Communications of the Association for Information Systems

Volume 39 Article 13

9-2016

Idiosyncratic Values of IT-enabled Agility at the Operation and Strategic Levels

One-Ki (Daniel) Lee
University of Massachusetts Boston, daniel.lee@umb.edu

Peng Xu
University of Massachusetts Boston

Jean-Pierre Kuilboer
University of Massachusetts Boston

Noushin Ashrafi
University of Massachusetts Boston

Recommended Citation
Lee, One-Ki (Daniel); Xu, Peng; Kuilboer, Jean-Pierre; and Ashrafi, Noushin (2016) "Idiosyncratic Values of IT-enabled Agility at the Operation and Strategic Levels," *Communications of the Association for Information Systems*: Vol. 39 , Article 13.
DOI: 10.17705/1CAIS.03913
Available at: http://aisel.aisnet.org/cais/vol39/iss1/13

Communications of the Association for Information Systems

Research Paper ISSN: 1529-3181

Idiosyncratic Values of IT-enabled Agility at the Operation and Strategic Levels

One-Ki Daniel Lee
Department of Management Science and Information Systems
University of Massachusetts Boston
daniel.Lee@umb.edu

Peng Xu
Department of Management Science and Information Systems
University of Massachusetts Boston

Jean-Pierre Kuilboer
Department of Management Science and Information Systems
University of Massachusetts Boston

Noushin Ashrafi
Department of Management Science and Information Systems
University of Massachusetts Boston

Abstract:

Although research recognizes the role of IT and organizational agility on firm performance, a research gap to investigate IT-enabled agility at strategic and operational levels exists. In this study, we define operation-level agility as a firm's ability to respond to market changes or emerging opportunities by quickly modifying its business routines. In contrast, we define strategic-level agility as a firm's ability to define long-range investment decisions and implement them to accommodate strategic moves and business initiatives. We investigate how IT can empower these two levels of agility, and, in turn, how these two levels of agility can influence firm performance. We also examine the relative roles of the two levels of IT-enabled agility in manufacturing and service settings. We use survey data to validate the proposed hypotheses. The results indicate that, in general, IT leads to superior firm performance through agility at both levels. Further analyses, however, suggest that IT-enabled operation-level agility is a stronger success factor for service firms and IT-enabled strategic-level agility is more critical in manufacturing firms. Our findings provide a theoretical insight regarding the industry-specific values of IT-enabled agility at operation and strategic levels and practical implications for organizational IT deployment under specific industrial settings.

Keywords: Organizational Agility, IT Competence, Operational and Strategic Capabilities, Service vs. Manufacturing.

This manuscript underwent peer review. It was received 03/28/2014 and was with the authors for 8 months for 3 revisions. Thomas Case served as Associate Editor.

1 Introduction

Globalization and technological progression generated an intensely competitive, dynamic, and unstable business environment. Agility, a firm's ability to move fast to respond to environmental changes and seize novel opportunities (Dove, 1992; Sambamurthy, Bharadwaj, & Grover, 2003; Trinh, 2012), is a significant business capability that enables firms to develop and execute meaningful decisions and effectively respond to predictable and unpredictable changes. Studies on agility have examined various aspects of this high-level organizational capability, such as continuous improvement (Dove, 1992), dynamic assembly of organizational resources (Sambamurthy et al., 2003), coordination of internal capabilities (Menor, Roth, & Mason, 2001), and environmental sensing and responding (Overby, Bharadwaj, & Sambamurthy, 2006). As agility became vital for today's business competition, researched highlighted information technologies (IT) as a critical antecedent of firms' agile aspects (Liu, Ke, Wei, & Hua, 2013; Sambamurthy et al., 2003; Yusuf, Gunasekaran, Adeleye, & Sivayoganathan, 2004). In particular, Sambamurthy et al. (2003) propose that IT as a digitized platform for business processes allows firms to respond to market changes in a timely manner. For example, advances in IT can facilitate a firm's agile practices (e.g., rapidly adjusting demand forecasts and inventory planning in its supply-chain management or quickly delivering new product with unprecedented speed to respond to market) by providing seamless integration among systems, data, and applications (Liu et al., 2013; Roberts & Grover, 2012).

