

A comparative case study of sustaining quality as a competitive advantage



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ABSTRACT

Many organizations have achieved high levels of quality performance only to lose it later on. These firms that were once quality leaders can no longer compete on the quality of their products or services. This research develops a theoretical understanding of how organizations can sustain a quality advantage. It offers a conceptual definition of sustaining a quality advantage which involves not only sustaining a high level of quality performance, but also sustaining a high consistency of quality performance. A comparative case study provides evidence of three capabilities that distinguish firms with different levels of sustaining quality. These capabilities include: (1) meta-learning, (2) sensing weak signals, and (3) resilience to quality disruptions. The case analysis argues that meta-learning helps sustain a high level of quality performance, while sensing weak signals and resilience improves the consistency of quality performance. This study offers a dynamic capability-based strategy that explains how to sustain a competitive advantage in quality, which may also have implications for sustaining other operational competitive advantages.

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1. Introduction

Operations strategy scholars have long noted the importance of establishing a competitive advantage in quality. Previous research has examined the link between quality and financial performance. Higher quality increases revenue by making products more attractive and creating a market advantage or reduces cost by increasing efficiency (Buzzell and Gale, 1987; Garvin, 1988). The ‘sand cone’ model argues that a competitive advantage in quality is the foundation for other operational competitive advantages (Ferdows and De Meyer, 1990). Empirical evidence further supports that quality provides a foundation to other competitive dimensions in operations (Rosenzweig and Roth, 2004; Roth and Miller, 1992). Over the past few decades scholars have extensively studied how organizations can obtain a competitive advantage through quality performance (Ahire, 1996; Ahire and Dreyfus, 2000; Anderson et al., 1994; Benson et al., 1991; Flynn et al., 1994, 1995; Kaynak, 2003). Researchers have drawn on different theoretical perspectives to understand the relationship between quality and competitive

advantage. For example, scholars have drawn on the resource-based view (RBV) (Barney, 1991) of the firm to explain how a number of practices, and frameworks such as TQM (Flynn et al., 1994, 1995; Powell, 1995), Baldrige (Flynn and Saladin, 2001) and ISO 9000 (Corbett et al., 2005; Martínez-Costa et al., 2009; Naveh and Marcus, 2005) lead to a competitive advantage in quality.

However, we know very little about how to sustain a competitive advantage in quality. In the past few years product recalls from the long time quality leader Toyota reflect the difficulty of sustaining quality performance (Ohnsman et al., 2010; Valasic, 2010). Reports of uncontrolled acceleration in some of Toyota’s vehicles first surfaced in 2002, yet those signals were largely discounted. Ultimately Toyota’s Consumer Report’s reliability ranking slipped from number one to fifth in 2007. These events culminated in 2008, when a Toyota Avalon allegedly caused an accident that killed four people. Toyota’s market share ultimately dropped in the face of these recalls (Oliver, 2014). Other leading companies such as Sony, Hitachi and Mercedes-Benz experienced similar difficulties in sustaining a competitive advantage in quality (Fackler, 2006; Taylor, 2003). For example, throughout the 1990s Mercedes was in the top 10 and often ranked in 1st place on the J.D. Power surveys for vehicle quality. Then suddenly they dropped to 26th in 2003 and had more than 300 problems reported per 100 vehicles (Taylor, 2003). Taylor notes, “In an ever more complicated world . . . [Mercedes]

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once unquestioned position at the top of the automotive pecking order is under threat as never before” (p. 145). Although few would deny Toyota's and Mercedes-Benz's competitive advantage in quality over the past few decades, even the best have trouble sustaining it. A theoretical framework is needed to guide both practitioners and academics on strategies to sustain a competitive advantage in quality. This paper fills this gap by examining the following research question: *how do organizations sustain a competitive advantage in quality?*

To investigate this question we conduct a comparative case analysis that iterates between the literature and the case data to develop a theory on sustaining a quality advantage. The analysis draws on literature from quality management (Flynn et al., 1994, 1995), dynamic capability (Tece et al., 1997; Zollo and Winter, 2002), Red Queen Effect (Barnett and Hansen, 1996; Barnett and McKendrick, 2004; Barnett and Pontikes, 2005), organizational learning (Argote, 2013; Argyris and Schön, 1996) and high reliability organization (HRO) theory (Weick and Sutcliffe, 2001, 2007; Weick et al., 1999). The results show that three important capabilities differentiate organizations that sustain quality from those that don't. The first capability is *Meta-learning*, which continually increases an organization's ability to learn. This capability enhances an organization's ability to engage in both first-order and second-order learning. The second capability, *sensing weak signals*, gives organizations the ability to detect subtle changes that could disrupt their quality performance. Sensing weak signals involves an organization's vigilant engagements with their operations, customers and the environment. The third capability, *resilience to quality disruptions*, helps organizations quickly adapt and recover from quality disruptions when they do occur. These capabilities come together to form a dynamic capability that explains how organizations sustain a quality advantage by increasing their ability to adapt and respond to changes in the environment.

This study contributes to the literature by identifying capabilities that sustain high quality performance which prior studies have not considered. The comparative case analysis brings together literature streams that have been previously disconnected. It views sustaining a quality advantage as an ongoing race, where organizations need to evolve and adapt faster to stay ahead of the competition. Departing somewhat from previous research, we suggest that sustaining a quality advantage is not about developing an imitable resource that cannot be replicated, but instead it's about constantly evolving and improving faster than the competition. We offer an evolutionary dynamic perspective of sustaining a quality advantage which has not been fully considered in the past.

The rest of the paper has the following organization. Section 2 defines the concept of sustaining a competitive advantage in quality. Section 3 gives the conceptual background for the literature streams related to this research. Section 4 describes the case study research methodology, Section 5 presents the findings and propositions, and Section 6 summarizes the conceptual model. Finally, Section 7 discusses the implications and conclusions.

2. Defining sustaining a competitive advantage in quality

Operations strategy scholars often use high quality performance relative to competition as an indicator of a competitive advantage in quality (Ward and Duray, 2000). However, previous studies in quality management often did not differentiate achieving high quality performance from sustaining a competitive advantage in quality. Organizations that meet or exceed customer expectations achieve high quality performance (Evans and Lindsay, 2008). Yet, while achieving high quality performance at one point in time indicates a high *level* of performance, it does not indicate high *consistency* of performance. Previous studies have not fully considered the

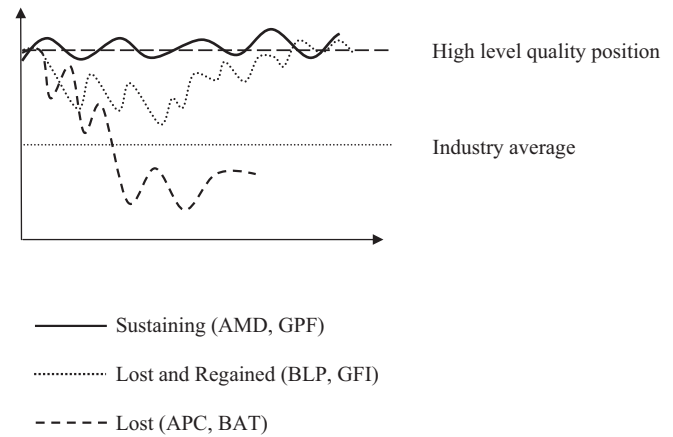


Fig. 1. Patterns of sustaining a quality advantage.

consistency dimension of performance.¹ In management literature, a high *consistency* of performance has been defined as achieving “collective outcomes of a certain minimum level repeatedly” (Hannan and Freeman, 1984, p. 153). High consistency of quality performance therefore indicates lower variance in quality performance. Organizations that sustain a competitive advantage in quality should not only achieve a high level of quality performance at a point in time but also do it consistently over time.

Fig. 1 illustrates the meaning of sustaining a competitive advantage in quality. It is important to note that this study investigates how organizations sustain a quality advantage, not about how they achieve it. Fig. 1 shows three different patterns that illustrate varying degrees of sustaining. The first pattern (solid line) shows organizations that sustain a competitive advantage in quality. They not only have a high level of performance but also have high consistency (lower variance) in performance. The second pattern (dotted line) shows organizations that lost and regained their quality performance. These organizations still meet or exceed customers' expectations (i.e. have high level of quality performance) but are less consistent. The third pattern (dashed line) shows organizations that lost their high quality performance. These organizations have lost their high level of quality performance and also have low consistency; they have the least consistency when compared with the other two cases. By distinguishing between the level and consistency dimensions of quality performance, this study defines sustaining a competitive advantage in quality as having a high level and high consistency of quality performance over time. These basic patterns were developed from the case analysis, which we describe later in the research methods section of the paper.

3. Conceptual background

Concepts from several different theories help inform the analysis of the case data. Each theory comes from a different literature stream and offers a unique perspective on how to sustain a quality advantage. In addition, prior research has not integrated these theories. The case data helped identify concepts from these theories to explain how organizations sustain a competitive advantage in quality. The following sections give an overview of each theoretical perspective that emerged from the comparative case analysis.

¹ Note that consistency refers to the organization performance on quality, such as Mercedes JD Power Quality Rating. This is different from SPC which controls process variation.

3.1. Dynamic capability

Strategy researchers have argued that sustaining a competitive advantage requires developing dynamic capabilities (Helfat et al., 2007; Teece, 2007, 2009). The concept of dynamic capability is defined 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 and Winter, 2002, p. 340). A dynamic capability has the objective of integrating, building, and reconfiguring internal and external resources to adapt to changes in business environments (Teece, 2009; Teece et al., 1997). Researchers argue that dynamic capabilities are embedded in organizational routines that enable organizational change (Amit and Zott, 2001; Eisenhardt and Martin, 2000). Dynamic capability assumes that sustaining competitive advantage involves the ability to adapt and change, and serves as an overarching theory in this study.

