, 2006; Ohnsman et al., 2010) further highlight the challenges of sustaining high-quality performance.

How to achieve high-quality performance has been examined from various strategic perspectives. Early researchers embraced the industry structure perspective (Porter, 1991) and proposed that firms should compete on different dimensions of quality to create entry barriers for competitors (Garvin, 1987). Other researchers used the resource-based view (RBV) of the firm (Barney, 1991) to argue that creating unique resources (such as different quality practices) leads to high-quality performance (Powell, 1995). However, strategy scholars note that it is becoming difficult to sustain performance using RBV resources in today's hypercompetitive environments (D'Aveni, Dagnino, & Smith, 2010). This perspective argues that intense competition triggers rivals' learning efforts, and as a result once difficult-to-imitate resources eventually become replicated (Teece, Pisano, & Shuen, 1997). Sustaining high-quality performance may require a more dynamic perspective where firms need to constantly sense and adapt to changes just to maintain their performance level.

This research carries out one of the first empirical studies to address the following research question: *What capabilities lead to sustaining high-quality performance?* The study begins with the development of a conceptual framework for how firms can sustain high-quality performance, which initially emerged from a case study (Su, Linderman, Schroeder, & Van de Ven, 2014). We then take the following steps to address this research question. First, we conceptually define sustaining high-quality performance as having two distinct components: *level* and *consistency*. From this perspective, sustaining high-quality performance involves *consistently* maintaining a high *level* of performance. Using this definition, we draw on the quality management (Dean & Bowen, 1994; Hackman & Wageman, 1995) and organizational resilience (Weick & Sutcliffe, 2001, 2007) literatures to theorize four distinct capabilities that contribute to sustaining high-quality performance. The theory of dynamic capabilities provides an overarching explanation about how these capabilities collectively help sustain quality performance. We argue that these capabilities reflect the three dimensions of a dynamic capability: sensing, seizing, and reconfiguring (Teece et al., 1997; Teece, 2007), which increases an organization's adaptability so they can sustain high-quality performance.

We empirically test this framework with a sample of 147 manufacturing organizations. The results show that specific capabilities (improvement, innovation, sensing weak signals, and responsiveness) influence different components of sustaining quality performance. Specifically, the innovation capability and the capability to respond influence the level component of sustaining quality performance; while the improvement capability and the capability of sensing weak signals influence the consistency component of sustaining quality performance. A *post hoc* analysis investigates contingencies of contextual variables that further affect these capabilities. Interestingly, the analysis shows that the capabilities for the consistency component of quality performance do not depend on context, while the capabilities for the level component of sustaining quality performance depend on context. Consequently, organizations may need to invest more in some capabilities than others to sustain performance given their environmental context.

To the best of our knowledge, this is the first study to empirically examine the relationships between the capabilities of innovation, improvement, sensing weak signals, and responsiveness on the level and consistency components of quality performance. Further, this study demonstrates the applicability of the concepts of "sensing weak signals" and "responsiveness" which have not received much discussion in the quality management or operations management literature. Finally, we believe that this general model may have broader implications for the operations strategy literature. Operations strategy scholars have long noted the importance of quality to create a competitive advantage. For instance, the "sand cone" model argues that quality is the foundation for other manufacturing competitive advantages (Ferdows & De Meyer, 1990). Understanding how to sustain quality performance could provide a foundation to understand how to sustain other operational dimensions of performance.

LITERATURE REVIEW

Dynamic Capability

The literature on dynamic capability draws from both the resource-based view of the firm and evolutionary economics (Nelson & Winter, 1982; Barney, 1991; Di Stefano, Peteraf, & Verona, 2010). It suggests that to sustain performance a firm needs to constantly adapt to changes in their situated environment, and that developing "dynamic capabilities" helps increase a firm's adaptability (Helfat et al., 2007; Teece, 2007, 2009). Eisenhardt and Martin (2000) refer to dynamic capability as a firm's ability to alter their resource base. Zollo and Winter (2002) define it as "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" (Zollo & Winter, 2002, p. 340). The literature is far from reaching a consensus of a definition of dynamic capability (Di Stefano et al., 2010). Recent studies have looked at the micro-foundation of a dynamic capability to overcome these definition issues (Teece, 2007, 2009). This study follows Teece's (2007) micro-foundation perspective of a dynamic capability. Teece (2007) argued that a dynamic capability can be disaggregated into three generic components: *sensing, seizing,* and *reconfiguring*. *Sensing* refers to the capacity to sense, shape and search for new or emerging opportunities and threats. *Seizing* is the capacity to seize and capture opportunities after they are recognized. *Reconfiguring* refers to the capacity to transform, change, and modify existing processes. This dynamic capability perspective serves as an overarching theory to our study.

Resilience and Adaptability

A dynamic capability creates positive changes as well as reacts to negative and unexpected changes in order to promote adaptation (Eisenhardt & Martin, 2000). Researchers have noted that the adaptability to undesirable changes could be viewed as a form of organizational resilience (Sutcliffe & Vogus, 2003; Weick & Sutcliffe, 2007; Lengnick-Hall, Beck, & Lengnick-Hall, 2011). Internal or external changes may disrupt a firm's performance, researchers view a firm's "resilience" as the ability to cope with and respond to such changes. For example, Wildavsky (1991) argued that resilience means a firm is prepared for adversity, which requires the capacity to prepare and react to events without knowing them in advance. In complex environments where the unexpected is becoming a norm, organizations may have limited capacity to foresee every challenge that could arise (Weick, Sutcliffe, & Obstfeld, 1999; Weick & Sutcliffe, 2007). Scholars have begun to study certain types of organizations, called High Reliability Organizations (HROs), which maintain consistent performance in spite of being situated in high-risk environments (Roberts, 1990; La Porte, 1996; Weick et al., 1999; Weick & Sutcliffe, 2007). They find that HROs develop two generic capabilities to become resilient and achieve consistent performance: (1) the capability of sensing weak signals, which focuses on early detection of emerging threats and potential problems, and (2) the capability to swiftly respond and quickly address emerging issues. The organizational resilience literature develops similar concepts. For example, Hamel and Valikangas (2003) viewed resilience as continuous anticipation (i.e., sensing problematic signals) and continuous adjustment to disturbances (i.e., responsiveness). Likewise, Rerup and Center (2001) found that organizational resilience comes from the capacity to anticipate and improvise. Only recently, researchers have begun to demonstrate the importance of organizational resilience in a variety of settings such as information systems (Swanson & Ramiller, 2004), supply chain risks and disruptions (Bode, Wagner, Petersen, & Ellram, 2011; Speier, Whipple, Closs, & Voss, 2011), and nonprofit organizations (Ray, Baker, & Plowman, 2011). The concepts from organizational resilience have important implications for sustaining quality performance.