However, the research on IT-enabled agility has gaps. First, little research has analyzed the role of agility pertaining to organizational decision making and execution processes at the strategic and operation levels. To achieve and sustain their competitiveness in the market, firms should efficaciously address both strategic and operational issues (Miles, Snow, Meyer, & Coleman, 1978). However, research has done little to explicitly define the differences between agility at the operation and strategic levels, to understand how IT can enable them, and to understand how they can influence firm performance differently. In this study, we define operation-level agility as a firm's ability to respond to market changes or emerging opportunities by quickly modifying its business routines in the focused business model (Sambamurthy et al., 2003; Sull, 2009). In contrast, we define strategic-level agility as a firm's ability to define long-range investment decisions and implement them to accommodate strategic moves and business initiatives (Sull, 2009; Weill, Subramani, & Broadbent, 2002). These different levels of agility in firms impact the decisions firms make as they maneuver to respond to various environmental changes. Thus, we focus primarily on investigating the distinct roles of operation-level and strategic-level agility in materializing the values of IT.

Second, research has paid little attention to comparing the values of IT and agility at different business settings, such as different industries. Evidence shows that industry heterogeneity is associated with varying economic impacts of IT and business investments (Melville, Gurbaxani, & Kraemer, 2007). For example, the manufacturing and service industries have their specific set of characteristics and challenges for business competition (e.g., Chase & Apte, 2007; Roth & Menor, 2003). This distinction requires non-homogeneous IT-relevant resources and capabilities to achieve high performance. However, most of the current studies investigating IT and IT-enabled business capabilities consider only a homogenous industry setting and do not consider the idiosyncrasies among different industry settings (e.g., Chae, 2014; Lee, Sambamurthy, Lim, & Wei, 2015; Melville et al., 2007; Zhu & Kraemer, 2002).

To address these gaps, we evaluate IT's role in firms' effectively implementing agility at the operation and strategic levels. We then compare the relative impacts of operation-level and strategic-level agility on manufacturing and service firms. In particular, we theorize and test the idiosyncratic roles of IT-enabled operational and strategic capabilities (i.e., a higher value of operation-level agility in service settings and a higher value of strategic-level agility in manufacturing settings). Considering the recent failures of traditional business models in service and manufacturing firms (e.g., those by financial firms that did not focus on operational efficiency and those by mobile phone manufacturers that did not invest in strategic movements), we see the need for a new line of research to examine agility in service versus manufacturing. Hence, findings from this study will be timely and useful to both academics and practitioners interested in finding solutions about how to use IT to facilitate agility at the operation and strategic levels both in manufacturing and service industries.

This paper proceeds as follows. In Section 2, we review the relevant literature and propose the study's theoretical basis. In Section 3, we develop our hypotheses. In Section 4, we present the research methodology and, in Section 5, discuss the data-analysis results. In Section 6, we discuss the findings' implications, the study's contributions, and future research opportunities. In Section 7, we conclude the paper.

2 Literature Review and Theoretical Bases

2.1 Resource-based View and Capability-building Perspective

The resource-based view (RBV) of firms posits that firms are heterogeneous with respect to their resources and capabilities, which determine their competitiveness (Teece, Pisano, & Shuen, 1997). This view is one of the most widely accepted theoretical perspectives in strategic management and information systems (IS) fields. According to the RBV, organizational resources, tangible or intangible, are the basis for competition and rent-yielding when they are valuable, rare, imperfectly imitable, and nonsubstitutable (Barney, 1991). A resource's value refers to its ability to support organizational strategies; a resource's rarity measures its relative unavailability to competitors; a resource's inimitability reflects the difficulty with which competitors can duplicate it; and a resource's non-substitutability evaluates the nonexistence of equivalent organizational resources (Nevo & Wade, 2010). Such resources tend to survive competitive imitation because of isolating mechanisms such as causal ambiguity, time-compression diseconomies, embeddedness, and path dependencies (Lim, Celly, Morse, & Rowe, 2013; Ravichandran & Lertwongsatien, 2005).