3.2. Quality management

Quality management (QM) has been defined as a “set of mutually reinforcing principles, each of which is supported by a set of practices and techniques” (Dean and Bowen, 1994). Existing quality management research has examined the relationship between a number of quality practices and quality performance. Research shows that quality practices such as leadership support, customer focus, workforce involvement, process management, and cross-functional product development have a positive effect on quality performance (Ahire and O’Shaughnessy, 1998; Dow et al., 1999; Flynn et al., 1995). Kaynak (2003) conducted a comprehensive study that examined the relationships between a number of quality practices and their performance benefits. Some research has viewed the development of these quality practices as a unique and imitable resource that can lead to a competitive advantage (Powell, 1995). However, once difficult-to-replicate resources can eventually become replicated due to learning efforts triggered by intense competition (Teece et al., 1997). As various strategy researchers have argued, it is difficult to sustain a competitive advantage using static resources in today’s highly dynamic environments (D’Aveni, 1994; D’Aveni et al., 2010; Eisenhardt and Martin, 2000).

Instead of focusing on specific quality practices, we focus on capabilities. Recent studies have begun to take a capability perspective and suggest that it is the capabilities, built by practices that lead to competitive advantage. For example, Peng et al. (2008) argued that improvement and innovation are two critical dynamic capabilities in operations that are built by different quality practices. Similarly, Sitkin et al. (1994) classified quality practices into two distinct types: Total Quality Control (TQC) and Total Quality Learning (TQL). These different types of quality practices lead to different capabilities (Zhang et al., 2012). TQC practices focus on the ability to refine and stabilize products and processes (first-order learning), while TQL practices focuses on the ability to explore the unknown (second-order learning) (Sitkin et al., 1994). Zhang et al. (2012) empirically modeled these two different orientations as second order constructs which reflect the overall capabilities rather than specific practices. Similarly, we view sustaining quality as a business level strategy and focus on the content of the strategy (i.e. the factors that lead to sustaining quality) rather than the implementation process of the strategy (i.e. quality practices) (Reed et al., 1996).

Increasingly operations management scholars have also taken a capability perspective. For example, Wu et al. (2010) proposed several operational capabilities that are embedded in a broader set of operations practices. Operations scholars have argued that it is the operational capabilities that firms develop that lead to competitive advantages in operations (Hayes et al., 2005; Hayes

and Wheelwright, 1984). Several researchers also encourage quality management scholars to go beyond practices and focus more on the capabilities that give organizations the ability to compete (Reed et al., 1996). Consequently, we focus on identifying the capabilities that can be implemented by various quality practices to sustain a quality advantage. This approach helps increase the generalizability of our framework (Wacker, 1998) and provides flexibility for organizations to design a specific set of quality practices that fit their business context.

3.3. Organizational learning

Dynamic capability, by definition, involves organizational learning (Zollo and Winter, 2002). Scholars have defined “organization learning as a change in the organizations knowledge (Argote, 2013, p. 31)” that increases “the range of its potential behaviors (Huber, 1991, p. 89).” Two broad forms of learning processes have often been discussed in the literature: first-order learning and second-order learning² (Argyris and Schön, 1978). First-order learning involves enhancing existing skills and knowledge to address known problems. This type of learning has been characterized as refinement, efficiency, improvement and exploitation (Cheng and Van de Ven, 1996; March, 1991). Examples of first-order learning include detecting and correcting quality defects. In contrast, second-order learning involves search, experimentation, innovation and exploration. Examples of second-order learning include understanding the underlying causes of problems and discovering the norms and values behind actions. Sitkin et al. (1994) took a learning perspective to classify different quality management practices. They classified some practices as TQC and relate them to first-order learning, and classified other practices as TQL and related them to second-order learning. Quality management often involves both types of learning, which results in changes to internal processes (Sitkin et al., 1994; Sutcliffe et al., 2000; Zhang et al., 2012).

A third type of learning that has not been discussed in quality or operations management literature is *Meta-learning*. Meta-learning refers to the “reflection on and inquiry into the process of (first-order and second-order) learning at the individual level and group level in organizations. This form of learning is discontinuous, cognitive, and conscious. It is, to a large extent amenable to steering and organizing. It is directed at organizational and individual improvement” (Visser, 2007, p. 664). In a sense, Meta-learning refers to an organization’s ability of *learning how to better learn* and its ability to systematically improve the first-order and second-order learning processes. Just as prior scholars have related first-order and second-order learning to achieving high quality, this study relates meta-learning to sustaining high quality.

3.4. High reliability organization theory

Some organizations operate in settings with high potential for error and disaster, for example, nuclear aircraft carriers, air traffic control systems, and nuclear power generation plants (Eisenhardt, 1993; La Porte, 1996; Roberts, 1990). These diverse organizations share three main characteristics: the potential to create catastrophe, operating in an environment with highly interdependent components (e.g. high interactive complexity), and actions in one part of the system directly affect other parts of the system (e.g. tight coupling) (Perrow, 1999). Although these organizations constantly face a high risk of failure, some of them consistently achieve reliable, error free performance. These types of organizations have been called High Reliability Organizations (HROs) (La Porte and

² Similar concepts like exploration and exploitation have also been discussed in the management literature (e.g. He and Wong, 2004).

Consolini, 1991; Roberts, 1990). Research in HRO seeks to explain how these organizations sustain reliable performance under high risk conditions (Carroll, 1998; La Porte, 1996; Schulman, 1993). Scholars argue that HROs are attentive to details and have an enhanced ability to “discover and correct errors that could escalate into crisis” (Weick and Sutcliffe, 2001, p. 2). Weick and colleagues identify five types of behaviors in HROs that promote reliable performance: preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise (Weick et al., 1999). Weick and Sutcliffe (2001) suggested that “Today’s business conditions involve increased competition, higher customer expectations, reduced cycle time, and tight interdependencies. These changes produce environments that are almost as harsh, risky, and unforgiving as those that HROs confront. That being the case, organizations that confront an HRO-like environment with HRO-like processes should have more success at learning and adaptation than those who don’t” (Weick and Sutcliffe, 2001, p. 114). In a sense, sustaining a competitive advantage in quality is about increasing the reliability of quality performance in environments characterized by intense competition and changing customer requirements, which requires HRO-like capabilities. Therefore, the HRO literature provides a valuable theoretical lens to examine the case data, which previous quality management studies have not considered.

3.5. Red Queen Effect

Strategy researchers have used the term “Red Queen Effect” to describe the evolution of organizations which are triggered by intense competition and changes in their surrounding environment (Barnett and Hansen, 1996; Barnett and McKendrick, 2004; Barnett and Pontikes, 2005). The Red Queen Effect takes an evolutionary perspective and argues that performance is a function of competitive actions between a focal firm and its rivals. This perspective implies that competitors’ actions can influence a firm’s competitive position. Only firms that can out-run their competitors can sustain a competitive advantage. The term Red Queen Effect came from what the Red Queen said to Alice in Lewis Carroll’s *Through the Looking Glass*: “Here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!” (Carroll, 1960, p. 345). Strategy researchers have used the Red Queen Effect perspective to examine competitive behavior in various business contexts (Barnett and Hansen, 1996; Barnett and Pontikes, 2005; Barnett and Sorenson, 2002). The Red Queen Effect emphasizes the need for dynamic capabilities to adapt and evolve faster than competitors to sustain a competitive advantage. From a quality perspective, sustaining a quality advantage is not just achieving high quality performance, but it is about how organizations stay in the race.

4. Methods

4.1. Data collection and research methods

This research conducts a comparative case study following the inductive theory-building approach (Eisenhardt, 1989; Yin, 2003). Since sustaining a quality advantage has not been well studied, the inductive case study approach helps generate valuable insights. The qualitative data comes from six business units in three manufacturing firms. Data collection involved multiple rounds of interviews over a three year period. The case analysis triangulates the qualitative data with the literature to establish a connection between concepts in different literature streams and sustaining a competitive advantage in quality. Fig. 2 gives the overview of the research method.

4.2. Case selection and performance patterns

This study uses a purposive sampling strategy (Patton, 1990) to include cases that span different industrial settings which increases generalizability. The research team first approached several firms that had won national quality awards to solicit participation. Three manufacturing firms agreed to participate (hereafter Alpha, Beta, and Gamma). Two business units were selected from each of the three manufacturing firms based on the degree to which they sustained quality performance. Following the principles of purposive sampling, the sample includes business units with varying degrees of sustaining quality performance. In each firm, a high level senior manager (e.g. President or VP) was asked to first assess the quality performance level of their business units. Since each firm operates in different industries, we asked managers to assess their quality performance according to their industry norms. We also emphasized that the focus of this study is on sustaining quality over time. The senior managers identified two business units in each firm, one with a higher and one with a lower degree of sustaining quality performance (AMD versus APC in Alpha, BLP versus BAT in Beta, and GPF versus GFI in Gamma). This ensured variation in the degree of sustaining quality performance across the cases, which helps assess construct viability (Singleton and Straits, 1999). Senior management in each business unit then helped identify several informants with roles in different functions such as general management, operations, quality, marketing, and finance. Table 1 summarizes the case profiles. Appendix B provides detail descriptions of each firm and business unit.

During the interviews, we asked senior managers in each business unit to describe the historical quality performance of the business units over the last ten years. These questions included “In the last 10 years, how would you describe your quality performance? How is it going? Any ups and downs?” We focused on general indicators of quality performance over time such as quality awards, customer satisfaction level, product quality, and process quality. Based on the interview responses, we confirmed the business units as either higher level (AMD, BLP, and GPF) or lower level (APC, BAT, GFI) of sustaining. In addition, general comments from managers indicated fluctuations in performance, which led to the development of the sustaining patterns described in section 2. For example, one senior manager at GFI made the following comments when discussing the ups and downs of their quality performance history:

“we [are] meeting the [quality] specifications that we have internally as well as those the customers have for our product. Customers are satisfied . . . Over the last 10 years that’s improved significantly to where we’ve pretty much plateaued to where the industry has also gotten to the same level . . . we experienced what the customers are looking for today [beyond specifications] and what they recognize for is the extra things . . .”