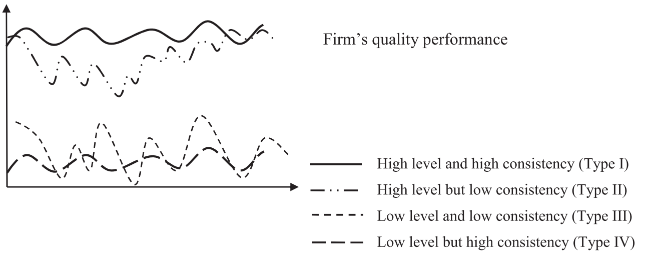
Quality Management

Over the years scholars have developed several theories and frameworks to achieve high-quality performance (Dean & Bowen, 1994; Flynn, Schroeder, & Sakakibara, 1994). Empirical research has examined how various practices enhance quality performance (Benson, Saraph, & Schroeder, 1991; Flynn et al., 1994). Kaynak (2003) conducted a comprehensive study of total quality management (TQM) practices and cited eighteen different studies that link quality management practices to high-quality performance. Recent studies have expanded the scope of traditional quality management practices to include Six Sigma (e.g., Zu, Fredendall, & Douglas, 2008) and the supply chain (e.g., Robinson & Malhotra, 2005; Foster, 2008; Kaynak & Hartley, 2008), while other studies have considered the effect of contextual factors (Rungtusanatham, Forza, Koka, Salvador, & Nie, 2005; Sousa & Voss, 2008; Zhang, Linderman, & Schroeder, 2012). However, none of these studies go beyond the effect of quality practices on quality performance and address how to sustain high-quality performance.

Understanding how to sustain quality first requires understanding the basic concepts and capabilities that underline quality management. Dean and Bowen (1994) defined quality management (QM) as a "set of mutually reinforcing principles, each of which is supported by a set of practices and techniques." Prior research has identified several key quality practices and examined their effects on firm performance (Flynn, Schroeder, & Sakakibara, 1995; Ahire & O'Shaughnessy, 1998). Sitkin, Sutcliffe, and Schroeder (1994) argued that in general quality management practices have two different orientations: total quality control (TQC) and total quality learning (TQL). TQC represents "a process in which a feedback loop is represented ... about unwanted variances in the system and modifying the system" (Sitkin et al., 1994, p. 544). TQL represents the "ability to uncover new problems or develop solutions independent of the current problems... this exploration aspect... increases an organizations ability to explore the unknown and to identify and pursue novel solutions" (Sitkin et al., 1994, p. 544). Sutcliffe, Sitkin, and Browning (2000) theoretically argued that these two approaches coexist independently of one another and quality management needs both to achieve the two distinct goals of control and learning. More recent research gives insights into the measurement (Zhang, Linderman, & Schroeder, 2014; Su & Chen, 2013) and implementation (Zhang et al., 2012) of quality practices with these different goals, that is, one toward exploitation and the other toward exploration (Zhang et al., 2014). Because firms may implement a wide array of quality practices that have different goals, rather than looking at specific practices, we take a capability perspective and look at the underling capabilities to achieve these goals.

From a dynamic capability perspective, the capabilities that organizations develop explain the heterogeneity in their performance (Dierickx & Cool, 1989; Teece et al., 1997). Organizational capabilities are high-level practices that produce a valuable output using specific organizational resources (Helfat & Peteraf, 2003; Winter, 2003). Organizational capabilities can be built from organizational practices (Winter, 2003). Viewing quality management practices from a capability perspective, suggests that they form two distinct capabilities: (1) the exploitation-oriented capability, that is, the capability to refine and increase efficiency and reliability of existing products and processes and (2) the exploration-oriented capability, that is, the capability to explore and develop new products and processes. Viewing quality management from a capability perspective rather than individual practices offers several advantages. First, individual quality best practices are static resources that could be imitated due to learning efforts of rival firms triggered competition (Teece et al., 1997). In fact, investment in quality practices does not necessary lead to a capability that translates into a performance advantage (Narasimhan, Swink, & Kim, 2005). Further, capability building is path-dependent and exhibits equifinality (Helfat & Peteraf, 2003). Organizations can apply a different set of quality practices that better fit their context to build these two core capabilities. Research in quality management has begun to take a capability perspective. For example, Douglas and Judge (2001, p. 165), in their analyses of quality management in hospitals, found that the capability to control internal procedures and the capability to adapt processes to environmental changes are two key capabilities that lead to competitive advantage in quality. In summary, two core capabilities emerged from the quality management literature: (1) exploitation-oriented capability or the improvement capability and (2) exploration-oriented capability or the innovation capability. Both of these capabilities act as high-level practices that alter internal resources for the purpose of adaptation.

Figure 1: Patterns of sustaining quality performance.



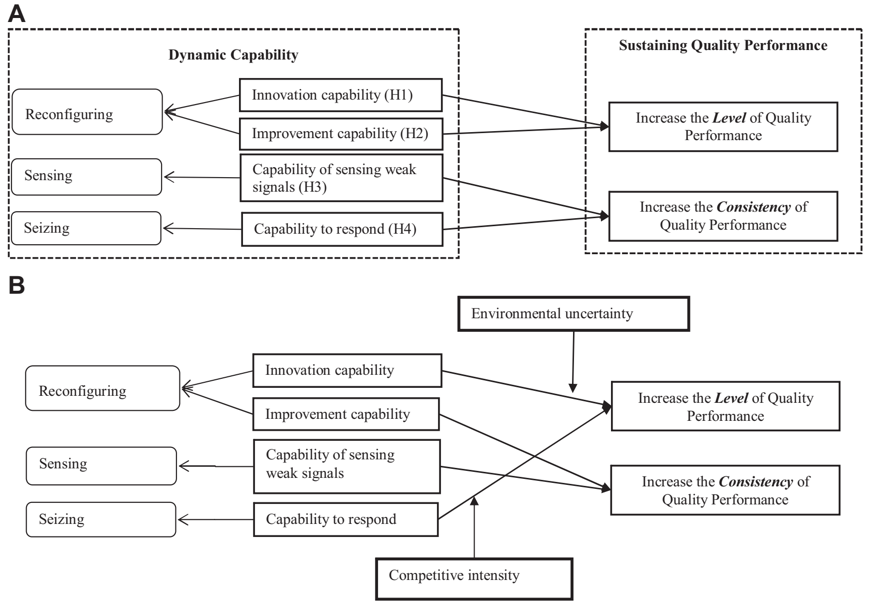
	Low Consistency	**High Consistency**
High Level	**Type II:** Organizations that gain high level of quality performance but with low consistency in performance.	**Type I:** Organizations that sustain quality performance over time.
Low Level	**Type III:** Organizations that show low performance level but with certain variability.	**Type IV:** Organizations that show consistently low performance.

DEFINING SUSTAINING QUALITY PERFORMANCE

Previous studies in quality management often did not conceptually differentiate achieving from sustaining high-quality performance. Many studies have viewed quality as a competitive advantage, which implicitly assumes sustaining quality performance (Flynn et al., 1994, 1995). Following Su et al. (2014), we argue that sustaining quality requires achieving both a high *level* and *consistency* in performance, which are conceptually distinct. A firm with a high *level* of quality performance indicates the firm's overall quality performance is high relative to their competition for a period of time. However, a high level of quality performance for a period of time does not necessary implies high *consistency* of quality performance, which previous studies have not fully considered. Consistency indicates lower variance and robustness in performance under perturbations (Wildavsky, 1991; Farjoun, 2010). Failure to consider the consistency component of performance could directly affect the chance that a firm survives. For instance, Levinthal (1991) used a simple random walk model to demonstrate that firms with more variable performance are more likely to deplete their resources and fail. Without considering the consistency component, one cannot differentiate between sustaining and achieving a high level of quality performance. It should be pointed out that sustaining quality performance is not having zero variance in quality performance outcomes. Instead, it is having lower variance (higher consistency) in quality performance.