While the resources that the early RBV literature defines are generally static in nature, more recent research argues that firms need to create competitive advantage by deploying and assembling individual resources using organizational processes to create firm-specific high-level capabilities, such as product innovation capability, organizational learning capability, and business agility (Grant, 1996; Newbert, 2007; Teece et al., 1997). Organizational processes embed such firm-specific capabilities; as such, these capabilities are more valuable, rare, imitable, and nonsubstitutable. Although they take time to design and build, these firm-specific capabilities, unlike individual resources, cannot be easily duplicated in the short term (Teece et al., 1997; Winter, 2003). As such, the RBV literature introduces internal capability-building mechanisms to develop firm-specific high-level capabilities (Bogner & Bansal, 2007; Lim et al., 2013; Makadok, 2001). Capability-building mechanisms in a firm refer to the organizational processes that integrate, build, and reconfigure internal and external resources to create the firm's high-level capabilities that lead to superior firm performance (Teece et al., 1997). According to Grant (1996), these capability-building mechanisms are hierarchical relationships among lower-level resources, higher-level capabilities, and firm-level performance; firms combine the lower-level resources (e.g., IT and knowledge) to build higher-level capabilities, and, in turn, the higher-level capabilities produce superior firm performance. The trend toward examining high-level organizational capabilities is on the rise since these capabilities are far more significant in explaining competitive advantage and performance than resources (Newbert, 2007; Sambamurthy et al., 2003). We adopt this capability-building perspective and investigate how IT, as a vital organizational resource, leads to superior firm performance through organizational agility.

2.2 Information Technology Resources

Adopting the RBV, IS research argues that superior IT resources can positively affect firm performance and competitive advantages (e.g., Bharadwaj, 2000; Mata, Fuerst, & Barney, 1995; Ross, Beath, & Goodhue, 1996; Santhanam & Hartono, 2003). We need to understand how firms can leverage various IT resources to influence their performance. Whereas some research has posited a direct relationship between IT resources and firm performance (Bhatt & Grover, 2005; Mata et al., 1995), other research has questioned such direct-effect and argued that IT resources affect firm performance via IT-enabled business capabilities (Ravichandran & Lertwongsatien, 2005; Sambamurthy et al., 2003). The former perspective focuses on IT-based competence, which is embedded in a firm's IT resources (e.g., the physical IT infrastructure comprising databases and IT platforms, the human IT resources comprising the technical and managerial IT skills, and the intangible IT-enabled resources such as IT-supported knowledge and customer orientation) (Mata et al., 1995; Ross et al., 1996).

Drawing on the capability-building perspective, however, the latter stream of research argues that research on direct influence of IT resources on firm performance overlooks IT-enabled organizational high-level capabilities that bridge the relationship between IT and firm performance (Sambamurthy et al., 2003; Tanriverdi, 2005). It argues that how effectively a firm uses IT to support and enhance its core business capabilities influences its performance (Ravichandran & Lertwongsatien, 2005). Prior research has examined how various IT resources enhance firm performance via market access capability, integrity-related capability, functionality-related capability, knowledge management capability, and business agility (Overby et al., 2006; Ravichandran & Lertwongsatien, 2005; Sambamurthy et al., 2003; Tanriverdi, 2005). Following this stream of research, we focus on IT-enabled agility as a key driving force of a firm's competitive actions. Specifically, when facing today's turbulent environment, research has highlighted IT resources as a catalyst to create or improve this high-level organizational capability (i.e., agility) (Chakravarty, Grewal, & Sambamurthy, 2013; Lu & Ramamurthy, 2011; Sambamurthy et al., 2003).

2.3 IT-enabled Agility

In today's hypercompetitive environment, competitive advantages do not come from daily routines but from dynamic and adaptive capabilities (Volberda, 1996; Winter, 2003). For these advantages, firms need to possess adequate organizational resources in technology infrastructure and managerial skills to enable organizational agility and flexibility (Volberda, 1996). IT can increase agility by introducing a firm to available digital options (Sambamurthy et al., 2003). In particular, flexible IT infrastructure and strategic IT alignment are crucial to enable firms' agile movements to sense and respond to rapid changes in their marketplaces (Chakravarty et al., 2013; Nazir & Pinsonneault, 2012; Roberts & Grover, 2012; Tallon & Pinsonneault, 2011; Weill et al., 2002). Accordingly, research has found firms' proactive embracement of new IT innovations to support emerging business opportunities to be critical for agility. By doing so, firms can quickly improve their product/service and adjust their operations to rapidly cope with market or demand changes (Lu & Ramamurthy, 2011). Thus, agility is a vital IT-enabled organizational capability for today's dynamic business environments (Nevo & Wade, 2010).