Four researchers independently classified the sustaining pattern of the six business units according to the three patterns shown in Fig. 1. Fleiss’ kappa (Fleiss, 1971) was used to calculate the inter-rater reliability. The inter-rater reliability of the classification is 0.86, which is interpreted as substantial agreement (Landis and Koch, 1977). As a result, AMD and GPF were categorized as high level of sustaining (hereafter Sustaining), GFI and BLP as medium level (hereafter Lost and regained), APC and BAT as low level of sustaining (hereafter Lost). Tables 1 and 2 show the respective sustaining patterns of the six business units.

Performance data from archival sources helped further verify the performance patterns in the business units. For example, Gamma provided the research team with internal audit reports of their quality and financial performance ratings of the two business units in the study. The internal audit scores represent the average

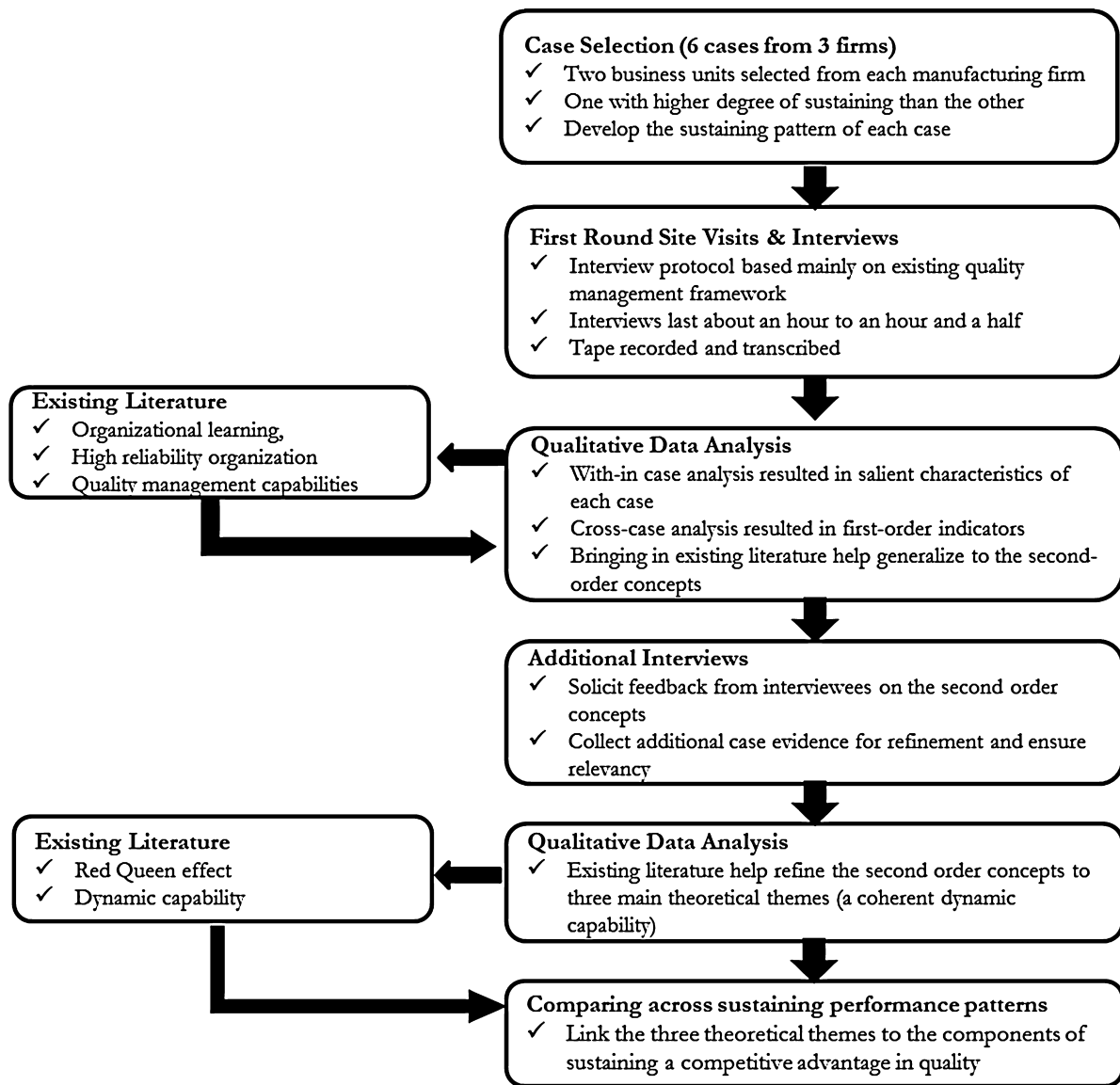


Fig. 2. Overview of the research method.

ratings of the sales growth and product or service quality performance. The ratings were performed by internal examiners within the organization, which were patterned after the Baldrige Award scoring process. The archival data sources from the business units in some cases exceeded fifteen years.

4.3. Site visits

The researchers designed the initial interview protocol based on the literature. A separate interview protocol was designed for each managerial function. The initial interview protocol consisted

Table 1
Summary of the six business units.

Firm	Alpha	Beta	Gamma
Business unit	Medical Division (AMD)	Personal Care (APC)	Laboratory Product (BLP)
Number of employees	1300	4300	3000
Primary customers	Hospitals, clinics	Industrial manufacturers	Research labs, medical companies
Number of informants	5	3	5
Sustaining pattern	Sustaining (high level and consistency)	Lost (lost the level and low consistency)	Lost and Regained (medium level and consistency)
Financial performance	Sales growth 17% from 2007 to 2011 S.D. in sales = 276	Sales growth 11% from 2007 to 2011. S.D. in sales = 346	Sales growth 113% from 2007 to 2011 S.D. in sales = 125

^a Rating of financial performance.

Table 2
Cross-case comparisons across three main capabilities.

Business unit	Sustaining pattern	Meta-learning		Sensing weak signals	Resilience to disruptions in quality
		Enhancing first-order learning	Enhancing second-order learning		
AMD	Sustaining	High	High	High	High
GPF	Sustaining	High	High	High	High
GFI	Lost and Regained	High	Low	Medium	High
BLP	Lost and Regained	Medium	Low	Medium	Medium
BAT	Lost	Low	High	Low	Low
APC	Lost	Low	Medium	Low	Low

of a series of open-ended questions about existing quality practices from the quality management literature and additional questions that solicit manager's opinion on sustaining quality performance (see Appendix A). The study used well-established quality management frameworks (e.g. Flynn et al., 1994, Baldrige Award) as a starting point, and then investigated any additions, enhancements or deviations from the frameworks which could contribute to sustaining quality performance. This served as a starting point in differentiating the sustaining from the non-sustaining business units.

4.4. Interviews

The first round of interviews typically included two researchers: one leading the discussion and pursuing directions proposed by the informants and the other taking notes and asking additional questions. During the interview, the researchers probed informants with questions and encouraged informants to discuss additional managerial practices or concepts that might affect the sustainability of quality performance. The interviews included respondents from different strategic areas such as quality, operations, general management, marketing, and finance. All interviews lasted about an hour to an hour and a half, and specific questions were targeted to the informant's expertise. They were tape recorded, transcribed, and assembled into manuscripts that contain details of each of the six business units for the qualitative data analysis (Andriopoulos and Lewis, 2009; Gioia and Thomas, 1996; Miles and Huberman, 1994).

Following the interviews, the researchers had post interview discussions that focused on summarizing and cross validating each other's observations (Gioia and Thomas, 1996). Additional archival data such as reports on business unit's quality performance, quality assessments, and quality award applications were also collected to help minimize the retrospective bias (Langley, 1999). In the first round of interviews a total of 26 interviews were completed in 2008.

4.5. Qualitative data analysis

The qualitative data analysis began with a within-case analysis followed by a cross-case analysis (Miles and Huberman, 1994). The research team (3 researchers and two research assistants) familiarized themselves with over 400 pages of transcribed interviews and had multiple meetings after the first round of interviews to compare and contrast business units. The qualitative analysis started with a within-case analysis of each business unit to understand how they did or did not sustain quality performance. Two researchers were responsible for each business unit and they identified possible explanations for its pattern of performance. Each researcher first read the interview transcripts closely and independently provided ideas of possible indicators. Subsequent debates among the

researchers led to either retaining or dropping indicators. Case summary reports were prepared and reviewed by the research team to improve validity (Yin, 2003).

The researcher team then conducted a cross-case analysis of business units *in the same firm* to compare units with higher and lower levels of sustaining quality performance. The cross-case comparisons helped rule out business unit-specific characteristics and extract the common indicators. This resulted in the first-order indicators of sustaining quality performance. The first-order indicators came from comments and views made by informants. The relevant literature was incorporated at this stage to conceptually understand the emerging concepts, which also provided an additional source of validation (Eisenhardt, 1989). The quality management, organizational learning, and high reliability literature streams provided a useful conceptual lens to interpret the qualitative data. From the literature the research team then simplified the first-order indicators to six second-order concepts.

4.6. Additional interviews and data analysis

A year after the first round of interviews, the researchers conducted a second round of interviews. The second round interviews focused on gathering additional data that would help verify or shape the second-order themes that emerged from the first round of interviews. These interviews also provided additional information about changes in business unit's quality practices and performance. During the second round interviews, the researchers gave interviewees an overview of the concepts that emerged from the first round of qualitative analysis and solicited their feedback about the emerging concepts. Multiple contacts with the informants also provided relevancy to the concepts and theory that emerged from this study (Emden et al., 2006; Madhavan and Grover, 1998). The second round of interviews resulted in a total of 26 interviews. The research team then went back and forth between the concepts, second round interview data, and existing literature to better refine the second-order concepts (Eisenhardt, 1989; Yin, 2003).

Two researchers then coded the interview data using NVIVO 8 based on the second-order concepts developed from the qualitative analysis. Disagreements during the coding process were discussed and resolved through evidence from the data. The Kappa coefficients for inter-rater reliability for the six second order concepts: Constantly looking for ways to capture customers' future and emerging needs, Ongoing renew and update of products and processes improvement practices, Applying practices to increase awareness to changes in the environment, Strong tendency toward finding potential problems within operations, Strong commitment toward preserving the value of quality among employees, and Employees commitment to resolve quality issues are 0.89, 0.83, 0.73, 0.89, 0.85 and 0.88 respectively, which is consistent with previous research (Morse, 1997).