Figure 1 illustrates four different patterns of sustaining quality performance based on the level and consistency components. The Type I pattern in Figure 1 illustrates organizations which achieve a high level and consistency (lower variance) of quality performance. The Type II pattern illustrates organizations which still achieve high level of quality performance but were less consistent. The Type III

Figure 2: Conceptual framework and revised model. (A) The conceptual framework derived from the literature. (B) The revised model based on empirical results and *post hoc* analysis.



and IV patterns illustrate organizations that do not achieve a high level of quality performance and with different extents of consistency. This conceptual distinction enhances theory development and helps operationalize the constructs of sustaining quality performance.

HYPOTHESES DEVELOPMENT

Figure 2 gives an overview of the conceptual model under investigation in this study. The theory of dynamic capabilities gives the overarching structure to the model. The capabilities to sustain high-quality performance align with the three generic components of a dynamic capability. This framework helps integrate different literature streams to develop a conceptual understanding of how firms sustain high-quality performance. It argues that the level and consistency components of sustaining quality performance benefit from different capabilities.

Achieving High Level of Quality Performance

Capacity of reconfiguring

Achieving a high *level* of quality performance is required to sustain high-quality performance. This study adopts a user-based definition of quality as *meeting or exceeding customers' expectations* (Evans & Lindsay, 2008). From this perspective, a firm's products or services have to provide more value to customers than their competitors for customers to perceive it as having high *level* of quality. The perceived product or service quality depends on the customers' expectations and needs. Therefore, achieving high level of quality implies that organizations need to constantly adapt to the changes and needs of their customers to remain competitive in providing better quality products and services (Nelson & Winter, 1982). As customers' needs and expectations change, the quality level perceived by customers also changes. Simply meeting pre-established requirements will not ensure high level of quality performance. As a result, achieving a high level of quality performance requires organizations to constantly adapt to the customers' changing needs. From a dynamic capability perspective, organizations need the *capacity of reconfiguring* so they can continually make changes to their products and processes to adapt to customers' changing expectations. Researchers have suggested that *innovation capability*, defined as the ability to develop new products and processes, provides such a capacity to adapt to customers' changing expectations (Sitkin et al., 1994; Brown & Eisenhardt, 1997; He & Wong, 2004; Wu, Melnyk, & Flynn, 2010). As discussed in quality management literature, innovation capability involves processes that focus on constantly developing new ways to meet in customers' changing quality expectations (Sitkin et al., 1994; Zhang et al., 2012). Innovation capability helps firms adapt to customers' changing expectations by developing new products, process technologies, or alternative approaches of delivery, which requires constant altering of their internal resources. As customer preferences change over time, so must the firm's products and processes. Achieving a high level of quality performance requires organizations to have the capability to innovate. Otherwise, they will not be able to deliver high level of quality products and services in the eyes of their customers. This suggests the following hypothesis:

H1: The innovation capability is positively associated with the level component of quality performance.

Improvement capability is another key capability discussed in quality and operations management literatures that helps a firm adapt to customers' needs (Ahire, 1996; Swink & Hegarty, 1998; Peng, Schroeder, & Shah, 2008; Wu et al., 2010). Improvement capability has been defined as the ability to refine existing products and processes (He & Wong, 2004, p. 484; Peng et al., 2008; Wu et al., 2010; Zhang et al., 2012). This capability focuses on incremental changes of existing products, services and processes. As a result, improvement capability helps organizations to *better* meet customers' existing requirements and specifications (Sitkin et al., 1994; Zhang et al., 2012). From a dynamic capability perspective, improvement capability also reflects the *capacity of reconfiguring* because it constantly refines and makes changes to existing products, services, and processes. Improvement capability helps firms adapt to existing customers' raising expectations by refining current products and processes to better meet their requirements. It seeks *better* ways of satisfying existing customers' needs, which enhances the level of quality performance. The above arguments suggest the following hypothesis:

H2: The improvement capability is positively associated with the level component of quality performance.

Achieving High Consistency of Quality Performance

Capacity of sensing

In addition to the level component, sustaining quality performance requires achieving high *consistency* in performance. However, one cannot expect high quality performance to go on into perpetuity without any variation. Undesirable events can negatively influence quality performance. For example, internal events such as customer order changes, production upsets and process defects; or external disruptions such as delivery issues in distribution, and competitors' movements can all cause variations in quality performance. Organizations that can better cope with these undesirable events, can achieve more consistency in their quality performance.

Research on organizational resilience provides insights for increasing the consistency of performance. Scholars noted that resilient organizations were more adaptable to undesirable disruptions due to their ability to better "sense weak signals" within their situated context (Weick & Sutcliffe, 2001; 2007). The *capability of sensing weak signals* is defined as the ability to become aware of the undesirable situations earlier through vigilant attention to changes in a firm's situated context (Weick & Sutcliffe, 2001). From a dynamic capability point of view, the capability of sensing weak signals relates to the generic *sensing* component because it helps sense potential threats to quality performance for adaptation purpose. The constant urge to search for anomalies and to detect potential problems is the basis of the capability of sensing weak signals (Rerup, 2009). Organizations with the capability of sensing weak signals are more alert and aware of changes in their situated environment. They are more cautious about internal anomalies that might negatively affect quality performance. They are vigilant about potential changes in the external environment which helps detect problems. The capability of sensing weak signals increases an organization's adaptability by providing early detection to changes that could potentially disrupt their quality performance. It decreases the likelihood or the extent of negative effects to their quality performance, which translates to better consistency in quality performance. The above arguments suggest the following hypothesis:

H3: The capability of sensing weak signals is positively associated with the consistency component of quality performance.

Capacity of seizing

Despite an organization's best efforts at sensing quality problems, problems will inevitably happen. It is impossible to sense every potential quality issues that could arise. Nonetheless, when issues do occur, organizations need the *capability to respond* to undesirable disruptions. The capability to respond is defined as the ability to quickly resolve quality issues once they occur (Weick, 1995; Weick & Sutcliffe, 2007). Organizations that can quickly respond to quality issues and resolve them swiftly can mitigate the negative effects to quality performance. As a result, the capability to respond increases the consistency of quality performance. Form a dynamic capability perspective, the capability to respond reflects the capacity of *seizing* because it helps seize the opportunities to correct quality problems to cope with undesirable changes. Prior studies suggest that the capability to respond comes from a commitment to core values and accessibility to social capital resources (Schulman, 1993; Lengnick-Hall, Beck, & Lengnick-Hall et al., 2011). Capability to respond could come from the commitment of the employees toward quality value, because it is the people that manage quality problems and their adverse effects. In a case study, Schulman (1993, p.365) suggested that strong capability to respond came from the "values" held by people within the organization. Value affects the way people frame and label issues, which often influences the types of responses they generate (Dutton & Jackson, 1987). When facing events that may endanger quality performance, people with strong commitment to the value of quality are more willing to pitch in and take action to resolve issues. People tend not to sacrifice quality over other priorities such as cost. People are more willing to access other types of social capital to help resolve quality problems (Leana & Van Buren III, 1999). As a result, an organization with strong capability to respond is more adaptable to quality problems, which minimizes the negative consequences of disruptions and increases consistency of quality performance. The above arguments suggest the following hypothesis:

H4: The capability to respond is positively associated with the consistency component of quality performance.