The literature discusses several concepts of agility such as customer agility, entrepreneurial agility, market agility, and operational agility (Lee, Lim, Sambamurthy, & Wei, 2007; Overby et al., 2006; Roberts & Grover, 2012; Sambamurthy et al., 2003). However, we still need to further clarify and study agility (Trinh, 2012). In particular, the strategic literature recognizes that a firm's decisions and activities at the operation and strategic levels are distinct from each other yet vital to the firm (Miles et al., 1978). However, the research has seldom defined or questioned the differences between operation-level agility and strategic-level agility. Thus, the literature has rarely discussed how IT can empower these two levels of agility and how they can influence firm performance. Note that agility for short-term operation and agility for long-term strategic changes face different issues and challenges. Through this study, we conceptualize agility from these two distinctive levels and examine how IT enables them and, thus, leads to superior firm performance.

2.4 Environmental Contingency Perspective

Prior research recognizes that certain environmental conditions affect the links among IT, agility, and firm performance, which is known as the environmental contingency perspective (e.g., Lee et al., 2015; Tallon & Pinsonneault, 2011). According to the environmental contingency perspective, materializing various business activities depends on environmental factors (Frohlich & Westbrook, 2002; Verdü-Jover, Lloréns-Montes, & Garcia-Morales, 2004). Firms need to align their capabilities and resources with their environment. The lack of co-alignment between strategy and business environment leads to lower performance (Verdü-Jover et al., 2004). The research discusses several contingency factors, including environmental dynamism, strategic orientation, demographic characteristics, and IT maturity (Chakravarty et al., 2013; Sambamurthy & Zmud, 1999; Tallon & Pinsonneault, 2011).

However, the literature sparsely discusses how different industry characteristics influence IT-enabled agility and its impact on the firm performance (Melville et al., 2007). The nature of outputs and underlying production processes are different between manufacturing and service industries (Mills & Margulies, 1980; Verdü-Jover et al., 2004). While manufacturing involves mainly tangible products, service is intangible, heterogeneous, and perishable (Chae, 2014). Nie and Kellogg (1999) pinpoint the unique characteristics of service operations, such as "customer influence, intangibility, inseparability of production and consumption, heterogeneity, perishability, and labor intensity" (p. 340). Similarly, Frohlich and Westbrook (2002) suggest that the relationship between a firm's Internet-enabled supply-chain strategy and operational performance depends on its industry type. Drawing on this contingency perspective on industry type, we examine idiosyncratic value creation of IT-enabled agility in the manufacturing and service industries.

2.5 Summary of Research Gaps

In sum, agility is a significant business capability that enables firms to effectively respond to changes. Although agility experts have addressed several types of agility, little research has explored its role pertaining to organizational decision making and execution processes at the operation and strategic levels. In this paper, we explicitly define the differences between agility at these two levels. Because IT resources are fundamental to business capabilities, we focus on how IT resources can enable these two levels of agility and influence firm performance. Second, although specific characteristics of manufacturing and service industries can affect IT usage and business strategies, few studies have compared IT-enabled agility in these two industries. Therefore, we examine the different roles played by IT-enabled operation-level agility and strategic-level agility in manufacturing and service industries. By addressing these two important issues, we help close the research gap regarding the role of IT-enabled agility.

3 Hypotheses Development

Through this study, we propose a nomological network among performance of service and manufacturing firms, agility at the operation and strategic levels, and organizational competence on IT resources. Figure 1 shows our research model.