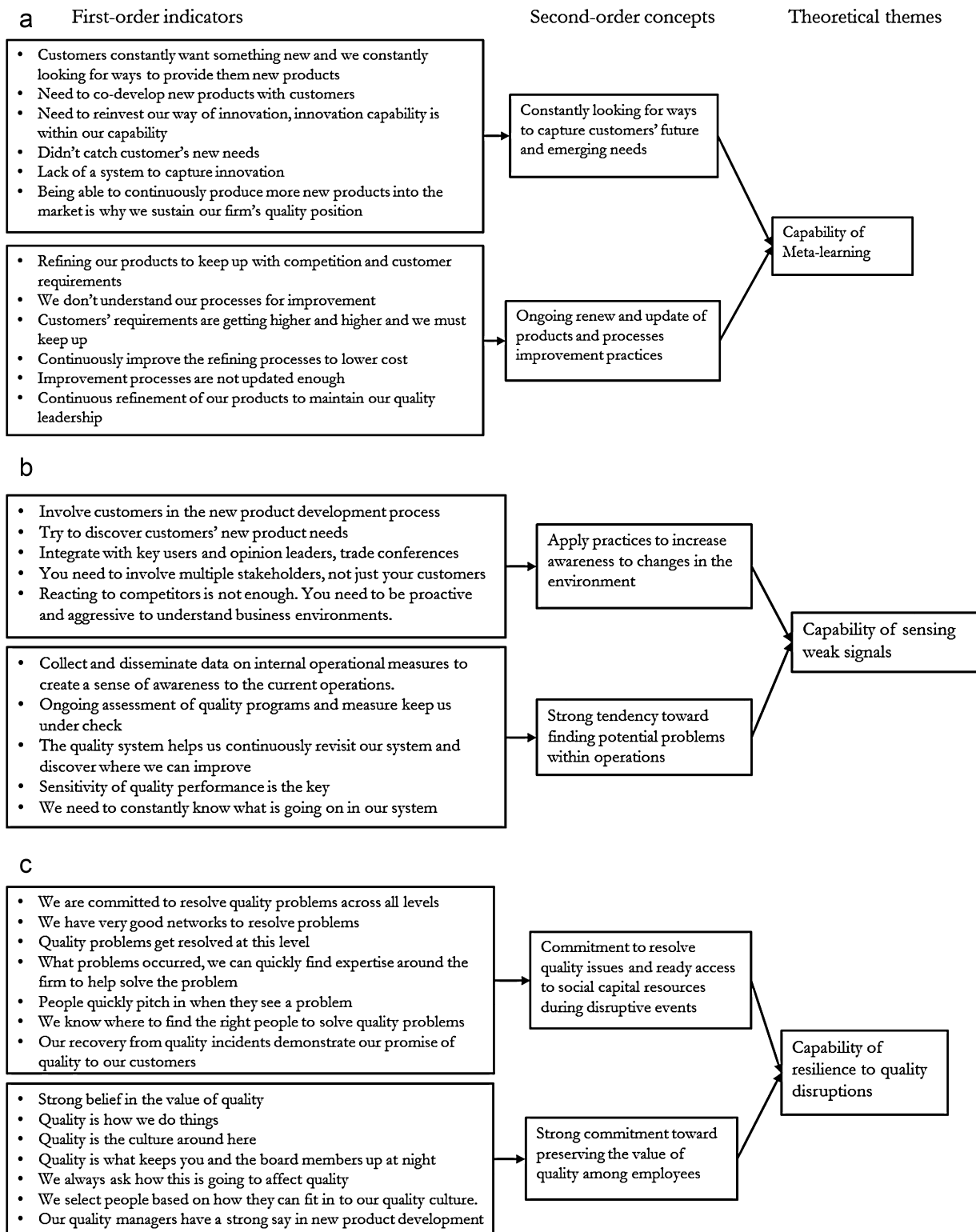


Fig. 3. (a) First and second order concepts of meta-learning. (b) First and second order concepts of sensing weak signals. (c) First and second order concepts of resilience.

Additional literature such as the dynamic capability and the Red Queen Effect were brought in at this stage. This iteration process resulted in the theoretical themes that emerged from the comparative case study and the existing literature. See Fig. 3 for details.

Finally, a third round of 13 interviews at participating business units was conducted in the third year to learn more about what changed and further test emergent themes. These interviews offered further confirmation of the themes that emerged. At this

point the research team felt they had theoretical saturation of the concepts.

4.7. Comparing cases across sustaining patterns

The final step involved establishing the link between theoretical themes and different *sustaining patterns*. Comparing the cases across the different patterns of sustaining (Sustaining, Lost

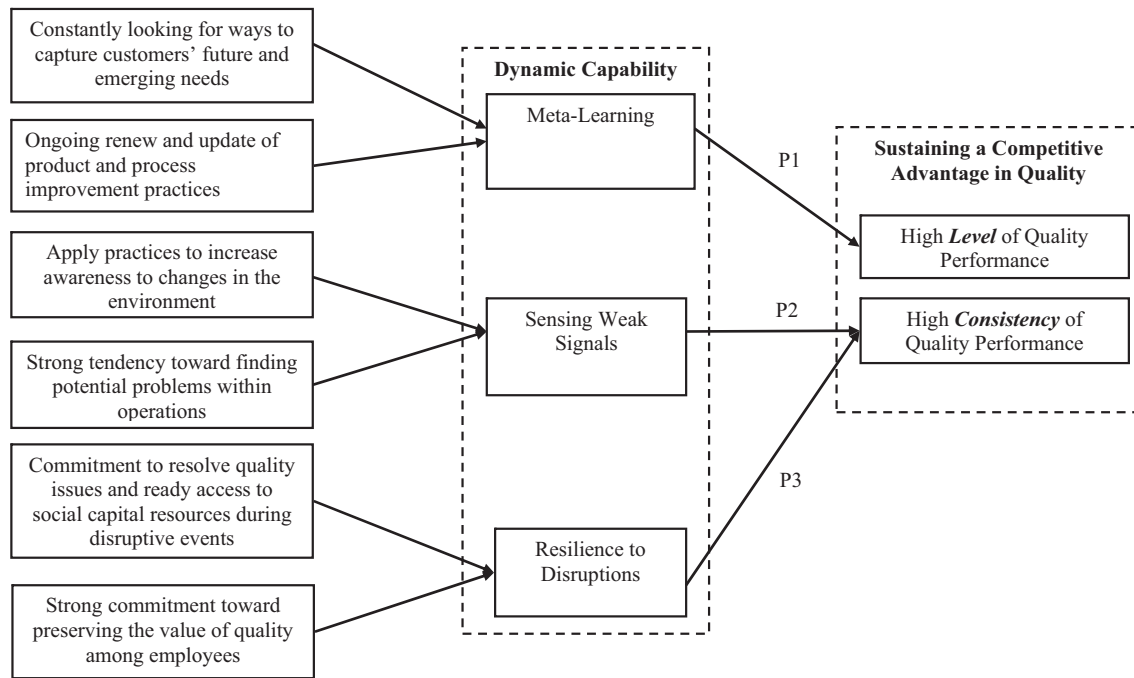


Fig. 4. Theoretical framework.

and regained, Lost) helped establish the connection between the theoretical themes and the components of sustaining a quality advantage (level and consistency). The cross-case comparisons are described below.

5. Findings

Fig. 4 gives the theoretical model that emerged from the above analysis. Sustaining a competitive advantage in quality is reflected by sustaining a high level and high consistency of quality performance. All business units in our study implemented several quality management practices (e.g. teamwork, customer focus, quality system, etc.) to a certain level. This is not a surprise since all business units in the study had to achieve high quality performance at an earlier date to be part of the study. However, three capabilities discriminated business that did sustain a quality advantage from those that didn't: meta-learning, sensing weak signals, and resilience to disruptions (see Fig. 4). The proposed theory not only reflects the key factors that discriminate the cases, but also joins together several areas of research that have been largely unconnected. We now develop propositions on these three capabilities to better understand the different sustaining patterns and explain how they promote sustaining a quality competitive advantage.

5.1. Meta-learning and high level of quality performance

By definition sustaining a competitive advantage in quality requires sustaining a high level of quality relative to competition. The Red Queen Effect implies that competitors' actions influence the level of an organization's quality performance. In a competitive environment, competitors will seek to offer better quality products to attract customers, which influence customers' expectations. Barnett and Hansen (1996) argued that for organizations to simply "stay" at the same position (e.g. sustaining a high level of quality performance relative to competitors), they need to constantly adapt to their surrounding business contexts (Nelson and Winter, 1982). From this perspective, sustaining a high level of quality entails evolving with customers' quality expectations (Evans and Lindsay,

2008). As customer preferences change over time, so must the firm's products and processes. Organizational learning processes offer one way to promote this adaptability (He and Wong, 2004; Levinthal and March, 1981).

Several business units in our sample expressed an ongoing concern about looking for ways to improve their quality system to enhance both first-order and second order learning. For instance, one manager indicated that the "quality system we have today will not be the quality system that we need in the future to remain competitive." Comparing business units that sustain high level of quality performance (AMD and GPF) with those that had difficulties (GFI, BLP, BAT, APC), the sustaining business units encouraged organizational members to reflect on how to enhance both first-order and second-order learning on a regular basis. Especially noteworthy was their framing of improvements as an ongoing re-examination of their approach of learning. They reflected on their current learning processes and frequently raised questions such as: how can we learn to enhance the improvement practices? Are we really learning what customers' want? How can we learn to satisfy customers' emerging needs? They expressed concerns about their rate of learning, and how to enhance the rate of improvement over time. In a sense, sustaining business units constantly re-examine their quality system by renewing and updating it. We posit that this indicates a *capacity of meta-learning*. It distinguished the business units that sustained (AMD and GPF) from the others that did not. We now examine meta-learning more deeply by comparing the case findings and the literature.