DATA AND METHODS

Sample and Survey Data Collection

The data used to test the hypotheses comes from 147 business units operating in the manufacturing industry in the United States and Taiwan. Prior studies in operations management often collect data from the United States. A sample with data from multiple countries increases the generalizability of the results. We collect data from Taiwan because it has a different culture from the United States (eastern vs. western culture), but also has a long history of advanced manufacturing. In addition, one of the co-author is fluent in Mandarin and has access to several manufacturing firms. Although sampling firms from other Asian and/or western countries would further increase the generalizability, it is better than a single country study. The level of analysis for the study is the business unit. Data collection took place through an online survey. All survey items use a seven-point Likert scale (see the Appendix for more information).

Common method bias may occur when using respondents for both the independent and dependent variables. Having multiple respondents improves the quality of the data, minimizes problems of common method bias, and increases the validity of the survey design. This study separates respondents for the independent and dependent variables to reduce common method bias. The survey questionnaire is divided into two parts: the quality or operations managers are responsible for questions related to innovation, improvement, sensing weak signals and responsiveness, and the division general managers are responsible for questions about quality performance and the business environment. The questionnaire was translated into Mandarin and translated back into English by two different individuals

Table 1: Sample distribution across industry and country.

		Industry				
		Food Processing	Industrial	Electronics	Chemical	Total
Country	United States	25	14	21	16	76
	Taiwan		56	12	3	71
	Total	25	70	33	19	

to ensure similarity of meaning. A complete survey required responses from both the quality/operations managers and the general managers.

For the U.S. sample, the researchers first approached associations such as Minnesota Council of Quality, Consortium of Baldrige Award Recipients, and the Juran Center of Quality to gain access to senior level contacts from over 300 business units within the United States. A short summary of the research study and potential benefits was sent to solicit participation, and 124 business units agreed to participate. These business units mainly operate in food processing, electronic manufacturing, and industrial manufacturing. The online survey was disseminated to the quality/operations and general managers within each business unit followed by personal phone calls and multiple email reminders (Dillman, 2000). The final sample (which has responses from both managers) consisted of 76 business units (a response rate of 25%) in 21 U.S. firms and 71 business units (a response rate of 63%) in 71 Taiwan firms (each business unit in Taiwan came from a single firm). To collect data from Taiwan, the researchers had access to the Ren-Wu manufacturing industrial park located in the southern part of Taiwan, which focuses mainly on electronic and industrial manufacturing. We ask a qualifying question about the extent to which management supports quality in Taiwan (5-point scale: 1 = lack of support, 5 = full support from management), and exclude business units that score less than 3 to insure the responding firms have a focus on quality. The total sample consists of 147 business units from both the United States and Taiwan.

The 147 business units in the final sample did not differ significantly from nonresponding business units (89) in size ($p = .493$). The Heckman's (1979) two-stage procedure is used to estimate selection bias caused by nonresponding business units due to size and industry. The Heckman test involves two stages. First, it computes the probability of a business unit participating in the study using predictors including organizational size and industry. The result indicated that most nonrespondents came from the electronic industry. The obtained inverse Mills ratio is then used as a predictor in the second stage performance equation. The Lamda/inverse Mill's ratio was insignificant ($p = .987$), indicating the sample did not suffer from selection bias toward good performance due to size or industry. Table 1 gives the distribution of the sample across countries and industries. It shows that the sample has a general focus on the manufacturing industry. All constructs are measured at the business unit level. The following sections discuss the operationalization of constructs.

Survey Measurements

Because capabilities are latent constructs that cannot be observed directly, this study measures the observable outcomes or behaviors that result from the presence of the capabilities. The items for the constructs used in this study largely came from a review of the literature in quality management (Zu et al., 2008) and organizational behavior (Knight, 2004; Vogus, 2004). See the Appendix for details of the measurement scales.

Dependent variable

The construct of sustaining quality performance involves two separate components: the level and consistency components of quality performance. One construct measures the *level* of quality performance relative to competition over the last year, and another construct measures the *consistency* of quality performance relative to competition over the last 5 years. These measurement scales are adapted from previous quality management research (Flynn et al., 1994; Zu et al., 2008). Because all the measurement items are related to quality performance, the latent construct is expected to cause changes in the measurement items. We model both level and consistency of quality performance as reflective constructs following previous research in operations management.

Independent variables

The independent variables include the four different capabilities investigated in this study: innovation, improvement, sensing weak signals, and responsiveness. We measure these four capabilities separately.

Improvement capability: This scale is adapted from He and Wong (2004). It consists of items which capture the outcomes of incremental improvement of products and processes relative to competition on dimensions such as refining existing products and services or reducing production costs.

Innovation capability: This scale is also adapted from He and Wong (2004). It consists of items which capture the outcomes of innovation such as developing new products, extending existing products, and entering new markets to satisfy customers' unmet needs.

We conceptualize innovation and improvement capabilities as formative constructs. Because the measurement items assess the underlying dimensions of competencies of improvement and innovation, these dimensions facilitate or "form" an overall competency of improvement or innovation. Conceptually, the underlying dimensions do not need to be highly correlated; they cumulatively combine to serve the overall purpose of improvement or innovation.

Capability of sensing weak signals: The sensing weak signals scale is adapted from the organizational resilience literature (Knight, 2004; Vogus, 2004). It captures the concept of focusing on potential failures. It consists of items that tap into organizational behaviors such as viewing small misses as mistakes, actively looking for anomalies, and the awareness of problems in the surrounding environment.

Capability to respond: This scale is adapted from previous research on organizational resilience (Knight, 2004). It taps into organizational behaviors such as commitment to solve quality problems, belief in the value of quality, and differing to expertise.

Capability of sensing weak signals and the capability to respond are modeled as reflective constructs. The measurement items of these two constructs are the perceptions of organizational behaviors that are influenced by these two latent constructs. That is, a latent competency construct directly influences changes in the organizational behaviors reflecting by the measurement items.

Control variables

Organizational size: Larger organizations may have more resources available to better weather through unexpected disruptions. On the other hand, larger organizations may have more organizational inertia, which might decrease the organization's adaptability to changes (Romanelli & Tushman, 1994). Following previous research, organizational size is measured as the number of employees.

Competitive intensity: Competitive intensity refers to the degree to which a firm faces competition within their industry. Intense competition is characterized by strong competitors, fierce price wars, and more players in the market (Porter, 1991). High level of competition significantly affects the perceived value of products and services that organizations offer to their customers (Buzzell & Gale, 1987). This reflective scale is adapted from Jaworski and Kohli (1993).

Environmental uncertainty: Environmental uncertainty encompasses environmental conditions of unpredictability due to rapid changes in technological development and market conditions in the industry (Dess & Beard, 1984). This can be either caused by uncertainty in market demands, consumer needs or technological changes which makes the business environment unpredictable. Because sustaining quality performance depends on meeting or exceeding customers' needs, the degree of changes in customers' preferences, technologies and competitors' activities could impact an organization's ability to sustain quality. This is a reflective scale adapted from Jansen, Van Den Bosch, and Volberda (2006).

ANALYSES AND RESULTS

Country Difference across Measurement Items

Because the data comes from two different countries, there could be issues with measurement equivalence between the countries. We perform the score test and compare the constrained and unconstrained model based on country to assess measurement equivalence (Lubke & Muthén, 2004). The null hypothesis is that the measurement items are equivalent across countries. The score test indicates that several measurement items are not equivalent across countries (see the Appendix). It could be that the respondents interpret the measurement items differently due to language differences or cultural differences. These items are excluded from subsequent analysis, because they differ in terms of their measurement properties and could affect the results.