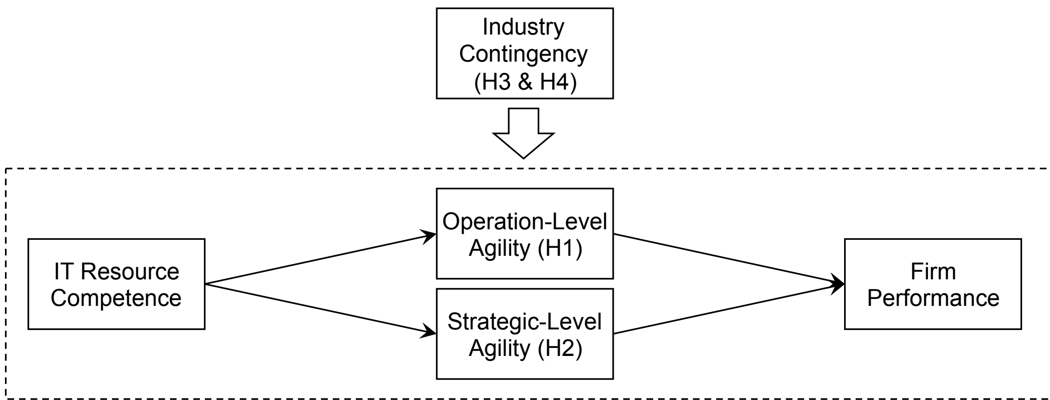


Figure 1. Research Model

3.1 IT Resource Competence

IT resources are fundamental to the growth of contemporary businesses (Weiss, Thorogood, & Clark, 2006). Drawing on RBV, research has argued organizational competence based on IT resources enables firms to innovate, which leads to superior performance (Bharadwaj, 2000; Davenport & Short, 1990; Mata et al., 1995; Sambamurthy et al., 2003; Wade & Hulland, 2004). Adopting this perspective, we focus on a firm's IT competence. Previous studies have defined IT competence in various ways. For example, Chakravarty et al. (2013) defines IT competence as IT infrastructure and IT capabilities, while Sambamurthy et al. (2003) defined it as IT investments, IT infrastructure, IT human capital, and IS/business partnerships. In this study, we exclusively focus on IT-based resources as the source of a firm's IT competence and conceptualize IT resource competence as the extent to which a firm possesses effective IT-based resources. IT resource competence is the key enabler of business innovation and superior firm performance (Mata et al., 1995; Sambamurthy et al., 2003). Since IT resource competence is heterogeneously distributed across firms, developed over longer periods of time, and based on socially complex relations in a firm, it is difficult and costly to imitate. As such, it serves as a powerful weapon in sustained competitive advantage (Mata et al., 1995).

A firm's IT resource competence reflects how effectively it deploys various IT resources, such as hardware, software, IT personnel, and IT-facilitated knowledge (Bharadwaj, 2000; Sambamurthy et al., 2003). Adopting a well-accepted IT resource categorization scheme (Bharadwaj, 2000; Mata et al., 1995), we conceptualize IT resource competence as a firm's latent capacity based on IT infrastructure (tangible resource), IT planning skills (human IT resource), and IT-based knowledge management (intangible resource). We define IT infrastructure as the common enterprise-wide technology platform for networking and database services in a firm (Bharadwaj, 2000). It serves as the resources for a firm's innovation and continuous improvement. IT planning skills are a human-based resource for discovering opportunities that IT provides and aligning IT planning with business objectives (Karimi, Somers, & Gupta, 2001). A firm with strong IT planning skills can more effectively align its IT and business-planning processes, develop reliable and cost effective applications, and support its business needs (Copeland & McKenney, 1988). Lastly, IT-based knowledge management refers to IT services that help firms capture, code, distribute, and share important business knowledge (Kankanhalli, Lee, & Lim, 2011). This intangible IT resource helps organizational divisions share their know-how and capabilities and achieve superior performance

(Bharadwaj, 2000). A firm that successfully achieves these IT resources can control IT costs, deliver required applications when needed, and affect business objectives through IT innovations (Mata et al., 1995; Ross et al., 1996). Therefore, IT resource competence is the vital source of superior firm performance.