5.1.1. Enhancing first-order learning

Quality improvement systems refine and improve existing products and processes. According to organizational learning scholars (Argyris and Schön, 1996; March, 1991), improvement practices are learning activities for refinement and efficiency in which first-order learning takes place. The ongoing search, renewal and update of the improvement system is one factor that differentiates the business units that sustained a quality advantage at a high level (GPF, AMD) to those units that had difficulties sustaining it (GFI, BLP) and those that lost it (BAT, APC). As one quality manager at GPF noted:

“The danger [of sustaining quality] is . . . an [improvement] process you had that served you well is no longer serving you well and sometimes you’ve got to make an investment.”

One manager at BAT pointed out that the failure to invest in and renew their improvement practices was a ‘root cause’ of their failure to sustain high quality performance:

“I think our history has been that we have some significant process upset . . . if we’ve been in business for 35 years, 32 of them we’ve had some significant process upset.”

Since BAT (Lost) didn’t make continual efforts to enhance their approach to improvement, they didn’t keep up with the competitors who were improving the quality of existing products at a faster rate while also lowering cost. In contrast, managers at BLP (Lost and regained) often expressed the need to renew their improvement practices in order to maintain their quality position:

“Investment in [improvement processes] to maintain your [quality] position in commodity products is counterintuitive, but you have to maintain the [product] quality relative to competitors.”

This business unit sold commodity type products and faced increasingly stringent customer requirements. One manager at APC (Lost) indicated that they did not reflect on their existing improvement practices and believed that they should have updated and renewed it:

“We have a lot of projects to improve [product and service] quality, but we weren’t necessarily improving the capacity to improve. There is a very importance difference between the two types of projects.”

Business units that sustained quality performance stressed the need to constantly search for new ways to improve the first-order learning processes. GPF and AMD (Sustaining) had an early exposure to Total Quality Management (TQM) principles, and strategically focused on improvement practices since their initial exposure to TQM. They continually renew and update the quality improvement systems to enhance their existing improvement toolbox. The president of GPF explains their constant search for better improvement practices this way:

“I mean, in the vein of continuous improvement, which is in our DNA, we’re always [looking for new ways to improve our quality improvement system] . . . We are at world-class levels for reject rates, we benchmark across many industries . . . that’s something we focus on all the time.”

AMD also maintained a strong focus on improving how to improve. Managers at AMD emphasize that their success formula involves having a state of the art system dedicated to renewing improvement practices over time. Their improvement journey began with TQM programs, then to Lean improvement programs, to Six Sigma, to Lean Six Sigma, and most recently to customized quality improvement systems. AMD’s ongoing pursuit of renewing improvement systems helps it better adapt to changes in customers’ requirements and the business environment (Dierickx and Cool, 1989). One manager at AMD explained their never ending pursuit this way:

“We keep looking at [different quality] programs to drive unit cost reductions, to drive service improvements, to drive product quality improvements. They’re all [improvement] projects, active, key projects that we all need to work on, because they’re all interrelated.”

The case data indicates that it’s the ongoing pursuit of renewing and updating the improvement system that increases the likelihood of meeting increasing customer expectations with existing

products and processes, which helps sustains the firm’s level of quality performance relative to competition. In contrast, not updating or renewing improvement system results in a decline of the organization’s quality position relative to competitors due to the Red Queen Effect.

5.1.2. Enhancing second-order learning

While renewing and updating the improvement system helps organizations continually meet existing customer expectations, it has limitations. An executive at BLP (Lost and regained) explained that the business unit had a strong focus on enhancing how to improve, but the benefits became less obvious over time:

“The product has been around for 30 years, and it has gotten improved, but it has been around. To the extent that [the product] stops solving problems for our customers and it will go fairly quickly [and not lead to quality outcomes].”

Besides enhancing on how to improve, the informants emphasize the importance of becoming more innovative at developing new products and processes to sustain high quality performance. According to organizational learning researchers, second-order learning is the process of searching for new things (Argyris and Schön, 1996; March, 1991). The business units that sustained high quality (AMD, GPF) reported that customers’ needs always change and they need to enhance their second-order learning processes to co-evolve and adapt. For example, the president at AMD discussed the need to improve second-order learning in a fast changing environment:

“[to provide new products] to a marketplace that has been referred to in the past as [having] a pathological need for new. Our customers really like new, and our business has been able to respond.”

The president of GPF also expressed a similar view:

“Innovation is [about] understanding our customer and what they’re really looking for. . . . Most of the time innovation is really within our capabilities. . . . If you look at the [restaurant] menus today versus 5 years ago, the amount of products [change significantly]. . . ; innovation is a key driver because [our customers] have to have something new.”

This business unit recognized that not only were product offerings changing (second-order learning), but the pace of change was increasing. As a result, they frequently reflected on ways to enhance their second-order learning system to better address customers’ changing and emerging needs. The president of GPF noted that constantly refining a customer-oriented innovation system is the key to adapt to customers’ changing needs:

“What we really try to do is understand the customer enough so that we [can] anticipate future opportunities or future problems for our customers. So then we’re bringing them solutions before they know they have a problem.”

That is, a process of constant reflection and inquiry into second-order learning is the key for GPF and AMD’s sustainability. It involves constantly looking for new ways to explore for the purpose of adaptation. GPF evolved from delivering standardized products to going into the kitchens of restaurants to work with their customers and better understand their customers’ emergent and changing needs. This practice went well beyond what their competition was doing. Sustaining business units inquire about new ways to enhance their second-order learning process. In contrast, some business units gradually lost the focus on enhancing their second-order learning, which eventually led to a decline in quality performance (GFI, BLP). Tables 2 and 4 show that GFI (Lost and regained) did not continue to go beyond the existing product

Table 3
Cross-case comparisons of meta-learning: enhancing first-order learning.

Business unit	Sustaining pattern	Summary	Degree
AMD	Sustaining	Formal quality system for continuous improvement is in place due to the early quality movement. More focus is placed on continuously improving process capability and efficiency.	High
GPF	Sustaining	The business unit established a system for continuous improvement. Quality systems are in place for monitoring and improving. Infrastructure of training and staffing employees about quality is highly valued.	High
GFI	Lost and regained	Historical focus on process improvement, cost reduction, production efficiency, and improving specific product attributes. Improvement systems are in place. Traditional focus on cost reduction and driving out variance in the system. Very strong operational excellence focus.	High
BLP	Lost and regained	The improvement processes are in place but the leaders think that there is still much to improve in process capability. This business unit is pushing to refine their improvement system for better understanding of their internal operation processes and process capability.	Medium
BAT	Lost	This business unit has not focused on internal process improvement. Lack of process capability. Don't have a systematic system for improving internal processes. Recently started a program to revamp their process improvement system.	Low
APC	Lost	Several improvement practices are in place. Most of the plants are ISO registered. Processes for quality control are in place. Largely relied on existing processes for improvement projects.	Low

development procedures and think about ways to explore new quality dimensions for their customers. But, GFI did maintain a strong focus on continuously renewing their improvement system. For a time this worked well since GFI was in a capacity constrained industry and the customers had few options. As long as they could meet rigorous technical and regulatory specifications, they could satisfy their customers. However, as industry evolved and capacity expanded, customers' expectations began to evolve. As a result, they were slow to respond. GFI lost some of their customers as a result of decline in the customers' perception of quality.

In summary, meta-learning is the ability to enhance *both* the first-order and second-order learning processes. Higher levels of meta-learning increases an organization's adaptability, which helps them sustain a high level of quality performance. Further, only business units that show a strong indication of renewing both types of learning processes exhibit the capacity of meta-learning. Business units that focus only on improving either first-order or second-order learning might still lose their level of quality position (e.g. GFI, BAT). Deming (1994) once said the *quality problem is never solved*, we believe that this captures the concept of meta-learning. Tables 3 and 4 summarizes the comparisons across business units on the capability of meta-learning, which suggests the following proposition.

Proposition 1. *Firms with a strong capability of meta-learning (renew and update their first-order and second-order learning processes on an ongoing basis) are more likely to sustain high levels of quality performance.*

Table 4
Cross-case comparisons of Meta-learning: enhancing second-order learning.

Business unit	Sustaining pattern	Summary	Degree
AMD	Sustaining	Business unit has been able to utilize different types of innovation practices and has kept introducing varying degrees of innovation onto the market over the past five years. The market place is in a "pathological need" for new products.	High
GPF	Sustaining	Continuously introduced new products over the past five years. Building practices to understand customer enough and create solutions before customers realize they have a problem. "And we don't see competitors. . . we have a lot of money spent on R&D, our largest competitor outsources their R&D. So we're leading edge as far as innovation and bringing new products to market."	High
GFI	Lost and regained	Not focused on innovation for a long period of time. Has started creating practices focusing on customer-oriented innovation recently. Customers are demanding more beyond operational excellence over time.	Low
BLP	Lost and regained	In a mature business, and product design has been the same over the years. BLP has been largely focused on incremental refinement of their existing products rather than producing new products. Struggling with launching successful new products in recent years.	Low
BAT	Lost	This division traditionally has high focus on R&D and getting new products to the markets on time. Practices related to innovation are highly encouraged and the sole main focus of the business unit. Customers participated at all stages of new product development.	High
APC	Lost	High level of focus on new product development and heavily invested in building innovation capabilities. Successfully created several new products which gained large market share. However, recent new product developments are not as successful as before.	Medium

5.2. Sensing weak signals and high consistency of quality performance

It is not reasonable to expect high quality performance to last indefinitely without any variation. Unexpected events may affect quality performance. For example, internal disruptions such as process changes, production problems, and unexpected changes in leadership positions can all create disruptions to a firm's quality position. According to the definition, sustaining quality includes consistency in quality performance, which requires the ability to cope with these disruptions. Drawing on the HRO literature and the case data, two capabilities, sensing weak signals and resilience to disruptions, help sustain high consistency in quality performance.