Reliability and Validity of Constructs

A confirmatory factor analysis (CFA) assesses the reliability and validity of the reflective scales. The Appendix gives the item loadings, composite reliability (CR), and average variance extracted (AVE) of the reflective scales. All items significantly ($p < .01$) load onto the factor, which indicates convergent validity at the item level. The AVE values exceed .5 for all constructs which indicates convergent validity. All the scales show good reliability because the CR values exceed .7. All reflective scales show good discriminate validity, because the square root of AVE (see the diagonal in Table 2) exceeds the related interconstruct correlations. The overall model fit statistics of the measurement model exceeds the recommended cutoff points (RMSEA = .056, CFI = .968, TLI = .960, SRMR = .050, χ^2/df = 1.46), which indicates a good measurement model fit (Hair, Black, Babin, Anderson, & Tatjam, 2006, p. 654). It is possible that small sample size leads to increase in multivariate nonnormality and the fit indexes could be inflated. We perform a bootstrapping procedure with 1,000 samples as an aid to address potential nonnormality. The model fit results are qualitatively similar. Further, the standardized root mean square error (SRMR) is an absolute measure of fit and a value of zero indicates perfect fit. SRMR is positively biased toward smaller sample size. That is, a small sample size can lead to high SRMR value. The SRMR = .05 is still less than .08, which is a cutoff point for considering a good model fit (Hu & Bentler, 1999). As a result, small sample size is not a concern.

Hair et al. (2006) suggest that "because formative indicators do not have to be highly correlated, internal consistency is not a useful validation criterion for formative indicators." Similarly, Bagozzi (1994, p. 333) warns that "reliability in the internal consistency sense and construct validity are not meaningful when indexes are formed as a linear sum of measurements." Researchers have since recommended using the Multiple Indicators and Multiple Causes (MIMC) model to evaluate formative constructs (Diamantopoulos & Winklhofer, 2001; Diamantopoulos & Siguaw, 2006). The MIMC model includes two or more reflective indicators and multiple formative indicators for each formative construct. The reflective indicators are usually not part of the research model, but rather used as external criterion to assess the formative construct validity. We examine the formative items' weights and magnitudes of the two formative constructs: improvement and innovation. The item weights should be statistically significant and the sign should be consistent with the underlying theory (Diamantopoulos & Winklhofer, 2001). Table 3 shows that except for the item imp_4, all item weights are statistically significant and have positive signs, indicating good construct validity. Although imp_4 is not significant, this item should be included because conceptually it is an aspect of improvement capability (He & Wong, 2004). Researchers also suggest regressing the factor score of the formative construct on the measurement items and check the multicollinearity of the measurement items (Diamantopoulos & Winklhofer, 2001; Petter, Straub, & Rai, 2007). All variance inflation factors (VIF) have values less than 3.3, a recommended criterion by Diamantopoulos and Siguaw (2006).

Table 2: Correlations among reflective and formative constructs.

Variable	*X*1	*X*2	*X*3	*X*4	*X*5	*X*6	*X*7	*X*8
Competition (*X*1)	**.8988**							
Environment uncertainty (*X*2)	.1452	**.7778**						
Improvement (*X*3)	.2030**	.1893**	**N/A**					
Innovation (*X*4)	.3017***	.2298***	.4684***	**N/A**				
Sensing weak signal (*X*5)	.1712	.1983**	.4037***	.3195***	**.7489**			
Respond (*X*6)	.1693**	.0197	.4039***	.4182***	.5157***	**.7483**		
Level of quality performance (*X*7)	.1446	.1492	.4726**	.4837**	.2546**	.4478***	**.8467**	
Consistency of quality performance (*X*8)	.1637**	.2369***	.5489***	.4593***	.4544***	.3664***	.6682***	**.9022**

** $p < .05$, *** $p < .01$ (two-tailed) ($N = 147$).
Note: The square root of average variance (AVE) is shown on the diagonal of the correlation matrix of the reflective constructs and interconstruct correlations are shown off the diagonal.

Table 3: Measurement properties of the formative constructs.

Innovation Capability: Adapted from He & Wong (2004) (Formative construct)	**Item Weights**	**VIF**
Please indicate your business unit's competency relative to major competitors on the following dimensions (1 = significantly worse, 4 = about same, 7 = significantly better)		
Inv_1: Introduce new generations of products and services [1]		
Inv_2: Extend product and service range	0.1614***	1.45
Inv_3: Open up new markets for new products[1]		
Inv_4: Enter new technology fields	0.3901***	1.45
Reflective indicators used in MIMC model		
The overall performance of our new product development program has met our objectives		
From an overall profitability standpoint, our new product development program has been successful		
Compared with our major competitors, our new product development program is far more successful		
Improvement Capability: Adapted from He & Wong (2004) (Formative construct)	**Item Weights**	**VIF**
Please indicate your business unit's competency relative to major competitors on the following dimensions (1 = significantly worse, 4 = about same, 7 = significantly better)		
Imp_1: Improve existing product and service quality	0.1908***	2.55
Imp_2: Improve production flexibility	0.1528***	2.43
Imp_3: Reduce production cost[1]		
Imp_4: Achieve economies of scale in existing products	0.0322	1.55
Reflective indicators used in MIMC model		
Please rate the extent to which quality improvement procedures and framework exists in your business unit		
Please rate the extent to which collection and use of quality improvement data exists in your business unit		
We continuously to seek areas of improvement in our current operations function		

Note: [1]removed due to country difference (score test, $p<0.05$), $^{***}p < 0.01$

Robustness Checks of the Perceptual Performance Constructs

Objective financial performance data helped validate the predictive validity of the perceptual measures. Prior research shows a relationship between quality performance and financial performance. We obtained 5 years of financial performance data from business unit's accountants of 18 business units. The perceptual measure of the level component of quality performance was correlated with the following objective measure: the business unit's recent year's financial performance minus the average financial performance over the last 4 years. This objective measure is a conservative estimation of the level of financial performance relative to industry average of each business unit, because the business unit benchmarks financial performance against their competitors. This objective measure had a significant ($p < .05$) correlation of .58 with the *level* of quality performance. In addition, the *consistency* of quality performance was correlated with the reciprocal of the *SD* of the financial performance for the last 4 years. These two variables had a significant ($p < .05$) correlation of .51.

For a further robustness check of the perceptual measure, we obtained internal audit scores that gave the average ratings of the product and service quality performance from the 18 business units. Quality leaders at the corporate level conducted the audits. They evaluated each business unit based on the following criteria: (1) current year's growth performance compared to previous year's performance and (2) 3 years or longer data points to show sustained and consistency trend of growth performance. Because the audit score combines both current and trend performance, we correlated the audit score with the multiplication of the level and consistency of quality performance. The correlation was positive and significant ($\rho = .52$, $p < .05$). Overall, these results further validate the *level* and *consistency* measures of quality performance.