Recent studies argue that the relationship between organizational IT resources and business performance should be mediated by business competences. Ravichandran and Lertwongsatien (2005), for example, argue that IT resources support a firm's core competences, such as market-access competence, integrity-related competence, and functional-related competence, and, thus, that IT resources contribute to better firm performance. Tippins and Sohi (2003) also show that, as a business competence, organization-learning capability mediates the relationship between IT investment and performance. These studies emphasize the underlying mechanisms of IT-enabled organizational-capability building that lead to competitive outcomes. In Sections 3.2 to 3.4, we further decompose the relationship between IT resource competence and firm performance and propose underlying mechanisms explaining how IT resource competence leads to firm performance.

3.2 Mediating Effect of Operation-level Agility

Operation-level agility enables a firm to swiftly sense market requirements and modify its routine processes in the focused business model to improve productivity and reduce costs (Sull, 2009). It emphasizes the effectiveness and efficiency of a firm's actions in response to changes in its daily operations, such as making a price change and improving existing processes (Sambamurthy et al., 2003). To be operationally agile, firms must have the capability to collect market intelligence (e.g., customer preferences) in a timely manner, disseminate such intelligence, and respond (e.g., tailoring products and services) accordingly on an organization-wide basis. This capability allows a firm to stay close to its customers, identify emerging needs quickly, and deliver new products and services in a timely manner (Ravichandran & Lertwongsatien, 2005). Moreover, to respond to changes and unexpected events, firms must be able to adjust internal business routines and mobilize limited resources on short notice. This ability to reconfigure business operations allows firms to assemble their internal activities and resources in different ways when necessary (Pavlou & El Sawy, 2006). Such agile integration of existing resources and operations into "novel" combinations to better match their market needs helps them respond quickly to external changes. To be agile at the operation level in the contemporary business environment, firms should also have strong supplier-management capabilities to quickly locate needed resources, negotiate terms, and be able to trust and rely on partners for speed and quality (Braunscheidel & Suresh, 2009). This capability of supplier management also helps firms manage sudden fluctuations of the market much better than if they did not have such a capacity.

We conceptualize operation-level agility as a multidimensional higher-order capability comprising three operation-level capabilities: market-responding capability, operational reconfigurability, and supplier-management capability. Market-responding capability refers to a firm's ability to obtain real-time information about market changes and respond quickly to market requirements to deliver products and services that their customers value (Grewal & Tansuhaj, 2001). Operational reconfigurability refers to a firm's operational capability to reconfigure internal resources and processes to accommodate prompt changes in its operations (Pavlou & El Sawy, 2006). Supplier-management capability refers to a firm's ability to manage its suppliers to quickly change volume allocation among suppliers and acquire requisite services (Swafford, Ghosh, & Murthy, 2006). To be operationally agile, a firm should have these operational capabilities to track and respond to the market in a timely manner by quickly modifying its business routines and using internal resources and external relationships.

IT resource competence for effective deployment of organizational IT resources, such as IT infrastructure, IT planning skills, and IT-based knowledge management, enables operation-level agility, which, in turn, affects firm performance. IT infrastructure implements common transaction processing among business units and, thus, expedites business operations by allowing firms to quickly access and share data across their business processes (Chung, Rainer, & Lewis, 2003; Fink & Neumann, 2009). For example, Zara, one of the world's largest clothing retailers, consistently polishes its capability to respond to market change by investing in its infrastructure to collect real-time market data (e.g., what is selling and what is not) and adjusts its actions accordingly (e.g., design modification) (Sull, 2010). This IT-based capability enables Zara to achieve agility at the operation level. Moreover, by providing standardized technical specifications and interfaces, an effective IT infrastructure allows a business one to easily modify existing business operations and integrate new technologies with them and, thus, allow the business to adopt new capabilities quickly and cost-effectively. Likewise, IT resource competence based on human IT resources is also vital in enabling operation-level agility. For example, research has discussed effective IT planning as an important human-based skill to help a firm design appropriate technology architectures and standards for business applications and manage on-going implementation plans (Feeny & Willcocks, 1998; Scott, 2005). Hence, a firm possessing good IT planning skills properly prioritizes its current IT services to adapt to emerging operational changes. IT-based knowledge management is also a significant part of the digitized business platform of contemporary business process. Such a digitized platform of business knowledge allows "firms to adapt to changing requirements more quickly by changing information-based value propositions, forging value-chain collaborations with partners that competitors cannot easily duplicate, and rapidly exploiting emerging and untapped market niches" (Sambamurthy et al., 2003, p. 243). This IT-based intangible resource can improve a firm's operation-level agility by sharing and assimilating knowledge about emerging market needs, guiding business users to reconfigure available resources when adapting its operations, and identifying the firm's needs and the missing resources so that it can seek help from its suppliers.