The sustaining businesses exhibited high concern for missing the first sign of trouble. We found that they were vigilant to the potential signs of trouble in order to address problems as soon as possible. They exhibited the characteristics from the attention-based theory of the firm described by Ocasio (1997) and Ocasio & Joseph (2005). For example, one quality manager in GPF (Sustaining) expressed this attentiveness while discussing the control charts display in the organization's "war-room":

"And [collecting and sharing process level measures] really has been valuable as far as being able to get attention on something early, if and when it needs attention. Because like I said, when someone sees a blip . . . whether it's a line yield or a customer complaint, it's kind of like, you see it one week, you see it the next week, now two or three points you have a trend . . . by the time I notice something,

Table 5
Cross-case comparisons of sensing weak signals.

business unit	Sustaining pattern	Summary	Degree
AMD	Sustaining	Develop a key quality index which combines several internal operational and external customer measures. Disseminate and communicate these operational measures across business unit. Create a community to stay in touch with key users and opinion leaders, to increase awareness of their products and changes in customers' needs and technological changes. Customers are highly involved in the new product development. Detail analysis of customer complaints. Ongoing self-assessments of operational measures. Perform internal and external audits at operational level to seek improvements in the quality system.	High
GPF	Sustaining	Collect, disseminate, communicate and increase visibility of data on operational measures. Believe that it could help get attention on something early. They work closely with their customers. This may involve working at customers' facilities to joint develop a better solution. Have a broader sense of movements in local community, suppliers, and even competitors. Ongoing self-assessment of quality system to prevent complacency. Self-assessment reports become part of their strategic planning.	High
GFI	Lost and regained	Similar to GPF, collect, disseminate, track, and communicate data on operational measures. "Tracking the data because it gives us insight in preventing a true customer rejection" – QM. Started utilizing more self-assessment of their quality system recently and relying on third party audit or customer audits. They are closer to customers but still less sensitive to other aspects of environment.	Medium
BLP	Lost and regained	The data for measuring quality is not consistent across plants. Different data systems in place create difficulty in communication. Attention to customer requirements has increased recently. There have been customer surveys and effort to understand external environments. Starting to build relationships with application scientists. Lack of systematic self-assessment or internal audit systems.	Medium
BAT	Lost	Different data systems across sub-units cause business unit members to have different perceptions of the current picture of operations. Strong sense of changes in technologies and related regulations. Having originally invented the product, leadership becomes complacent with the number one quality position in the market. Lack of systematic self-assessment or internal audit systems.	Low
APC	Lost	Have had a few successes with new products. Start to develop new products without input from external stakeholders. Gradually lost sight of what the customer values and changes in the external environment and took their eye away from quality. Became too internally focused and inattentive to complaints and changes in the external environment. Also reduced assessment efforts due to cost reduction and lack of support from leadership.	Low

maybe I make a call to the plant manager . . . So there's a dashboard that comes out that shows you [the measures of quality] that week, and then what are hanging in the break room are charts [that demonstrate this]. It's the other way we make it really visible to the whole organization. This helps get the action going . . . There are now some very tactical operational type of measures that are even set up in such a way that if we have a blip, you're going to see it big time"

Case comparisons in Tables 2 and 5 show that the business units that sustain higher consistency in quality performance are more vigilance and attentive to changes in their external and internal environment. They appear to strive to "see what others fail to see". This is similar to the notion of "sensing weak signals" in high reliability organizations (Weick and Sutcliffe, 2001, 2007). We found that business units with higher consistency in quality performance exhibit the following two types of behaviors similar to the HROs: (1) a strong cognitive attitude toward finding anomalies in their daily operations, and (2) a focus on enhancing awareness to changes in the external environment. We now examine these two behaviors more deeply by reporting findings from the cases and the relevant literature.

5.2.1. A strong cognitive attention to finding internal problems

Both AMD and GPF (Sustaining) showed a vigilant attention to potential internal failures compared with other business units. Both organizations were determined to search for any signs of operational problems. They systematically collect internal measurement data, investigate near-miss events, encourage employees to report problems, and review quality complaints regularly. In GPF, the employees have an attitude of "we need to actively look for potential problem spots in our system." The sales manager in GPF made the following comment about a near-miss event (defective

products almost delivered to the customers) and how they actively investigated the potential problem:

"We try to understand how that product is handled; we dig into our records and try to analyze the details behind it. We take the temperature recorder on the trucks, [and] we look [at] how that product deformed during that distribution and ensure that it didn't spike up to a temp higher than expectation."

In the end, GPF refined their delivery system completely for perishable products, even though the customers never experienced a product quality failure. The quality manager at GPF exhibited an ongoing concern for potential internal quality failures. She noted that:

"When we're building a new product line or something's being talked about, people are talking about 'what are the [product quality] risks going to be with this? What quality issues are there?' People ask those questions very upfront when we're doing things."

This attitude contrasts with hubris and over confidence bias (Kahneman, 2011) that can result in failing to detect quality problems. Although GPF won multiple national quality awards and was considered the undisputed quality leader in their parent organization, they exhibited no hubris or overconfidence bias about their future success. GPF actively utilizes an internal assessment process as a way to implement this mindset. Similarly, HROs use reviews and assessments as a "window on the system as a whole" (Weick and Sutcliffe, 2001) and view it as essential for organizational learning (Reason, 1997). In a similar vein, AMD views internal audits as an important function to find potential problems. The manufacturing manager at AMD elaborated on the importance of the internal audit function for sustaining their quality performance this way:

"All the elements of a quality system get summarized and reviewed. If you look at a typical quality [system]—management review,

corrective preventative action, internal audit, I mean those are the three primary diamonds of the standard . . . When you're running the plants, the internal auditors are absolutely critical to me for our successful quality system."

Other business units did not demonstrate such vigilant attention to actively look for problems and the ongoing desire to systematically search for potential internal failures. They simply repeated what seemed to "work" in the past. For example, BLP (Lost and regained) did not have a process for self-assessment and did not express any concerns. BAT (Lost) initially had an active system to collect quality data, but over time they began to rely on customers or third party audits to identify problems for them. As a result, BAT became insensitive to potential threats to their quality performance. Similarly, APC (Lost) used to have full-fledged systems to conduct full scale assessments of their quality system. However, over time these systems gradually drifted away because of other priorities and lack of support from management. Without a strong attitude or mindset to support these systems to keep the organization sensitive to potential internal failures, APC started to fall into the complacency trap and relied on practices of previous success.

5.2.2. Heightened attention to external changes

Sustainable business units also emphasize staying attentive to emerging changes in the external environment (e.g. changes in customers, competitors, suppliers, and regulators) which could potentially disrupt quality performance. They engage in social relationships with different entities in the external environment to stay attentive. GPF (Sustaining) encouraged employees to develop relationships with customers, suppliers, opinion leaders, and even local community members. They developed several employee performance metrics around this concept:

"We'll have a key result area around your relationship with regulatory agencies, your relationship with key people in the communities where we operate; with key customers . . . It is from the aspect of that this way you don't get caught off guard around something . . . And now thinking about, if they decide to go this way how [does] that impact us, what does that mean for us?"

AMD (Sustaining) used similar practices to stay attentive to emerging changes in the external environment. They maintained close working relationships with their external entities by participating in technological forums and joint-planning sessions with key users of their products. AMD often invites scientific leaders to give presentations about the latest technology advancements, participating in internal developmental events and informal social gatherings to keep up with latest changes in technologies and user bases. AMD also tries to inform and educate its customers of its latest medical technologies through different social media channels. One informant noted:

"in this division, I think one of the good things is we have so much interaction with the customers throughout the development process . . . I mean, there are guys, key opinion leaders, they are very open and they will tell you when this isn't worth it. . ."

Executives in AMD pay particularly close attention to the evolving concept of quality:

"The perception is, everybody has high quality standards . . . let's understand customer satisfaction and know their perception of quality in a little bit more depth so then we can educate customers."

What AMD does, according to one of the informants, is create a "quality experience." They immerse themselves in customers' contexts through frequent communications, interactions, feedback, and hope to capture emerging changes in the customers' contexts. Besides sensing changes in customer and technological trends, they

also monitor changes in regulations and standards. As a provider of healthcare products, AMD gets highly involved and engaged in various governmental agencies around the world. AMD engages with trade associations as well as key opinion leaders with different backgrounds trying to stay alert to any regulatory changes that may affect their quality performance. As one AMD executive noted,

"We leverage trade associations very closely because these experts are the same people who regulatory agencies go to for advice . . . you've got to jump into that and all of those different circles."

By embedding themselves into different external entities, the sustainable business units increased their chance of detecting potential disruptions from the external environment. Becoming insensitive to external changes can lead to disruptions in quality performance. APC (Lost) once achieved high levels of customer satisfaction and then shifted their attention away from their external entities. The quality director at Alpha discussed losing touch with the customer as a source of failure in APC. As a result, APC's disengaging from the external environment caused their quality performance to decline.

Overall, the case analyses suggest that a strong attitude toward recognizing problems in internal operations enables organizations to sense small anomalies, from the shop floor to the corporate level, which helps detect potential quality problems quickly. Heighten awareness of the external environment allows business units to become more attentive and sensitive to emerging changes in the business contexts, again allowing changes to be quickly detected. These anomalies can potentially disrupt quality performance. Table 5 summarizes the comparison of sensing weak signals across all business units. This suggests the following proposition:

Proposition 2. *Firms with strong capability of sensing weak signals (vigilant attention to changes in the internal and external environment) are more likely to sustain high consistency in quality performance.*

5.3. Resilient to quality disruptions and high consistency in quality performance

Business units that sustained (AMD, GPF) or lost and regained (GFI, BLP) quality performance demonstrated a higher resilience to quality disruptions. Both BLP (Lost and regained) and BAT (Lost) suffered from a corporate financial crisis in 2002 that led to devoting fewer resources to quality related issues. Informants from BAT recognized that failure to quickly respond to this disruption led to losing their quality advantage. The quality manager at BAT noted that some of their quality complaints took more than 300 days to resolve during this period:

"I looked at [the time to close a quality issue] and [one] was 327 days. That's [our] own system saying that. I said we need a responsiveness goal here because we kept losing."