Empirical Results

Table 2 gives the correlations for the variables used in the analysis. As expected, the level and consistency quality performance measures are highly correlated. Because the survey data came from different firms that had multiple business units, we use a linear mixed model with random intercept to accommodate unobserved heterogeneity at the firm level (Rabe-Hesketh & Skrondal, 2008). Random effects estimation method has the advantage of mitigating omitted variable concerns at the higher cluster level and accounts for both the within and between variation (Greene, 2003). That is, it accounts for higher level variations such as culture, which can potentially affect the outcomes at the business unit level. We use a random effect approach rather than a fixed effect approach because many firms provide only one business unit for survey. Because fixed effect approach only accounts for within firm variations, using such an approach will significantly decrease the effective sample size. In addition, random effects models can be used to make inferences about the population of firms. The estimated error terms of the business units that belong to the same firm may be dependent and correlated, consequently we report the cluster-robust standard errors in this study (Cameron & Trivedi, 2009). As a robustness check, we also conducted an ordinary least square (OLS) with cluster robust estimator and got similar results. Multicollinearity does not appear to be a concern because the VIF for all estimated models was below the acceptable limit of 3 (Hair et al., 2006). The Shapiro–Wilk test on the residuals indicates that normality does not appear to be a concern ($p = .81$). All predictors were standardized to reduce concerns of multicollinearity (Aiken & West, 1991). A hierarchical regression approach is used to evaluate the effects of hypothesized variables after including the control and nonhypothesized variables.

Table 4 summarizes the regression results of the hypothesized factors on the level and consistency components of quality performance. Petrocelli (2003) notes that several steps can help avoid common errors in hierarchical regression. First, we assess improvement in model fit to avoid misinterpretation of the regression

Table 4: Summary of regression analysis.

Dependent Variable (Quality Performance)	Level			Consistency		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Controls						
Level of quality performance				.684***	.526***	.548***
Consistency of quality performance	.616***	.574***	.510***			
Size	–.022	–.004	–.005	.056	.063	.062
Competitive intensity	.062	.037	.021	.011	–.008	–.018
Environment uncertainty	–.025	.007	–.016	.133*	.086	.054
Industrial industry	.301	.286	.280*	–.475**	–.402**	–.398**
Electronic industry	.406**	.413**	.368**	–.267	–.198	–.175
Chemical industry	.239	.337	.400*	–.174	.067	.079
Country	–.129	.046	.001	.486**	.363*	.250
Predictors						
Innovation			.158** (H1)		.087	.068
Improvement			.065 (H2)		.300***	.241***
Sensing weak signals		–.225**	–.215†			.286*** (H3)
Respond		.321***	.269***			–.101 (H4)
Wald χ^2	221.13***	227.87***	240.91***	259.96***	327.38***	426.25***
Wald test		11.07***	7.89**		18.59***	14.07***

$^{*}p < .1$, $^{**}p < .05$, $^{***}p < .01$ (two–tailed) ($N = 147$).
Note: Industry: Food processing, industrial, electronic, chemical.

results. Second, the order of entering predictors can be a source of errors (Petrocelli, 2003). We enter the hypothesized variables after the control variable and the nonhypothesized variables to avoid violation of causal priority, and also avoid using hierarchical regression in an exploratory manner. Models 1, 2, and 3 show results related to the *level* of quality performance as dependent variable. Model 1 shows the effects of the control variables only, which includes the consistency of quality performance because level and consistency may be related. Model 2 includes the effects of nonhypothesized variables on the level of quality performance (capability of sensing weak signals and capability to respond) as additional control variables. Model 3 includes the hypothesized factors for H1 and H2 (innovation capability and improvement capability) on the level of quality performance. Model 3 suggests that improvement capability has no significant effect ($b = 0.065$, $p > .1$), and innovation capability has a positive and significant effect ($b = 0.158$, $p < .05$) on the level of quality performance. The results provide support for H1 but do not support H2. Interestingly, although not hypothesized, Model 3 suggests that sensing weak signals has a weak negative association ($b = –0.215$, $p < .1$) and capability to respond has a positive association ($b = 0.269$, $p < .01$) with the level of quality performance.

Models 4, 5, and 6 give the results for testing H3 and H4 on the *consistency* component of quality performance. Model 4 shows the results of the control variables, which includes the level of quality performance. Model 5 includes the effects of nonhypothesized factors (innovation and improvement) as additional control variables. Model 6 includes the hypothesized variables of the capability of sensing weak signals and the capability to respond (H3 and H4). Model 6 suggests that sensing weak signals has a positive and significant effect on the consistency of quality performance ($b = 0.286$, $p < .01$), which supports H3. But it also shows that capability to respond has no significant effect on the quality performance consistency ($b = –0.101$, $p > .1$), which does not support H4. Finally, although not hypothesized, Model 6 indicates that improvement capability (a nonhypothesized variable) has a strong and positive effect on the consistency of quality performance ($b = 0.241$, $p < .01$). We discuss later the implications of the overall results.

***Post hoc* Analysis**

In light of the nonhypothesized results, a *post hoc* analysis is conducted to explore the possibility that contextual variables might explain the results that are inconsistent with the hypotheses.[i] We examine the interaction effects of the *competitive intensity* and *environmental uncertainty* with the four capabilities on sustaining quality performance. Table 5 shows the interaction effects of the competitive intensity and environmental uncertainty. Interestingly, we find that none of the interaction effects are significant for the consistency component of quality performance (see Table 5, Models 2 and 4), which suggests that the effects of the individual capabilities on consistency of quality performance are *context independent*. That is, their effects on quality performance consistency do not depend on the environmental context. In contrast, the contextual variables influence the effects of the capabilities on the level of quality performance. The interaction effect of *competitive intensity* and the *capability to respond* is negative and significant

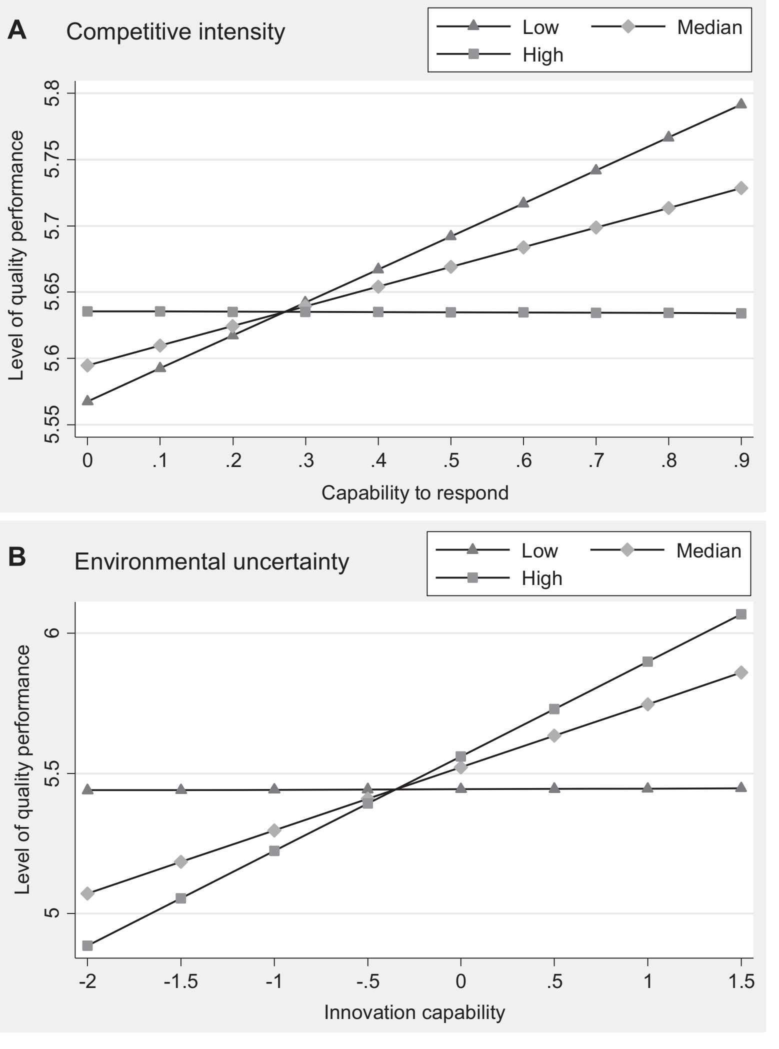
[i] We thank the anonymous reviewer for suggesting this idea.