On the contrary, BLP, suffered from the same crisis, but they were able to mitigate the disruption and reduce the negative effect on quality performance. Comparing the business units that sustained or regained their quality performance with those that lost, the case analysis shows that those business units are more resilient to disruptions. They have higher consistency in quality performance and their capacity to cope with disruptions and return to normal is better than the business units that lost (Wildavsky, 1991, p. 77). Resilience capacity differentiates business units based on two types of behaviors: (1) employee's commitment toward the value of quality, and (2) social capital resources to respond. Table 6 compares the capability of resilience to quality disruptions across the six business units.

Table 6
Cross-case comparisons of resilience to disruptions in quality.

Business unit	Sustaining pattern	Summary	Degree
AMD	Sustaining	Exposed to quality management in the 1980s and established several lasting frameworks and still train their employees in quality management philosophy. Informants in this business generally appreciate the investment in quality. Have a formal procedure to deal with unexpected quality issues such as recall. Good understanding of different firm level or informal assets at their disposal.	High
GPF	Sustaining	The commitment to quality is very strong and permeates the entire organization. They believe that their core quality values will outlive management. They use behavioral based hiring to ensure that their values will be preserved. Formal risk management system is in place even though it is not mandatory in the industry.	High
GFI	Lost and regained	This business unit view committing to the value of quality is intimately tied to the organization's survival. The CFO said the most important thing was quality of their product – not a financial focus. Relied on corporate level resources and informal social contacts to cope with unexpected events.	High
BLP	Lost and regained	Adopted quality practices at the firm level in the 1980s but previous leadership deemphasized quality and is in the process of rebuilding the focus on the value of quality. Started a complaint response project to improve the responsiveness of quality issues in 2007 and build up systems and procedures around the project.	Medium
BAT	Lost	Similar to BLP. The previous corporate leadership deemphasized quality and attention went toward cost reduction. This business unit is in the process of rebuilding the focus on the value of quality. No formal procedures or processes for responsiveness. Beginning to develop a “plan of action” system dedicated to the responsiveness to quality issues.	Low
APC	Lost	Responsiveness to quality problems raised from customers or employees is not a focus of this business unit at a strategic level. Training in quality management philosophy is also not a focus in this business unit. People in this business unit gradually lose interest in quality related programs.	Low

5.3.1. Employee's commitment to quality value

One executive at BLP (Lost and regained) describes how the employee's commitment to the value of quality contributes to their recovery from a quality crisis even without support from high level management this way:

“The beliefs [about the value of quality] at an individual level had not dissipated [during the crisis] so when [the leader that valued quality] came back, we were able to very quickly get back on stream because [of our] people, well, there was a belief there amongst the workers. The workers fundamentally knew it made sense; they just felt that leaders had abandoned them.”

This deep identification with basic core values of quality fosters a positive and constructive cognitive orientation, which gives a sense of direction (Collins and Porras, 1994). It encourages the organization to frame conditions in favor of the core values and take actions to achieve the desired outcomes (Dutton and Jackson, 1987). When facing events that might conflict with quality, employees that deeply identify themselves with quality values are more willing to frame and take appropriate actions in favor of preserving quality. Over time, this identification provides a common cognitive framework for noticing and interpreting events and taking appropriate actions. For example, the marketing director of AMD (Sustaining) framed multiple incidents of delaying a new product launch as to “minimize the potential harm” to quality. Because the quality manager found that a newly acquired plant did not have the processes to meet AMD's quality standard, they delayed a product launch. They were not willing to sacrifice quality to meet production and market goals.

Besides providing a common cognitive framework, employees who identify deeply with the value of quality fulfill their personal needs when the organization holds the same value. This leads to a deeply felt concern and responsibility among employees to serve the objective of the organization (e.g. achieve good quality) which motivates them to respond. A quality manager at GFI (Lost and regained) attributes the commitment of people as the reason for the business unit's fast recovery from a plant flooding incident that threatened their product and service quality:

“We're a company when there's adversity somewhere everybody pitches in, I mean, there were people who spent four months in [the plant] working 12-16 hour days practically without days off that weren't even people from that [business unit]. . . . It's just the nature

that when something's going on, people are, rather than backing away from it, people are stepping forward saying how can I help?”

APC (Lost), on the other hand, provides a contrasting view about how employees gradually lost identification with the value of quality, which led them to start shifting to other priorities:

“First they moved [the managerial position of quality] down under manufacturing, and after that they moved it to the laboratory because they felt they did a lot of work with the laboratory in validating product design, but now they have further and further removed [the quality position] to [a lower managerial level].”

These changes reflect the slow change of commitment to the value of quality which eventually caused APC to over commit to other priorities at the expense of quality. Without a strong commitment toward quality among employees, it is easy to sacrifice quality when facing adversity. As a result, during difficult times, APC decided to shift their focus from quality to other dimensions and eventually sacrificed quality performance.

5.3.2. Speed of accessing social capital resources

Sustainable business units also demonstrate the speed of accessing a broad resource network during difficult times. The quality manager from AMD (Sustaining) emphasized the importance of mobilizing internal human capital to address quality problems, without having to go through the organizational hierarchies which speed up the problem solving process:

“We've got a number of examples last year where we had [quality] issues coming from a supplier and we get our R&D research people on it.... And the good part is it doesn't have to go up to the management level and back down. It's happening at this level.”

The quality manager from GFI (Lost and regained) expressed a similar view and noted the importance of being able to have access to resources to resolve quality issues at the flooded plant:

“I mean, we had to get legal people and we had to get food safety people, and we had to get operations folks, to look at a flooded plant, what were we going to do to put it back to [a] state where we could have food-grade production area. . . . From the time we were flooded, we were searching the world to see who [were] the right folks to get involved on those teams.”

The capacity to tap into a resource network allows organizations to cope with events that they might not normally be able to handle. Social capital and resource networks foster resilience, since organizations can tap into their networks and effectively respond to adverse events (Leana and Van Buren III, 1999). Compared to high sustaining units (AMD, GPF), BAT and APC (Lost) were relatively slow to mobilize internal expertise to respond to quality crisis. BAT was criticized by their customers about their slow response to quality problems. Part of the reason is that BAT could not effectively mobilize internal expertise and resources to address the quality problems. Because of those criticisms, BAT has been working on building a formal corrective action system to improve their responsiveness to quality issues and problems. The corrective action team will employ internal expertise to investigate the issues and follow up with a process to prevent it from happening again. Table 6 summarizes the comparison of resilience to quality disruptions across all business units. Based on the case evidence, we suggest the following proposition:

Proposition 3. *Firms with a strong capability of resilience (where employees are highly committed to solving quality problems and can quickly access required social capital) are more likely to sustain high consistency in quality performance.*

6. Summary of the conceptual model

A dynamic capability enables firms to modify and reconfigure resources, evolve with changing environmental conditions, and sustain a competitive advantage (Helfat et al., 2007; Teece et al., 1997). According to researchers, a dynamic capability consists of three broad components: (1) sensing changes; (2) seizing opportunities; and (3) reconfiguring resources and processes (Teece, 2007, 2009). This study infers three separate capabilities from several different organizational behaviors that form a dynamic capability to sustain a quality advantage. These individual capabilities include the following.

First, business units with a high level of *meta-learning capability* continuously renew their quality system, which involves enhancing both first-order and second-order learning processes. This capability enables organizations to more quickly change and adapt their internal processes. Consistent with the Red Queen perspective, this helps sustain a high level of quality performance relative to the competition. Therefore, the capability of meta-learning is the *reconfiguration* component of a dynamic capability.

Second, sustaining competitive advantage in quality involves increasing the consistency of quality performance. The *capability to sense weak signals* enables organizations to sense emerging quality problems that may affect the consistency of performance. These organizations have a strong tendency to identify potential internal problems and recognize important changes in the external environment. Capability of sensing weak signals acts as the *sensing* component of a dynamic capability.

The *capability of resilience to quality disruptions* helps minimize disruptions to quality and ultimately enhance performance consistency. In a sense, capability of resilience seizes the opportunities to correct quality problems and increase consistency in quality performance. We view this as the *seizing* component of a dynamic capability.

Together, these three individual capabilities: *meta-learning, sensing weak signals, and resilience to quality disruptions* form a coherent dynamic capability, which enables organizations to *sense* changes, *seize* quality problems, and *reconfigure* internal resources for sustaining a competitive advantage in quality.

7. Discussion and conclusion

The comparative case analysis integrates several literature streams to develop a coherent dynamic capability that helps sustain a quality advantage. The case data helps identify concepts in different literature streams and connect them to an operations management context. Drawing on the Red Queen metaphor, sustaining a quality advantage is like a never-ending race. While racing, organizations need to be engaged in meta-learning in order to increase their adaptability to compete (Siggelkow, 2001). Organizations also need to be vigilantly attentive of their surroundings and sense weak signals that may disrupt quality, which prevents them from stumbling in the quality race. Finally, if they do stumble, they need to be resilient and quickly get back on their feet so that they can still remain in the quality race.

This research provides a conceptual model for sustaining a competitive advantage in quality. It differs from previous studies by specifying the level and consistency components of quality performance. The analysis suggests that without meta-learning, organizations cannot maintain their level of quality relative to the competition, and therefore cannot sustain it. Without sensing weak signals and resilience, organizations are not likely to detect and correct potential disruptions to quality performance. These new insights are revealed by studying organizations after they have achieved high quality performance.

The capabilities identified in this study have important implications for practice. In terms of the capability of meta-learning, organizations can benefit from periodic assessments of their quality system to renew and enhance the processes that lead to first-order and second-order learning. For example, Cargill Kitchen Solutions (formally Sunny Fresh Foods) won the Baldrige Award multiple times (NIST, 2005). They developed their own assessment framework to update their quality system periodically, which over time has evolved into a unique quality system that fits their specific business context over time (NIST, 2005). Firms should recognize the importance of such an assessment framework and reassess the organization on a periodic basis. The capability of meta-learning relies on the continuous renewing of the quality system so that the system can evolve and keep pace with the competition.

To develop the capability of sensing weak signals, organizations could adopt practices that foster employees' attentiveness to their operations environment and also practices that increase the visibility of potential quality failures. For example, an organization can encourage certain types of behaviors such as reporting small anomalies, discussing mistakes or near-miss events, learning from previous failures and disseminating that knowledge throughout the organization. In one case, a sustaining business displayed detailed process data in the lunch room which generated discussions and fostered their employees' sensitivity to operations. Further, sensing weak signals requires organizations to develop practices that are more toward flexible and "rule-guided" rather than "rule-governed". Static routines might make employees become mindless, where they simply follow the rules and become insensitive to environmental cues over time. For example, Levinthal and Rerup (2006) found that some nuclear power plants have a strict inspection procedure but the reporting process changes frequently, which foster employees' sensitivity to the operations. In summary, sensing weak signals requires practices that focus on increasing the employees' attentiveness to emerging changes in the environment and the visibility of small anomalies.

In terms of developing a capability of resilience to quality disruptions, organizations can establish a strong core commitment to quality by training programs and selective hiring. Creating an identity with the value of quality among employees encourages decision making that is consistent with this core value. Organizations could also encourage communications among employees so

that they can have a general idea of the distribution of social capital across the firm, which provides the foundation for rapid response to emerging troubling conditions. In summary, *the key take-away message from this study is that sustaining a quality advantage requires an organization to (1) create a disciplined way to update the existing quality system, (2) increase attentiveness to subtle cues internally and externally, and (3) nurture the capacity of resiliency.*

Finally, our study challenges the existing view of the resource-based strategy to sustain quality performance. Previous studies in quality management often draw on the RBV logic and argue that the complex interactions of various quality practices lead to a quality system that other firms cannot easily replicate, which explains sustained high performance (Powell, 1995). However, strategy scholars have also argued that sustaining competitive advantage using RBV resources has become difficult in today's dynamic environments (D'Aveni, 1994; D'Aveni et al., 2010). According to the Red Queen logic, the once difficult-to-replicate resources (such as a complicated quality system) can eventually become replicable due to rivals' intense learning efforts triggered by competition. This study advocates a dynamic capability approach to stay ahead in the race of quality instead. Organizations that build a dynamic capability which involves meta-learning, sensing weak signals, and resilience enhance their dynamic fitness (Siggelkow, 2001). It is the dynamic maneuvering rather than static resources and routines that creates a series of temporary advantages to help organizations sustain a quality advantage over time (D'Aveni et al., 2010; Grimm et al., 2005).

Like most studies, this research is not without limitations. The research is based on a purposive sample from six business units for the purpose of developing propositions and a theory for future testing. The qualitative research study only focuses on manufacturing organizations. Studying a wider array of business would improve the generalizability of the results. Future research should select different types of industries for further investigation. Although the study is based on reputable organizations in their respective industrial sectors, which ensures that the findings have some utility, a more fine-grained sample could further extend the insights from this study. We also understand that while the proposed theory has support from the case evidence, other theoretical lens and factors are possible. For example, this study did not consider disruptive forces such as disruptive technology, fundamental changes in business structure or changes in governmental regulations that could completely change the competitive landscape and render the current competitive advantage in quality irrelevant (Christensen, 1997). We hope this model sparks new thinking about sustaining a competitive advantage in operations. Still other frameworks may be proposed for this important phenomenon in the future. More research is clearly needed in this emerging area of interest.

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Appendix A. Interview guide

Instructions: We are conducting this interview to determine how the division (business unit) has managed the quality of its products and processes over the past ten years. (Informants are encouraged to provide responses freely.)

1. How does the division measure quality in terms of its dimensions (customer satisfaction, defect rates, warranties, etc.)?
2. In general terms, what has been the quality level of products or processes over the past 10 years? Has quality always been high or has it suffered some losses?

3. Do you know of any data that we can obtain that would show quantitatively the level and rankings of product or process quality over the past ten years? Is there anyone in the division who might have this data?

4. What have been the major quality initiatives/programs that were implemented in the last 10 years (e.g. Baldrige, ISO, Six Sigma, etc.)? When were these programs/initiatives implemented? Show years on event map.

Leadership (GM)

5. Top Leadership. What role has the top leadership of the division (business unit) played in sustaining or improving quality at various points over the last ten years?
6. Pressure for short-term financial returns. How much pressure for short-term performance was there in each year?
7. Future leaders. How much emphasis is focused on developing future leaders in the division? Were there significant changes over the years?

Environment (GM, marketing)

8. Competitors. Have competitors entered your market with better quality or lower cost of products?
9. Market. Have there been major shifts in the customers that you serve or in customer requirements?
10. Technology. Has the technology in your industry changed? If so, how?

Strategy/values (GM, quality)

11. Strategy. Was the division able to select the "right" products and processes over the past ten years to beat the competition (based on hindsight)?
12. Quality priority. How much was quality a top priority? When was the priority lost or gained?
13. Quality Intention. What position in quality did management seek in each of the last ten years.
14. Core values. How much emphasis was put on translating core quality values (continuous improvement and innovation) into managerial behavior at all levels each year?

Quality systems (quality)

15. Process improvement projects. Did the division continue to pursue process improvement projects and maintain the impact of process improvements?
16. Is there any data on the amount of savings due to quality projects or the effect on customer satisfaction over the past ten years? Who might have this data?
17. Training. How much training took place in the division over the past ten years related to continuous improvement and quality principles?
18. Is there any data on the amount of training on C.I. and quality principles (number of employees trained by year or expenditures by year)? Who might have this data?
19. Suppliers. Have suppliers affected quality ranking over the past ten years? What happened and when did it happen?
20. Customers. How much attention to customer requirements and customer input or has the customer focus been lost? What happened and when did it occur?
21. Employee involvement. How much were employees involved in quality improvement over the past ten years or was employee involvement lost. Could you describe what happened and when it happened?
22. Is there any data on employee attitudes, employee satisfaction, or teamwork over the past ten years? Who might have such data?
23. Control of Quality. How do you attempt to control quality? Were there any significant losses of control in the past ten years?
24. Is there any data on quality control failures that occurred (rework costs, warranty costs, major recalls, etc.)? Who might have this data?
25. Product Design. How much did product design contribute to a quality advantage in terms of customer preference or process excellence? When did this happen?

Final question (All)

26. Your business unit has maintained a top position in quality for several years. How did you do it? Or—You were at the top in quality and lost it. How did that happen?

Appendix B. Detail firm and business units descriptions

B.1. Firm Alpha

Alpha is a large Fortune 100 company operating in an environment characterized by fast product and technological changes. It is known for its innovativeness and produces a large variety of high technology products. The two business units studied from Alpha are called Alpha Medical Division (AMD) and Alpha Personal Care (APC).

B.2. Alpha Medical Division (AMD)

AMD manufactures a large variety of medical and clinical products for Alpha. They face continuously changing regulatory and safety standards enforced by government agencies. AMD has a very broad and segmented customer base, and quality is a top priority. This business unit has approximately one thousand employees with annual revenue at about nine hundred million dollars. The industry has a moderate level of technical change, and the division has been recognized as an innovative leader. AMD has been recognized as the quality leader in Alpha and has won numerous quality awards over the years.

B.3. Alpha Personal Care (APC)

APC supplies a variety of personal care products for multiple uses. The technology changes relatively fast, and research and development activities are intense in this business unit. APC was once the quality leader and was considered to have the best quality management practices in 1990s. However, starting from 2005, APC suffered from a significant decline in quality performance. Since then, APC continues to struggle to fully regain their quality advantage in the industry. APC lost its quality position after achieving it and, during the study, struggled to regain their high quality performance.

B.4. Firm Beta

Beta is a Fortune 500 company operating in a fast-paced business environment. It is known for its global leadership in technologies and manufacturing products. It invests a substantial amount of revenue in research and development. The two business units from Beta are called Beta Laboratory Products (BLP) and Beta Automotive Technologies (BAT).

B.5. Beta Laboratory Products (BLP)

BLP develops, manufactures, and supplies laboratory products to researchers and scientists around the world. BLP faces a customer base that is very sensitive to product and service quality. The pace of change in technology in this business unit is relatively slow compared with the other business units in Beta. BLP is considered a quality leader in Beta. Recently, BLP faced increasing competition and pressure to provide new products to the customers.

B.6. Beta Automotive Technologies (BAT)

BAT manufactures and supplies automotive components to automotive manufacturers in a fast changing industry. BAT faces several strong global competitors that offer similar products. Customers in this industry have become increasingly more demanding and have higher expectations. In the early years, BAT was the product and market leader and enjoyed a high market share due to their high quality products. However, BAT lost its leadership in quality position as overseas competitors were able to provide products with better quality at a lower cost. Since then, BAT has not regained its quality position.

B.7. Firm Gamma

Gamma, a large privately held company, operates in commodity based industries. Its main business activities include purchasing, processing, manufacturing, and distribution of commodity based products. The two business units studied in Gamma include Gamma Packaged Foods (GPF) and Gamma Food Ingredients (GFI).

B.8. Gamma Packaged Foods (GPF)

GPF produces packaged foods products to commercial customers, including restaurants, business and institutional food services, schools, and the military. It has approximately seven hundred employees and forty million dollars in annual revenue. Facing several strong competitors, GPF has been recognized as a quality leader in its industry for the past ten years and continues to maintain a top position. GPF has also won several internal and national quality awards over the past ten years.

B.9. Gamma Food Ingredients (GFI)

GFI produces ingredients in various food products. It has approximately two thousand employees with several manufacturing facilities and distribution terminals located throughout the United States. GFI's customers are mainly commercial users. The industrial standards of their products are well established and the process technology changes relatively slowly. Nevertheless, they suffered a decline in quality performance due to increasingly demanding customers and competition.

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