Table 5: *Post hoc* analysis for contextual variables.

Contextual Variable	Competitive Intensity		Environmental Uncertainty	
Dependent Variable (Quality Performance)	Level Model 1	Consistency Model 2	Level Model 3	Consistency Model 4
Controls				
Level of quality performance		.510***		.572***
Consistency of quality performance	.456***		.483***	
Size	.002	.078†	–.016	.063
Industrial industry	.204	–.348**	.121	–.343†
Electronic industry	.292**	–.090	.296	–.136
Chemical industry	.514†	.212	.285	.135
Country	–.009	.229	–.032	.236
Contextual variable	.048	.019	–.061	.053
Predictors				
Innovation	.155†	.091	.213***	.025
Improvement	.071	.256***	.038	.251***
Sensing weak signals	–.141	.286***	–.184†	.290***
Respond	.191**	–.146	.227***	–.113
Interactions				
Contextual variable × Improvement	–.003	–.035	–.578	.052
Contextual variable × Innovation	.051	.088	.174**	–.091
Contextual variable × Sensing weak signals	.070	.059	.051	–.041
Contextual variable × Respond	–.173**	–.103	.021	.028
Wald χ^2	541.85***	619.82***	436.14***	580.19***

†$p < .1$, **$p < .05$, ***$p < .01$ (two-tailed) ($N = 147$).

Figure 3: The interaction plots for level of quality performance. (A) *Competitive intensity* × *capability to respond*. (B) *Environmental uncertainty* × *innovation capability*.



($b = –0.173$, $p < .05$) (see Table 5, Model 1) and the interaction effect of *environmental uncertainty* and the *innovation capability* is positive and significant ($b = 0.174$, $p < .05$) (see Table 5, Model 3). Figure 3 shows the interaction plots to help better understand the interaction effects. In terms of competitive intensity, the positive effect of the capability to respond on the level of quality performance decreases as the competitive intensity increases (see Figure 3A). Therefore, the capability to respond is more effective for firms in a low competition environment than for firms in a high competition environment. That is, although the capability to respond has a positive effect in general on the level of quality performance, its effectiveness decreases (increases) as competition increases (decreases). On the other hand, the effect of innovation capability on the level of quality performance increases as environmental uncertainty increases (see Figure 3B). In other words, innovation capability becomes more effective for firms facing higher levels of environmental uncertainty. We discuss below the implications of the *post hoc* analysis.

DISCUSSION AND CONCLUSION

To the best of our knowledge, this is the first study that empirically links the capabilities of improvement, innovation, sensing weak signals, and responsiveness to the level and consistency components of sustaining quality performance. Previous research in quality management implicitly assumed that the capabilities to achieve high-quality performance were the same as those required to sustain it. This research argues that to sustain quality performance, firms need to develop capabilities that enhance their adaptability to both changing customers' needs and undesirable events. The theory of dynamic capabilities provides an overarching framework to understand how these capabilities come together and help firms sustain high-quality performance. The empirical results find that innovation capability and capability to respond positively influence the level component of quality performance, but the relative benefits of these capabilities depend on the environmental context. While the capability to improve and sense weak signals positively influence the consistency component of quality performance, and does not depend on the environmental context. Consequently, organizations that achieve high-quality performance may need to develop additional capabilities to sustain it. The relative benefits of some of these capabilities depend on the environmental context.

Theoretical Implications

The overall findings both confirm and extend our conceptual understanding of sustaining high-quality performance. Figure 2B summarizes the revised framework based on the empirical results and *post hoc* analysis. This reveals some surprising observations and interesting insights. First, the results show that innovation and improvement capabilities help sustain quality performance, which supports prior research in quality management (Sitkin et al., 1994; Zhang et al., 2014) and organizational behavior (e.g., ambidexterity) (Tushman & O'Reilly, 1996; O'Reilly & Tushman, 2004). However, contrary to our expectations, the main results indicate that innovation and improvement capabilities contribute to *different* dimensions of sustaining quality performance (H2 and H4 not support). As expected, higher innovation capability increases the level component of quality performance. However, higher improvement capability increases the consistency component rather than the level component of quality performance. Considering environmental factors does not change this result. An alternative explanation is that improvement capability reduces the variation of existing processes and products, and simply meeting the customers' specifications better than the competition may not warrant an increase in the level of quality performance as perceived by customers. That is, incremental improvement does not help firms adapt to customers' changing expectations (Tushman & Anderson, 1986), which poses a challenge to the existing quality management literature. But, the variance-reduction nature of improvement capability helps increase the reliability of products and processes, which decreases the likelihood of quality problems and translates into more consistent quality performance. That is, although better meeting customers' needs may not necessarily increase the level of quality performance as perceived by customers, meeting their needs consistently through more reliable and refined products and processes increases the consistency of quality performance. In addition, our results have implications to the ambidexterity literature. This literature defines ambidexterity as a firm's ability to explore (innovate) and exploit (improve) in comparison to competitors in a similar industry (Vickery, 1991; Chandrasekaran, Linderman, & Schroeder, 2012). This literature argues that organizations with more ambidexterity should have higher performance relative to their competitors, which leads to a competitive advantage. Our results confirm the importance of both exploration (innovation) and exploitation (improvement) in the context of sustaining high-quality performance. However, prior studies on ambidexterity only look at the level of performance and do not consider the consistency of performance. Our results show that sustaining quality performance still needs both innovation and improvement capabilities, as expected from the ambidexterity literature, but they contribute to different dimensions of sustaining quality performance. This raises the question of whether exploration contributes the level dimension and exploitation contributes to the consistency dimension is unique to sustaining quality or applies more broadly to the ambidexterity literature? We encourage future research to differentiate the level and consistency components of sustaining performance when studying ambidexterity.

Second, contrary to our hypothesis, the capability to respond has no significant effect on the consistency of quality performance. However, it has a significant positive effect on the level component of quality performance. This implies the capability to respond increases the level component of quality performance rather than the consistency component. An alternative explanation is that perhaps the capability to respond helps organizations' respond quickly to quality problems, and customers perceive this as exceeding their expectations. As a result, customers may perceive high responsiveness to quality problems as providing better value, which translates into a higher level of quality performance relative to competition. When quality issues do occur, organizations that can quickly respond to those issues increase the customer's perception of the level of quality. Consider the following example from a Lexus customer "Well, I suppose you could call the four times they had to replace the windshield a '[quality] problem.' But frankly, they took care of it so quick and always gave me a loaner car, so I never really considered it a 'problem' until you mentioned it now" (Berry & Parasuraman, 1997). Customers may view a fast response and quick recovery as a sign of high quality, which increase customer's perception of the level of quality performance.

Third, sensing weak signals has a strong positive effect on the consistency component of quality performance as expected. However, it also had a somewhat weak but negative effect on the level component. This suggests a potential trade-off because sensing weak signals contributes positively to the consistency component but negatively to the level component, but sustaining high-quality performance requires both level and consistency components. Possibly the capability of sensing weak signals requires organizations spend a significant amount of time collecting data and studying small anomalies which would otherwise go unnoticed. Consequently organizations may get mired in the details that distract them from activities that lead to increasing the level of quality performance. Also, sensing weak signals has a prevention focus that seeks to detect any potential threats to quality performance by being alert to changes. A heavy focus of preventing failures might cause a firm to become overly cautious, and not engage in riskier activities that may be necessary to increase the level of quality performance. In other words, they might become too focused on survival. Future research could further investigate the effect of sensing weak signals in different contexts and seek ways address the challenge of potential trade-off between level and consistency.

The exploratory *post hoc* analysis also yields some interesting observations worth discussing. The analysis shows that the capabilities to increase the *consistency* component of quality performance (improvement and sensing weak signals) are context *independent*. Their effects do not depend on level of competitive intensity or environmental uncertainty. On the other hand, the effects on the *level* component of quality performance (innovation and responsiveness) depend on context. For instance, organizations that confront high levels of environmental uncertainty face rapid changes in customers' needs. In these settings, successful adaptation depends on the ability to discover alternatives and search for unknowns (March, 1991). Consequently, innovation capability becomes more beneficial in environments with higher levels of uncertainty (see Figure 3B). Prior research also supports the notion that innovation of new products and processes helps firms better adapt in environments with high uncertainty (Brown & Eisenhardt, 1997). The results also indicate that in environments with high levels of competitive intensity, the benefits of the capability to respond reduce. Perhaps in a more competitive environment, when a firm has a quality problem, competitors will more quickly "seize the opportunity" which renders the capability to respond less effective. In a more competitive environment, competitors will more quickly capitalize on a firm's quality problem. In contrast, in low competitive environments, firms that can quickly respond to quality problems will less likely lose ground to the competition. Therefore, under low competitive intensity, the ability to quickly resolve quality problems is a more effective approach for providing high-quality products and services as perceived by customers. In a highly competitive environment, the negative consequences of having quality problems in products and services are more detrimental because competitors will take advantage of this situation, which renders the capability to respond less effective.

Managerial Implications

The recent setbacks with quality leader Toyota provide a useful narrative to understand the implications of this research for practice. For all the excellence in quality that Toyota has demonstrated in their production system over the years, it appears that they did not extend the same level of alertness (e.g., pulling the "*andon cord*" whenever you see a problem) to other parts of the organization (Bodek & Green, 2011). That being said, despite all the troubles in 2010, Toyota shows signs of regaining its top position after the crisis. In light of the recall crisis, Liker and

Ogden's (2011) recent assessments of Toyota corroborate the key concepts in our model. They pointed out several principles of Toyota which we find consistent with this study: regaining the spirit of challenge to fight complacency and remain vigilance (sensing weak signals), the respect for people so that people are willing to step up during crisis (capability to respond), increasing awareness of what is actually going on at customers' sites (innovation), the need of having a system to share the potential problems (sensing weak signals), and the never-ending cycle of continuous improvement (improvement). These comments not only demonstrate the usefulness and relevancy of the concepts in our model but also provide practical guidance to the practitioners. Organizations may establish these capabilities based on substantially different practices that suit their own unique situation.

LIMITATIONS AND FUTURE RESEARCH

The empirical relationships found in this study have several limitations. Conclusions drawn from the results should be interpreted as suggestive rather than decisive. In addition, the data used in this study comes mainly from the business unit level. Therefore, the results cannot be generalized to lower levels such as manufacturing plants, in which most quality practices are implemented. The survey data also largely came from the manufacturing sector, so the results might not be generalizable to other industry sectors. That being said, the manufacturing industry has a long history of implementing quality. We believe the manufacturing industry provides a good starting point for examining the sustaining quality factors. The formative constructs used in this study also might not enumerate all the underlying dimensions of the innovation and improvement capability. We encourage future research to examine the revised model as a replication study in different contexts or using data from other industries to examine the generalizability of the results. Future studies could also investigate several ideas considered above. We hope this article will stimulate new perspectives and help encourage other related studies on this important but mostly under studied question of sustaining quality performance.

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APPENDIX: RELIABILITY AND VALIDITY FOR REFLECTIVE MEASUREMENT ITEMS

Capability of Sensing weak signals (CR = 0.864, AVE = 0.561)	**Item loading**
To what extent do the following statements characterize your business unit?	
Sen_1: We actively look for anomalies in mundane details of ordinary daily activities	0.7702
Sen_2: We take even the smallest of mistakes seriously	0.7514
Sen_3: We talk about mistakes and ways to learn from them	0.7905
Sen_4: When mistakes happen, we discuss how we could have prevented them	0.7021
Sen_5: People here report work-related mistakes that could have serious consequences	0.7268
Capability to Respond (CR = 0.862, AVE = 0.560)	
How well do your agree or disagree with the following statements apply your business unit?	
Res_1: People here are committed to solve any quality issues that arises	0.8927
Res_2: Our business unit would quickly bounce back from any quality issues and problems	0.7119
Res_3: Our business unit has a strong sense of identity and purpose in quality that can survive anything	0.8283
Res_4: People here value expertise and experience over hierarchical position	0.6479
Res_5: People in this business unit readily pitch in to help out others whenever necessary[a]	
Res_6: People in this business unit respect the nature of each other's job activities	0.6265
Consistency of quality performance (CR = 0.929, AVE = 0.814)	
Please rate the consistency of quality performance on the following dimensions relative to major competitors in your industry	
cperf_1: Customer satisfaction with the quality of our products and services has *consistently* been higher than with our competitors over the past 5 years[a]	
cperf_2: The quality of our products and services has been *consistently* better than our competitors' over the past 5 years	0.8845
cperf_3: We have *consistently* outperformed our competitors on product and service quality over the past 5 years	0.9320
cperf_4: Our products or services have *consistently* met customer specification over the past 5 years	0.8890
Level of quality performance (CR = 0.884, AVE = 0.717)	
Please rate your business unit's level of product and service quality relative to major competitors in your industry over the last year	
lperf_1: The quality of our products and services[a]	
lperf_2: Customer satisfaction with the quality of our products and services	0.8943
lperf_3: The delivery of finished products and services to customer	0.8299
lperf_4: Conformance to customer specification	0.8148

(*Continued*)

Competitive intensity: (CR = 0.926, AVE = 0.808)	
Please indicate how well the following statements describe the industry of your business unit	
Comp_1: Competition in our major market is intense	0.8964
Comp_2: Our business unit has relatively strong competitors	0.8451
Comp_3: Competition in our major market is very high	0.9519
Environmental uncertainty: (CR = 0.820, AVE = 0.605)	
Please indicate how well the following statements describes the industry of your business unit	
Env_1: Our customers regularly ask for new products and services.	0.7899
Env_2: In our local market, changes are taking place continuously.	0.6887
Env_3: In our market, the amount of products and services to be delivered change fast and often.	0.8474

[a]Removed due to country difference (score test, $p < .05$).

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