In all, a firm's IT resource competence based on its current IT resources (e.g., IT infrastructure, IT planning skills, and IT-based knowledge management) enables agility at the operation level. In turn, this IT-enabled operation-level agility allows the firm to seize operational opportunities, respond to internal and external emerging changes, and sustain its competitive operational edge, which, in turn lead to its superior firm performance. This capability is especially crucial when considering today's ever-changing customer need and trend: "A good decision executed quickly beats a brilliant decision implemented slowly" (Rogers & Blenko, 2006, p. 54).

One can best capture the enabling process of IT resource competence with the mediating perspective. A firm cannot effectively leverage superior IT resource competence for business value if the firm has weak operation-level agility. Operation-level agility, enabled by IT resource, plays an important governing role in the relationship between IT resource competence and firm performance. Such an enabling process describes how and when the positive effects of IT resource competence on business will occur. Therefore, we propose:

Hypothesis 1: Operation-level agility mediates the relationship between IT resource competence and firm performance.

3.3 Mediating Effect of Strategic-level Agility

While operation-level agility deals with daily routines, strategic-level agility enables a firm to make significant long-range changes to its business model and strategy to take advantage of golden opportunities (Sull, 2009). Many environmental changes, such as technical innovations, market upheavals, ecological shocks, and political events, are so substantial that merely improving current business practices is not enough to realize organizational goals and objectives (Kim & Mauborgne, 2005). In such situations, firms need to modify their long-range strategies and make new initiatives that refocus on new resources and capabilities to allow them to access to future opportunities and maintain their sustained competitiveness (Teece et al., 1997; Weill et al., 2002). Strategic-level agility recognizes and seizes such long-range opportunities and turns them into realities. To be strategically agile, firms need flexibility by understanding the trends of marketplace and capability to fully implement their strategic decisions (Hitt, Keats, & DeMarie, 1998; Meredith & Francis, 2000). For this strategic implementation, a firm should not only act in functional and cross-functional dimensions simultaneously but also be able to identify its current and future competences, obtain the requisite resources and capabilities (through either internal development or external sources), and use them to realize new strategies (Braganza & Korac-Kakabadse, 2000; Johnson, Lee, Saini, & Grohmann, 2003). Firms need to rethink current strategic plans, redeploy resources, engage in new technologies, build new competences, and adopt new strategies to gain advantages over their competitors (Hitt et al., 1998). Organizational learning plays a crucial role in these processes because it enables firms to develop the new organizational capabilities necessary for future opportunities rather than just focusing on current competences (Tippins & Sohi, 2003). Hence, organization learning serves as a primary organizational capability on which firms establish and implement their long-range strategies.

Like operation-level agility, we conceptualize strategic-level agility as a multidimensional higher-order capability comprising three strategic-level capabilities: strategic-decision flexibility, strategic-execution capability, and organizational-learning capability. Strategic-decision flexibility refers to a firm's ability to develop strategic choices and change strategies to keep up with business opportunities (Beer & Eisenstat, 2000). Strategic execution capability refers to a firm's capability to realize the chosen strategic decisions through long-range investments in organizational competences and resources (Weill et al., 2002). In addition, since strategic maneuvering requires enterprise-wide and long-range learning in a firm, organizational learning capability (a firm's ability to search for relevant knowledge, acquire new knowledge, assimilate new knowledge, and apply new knowledge (Bhatt & Grover, 2005)) is another essential component of strategic-level agility. To be strategically agile, a firm should have these strategic capabilities to strategically use the requisite resources for its long-range decisions and maneuvers with on-going learning.

IT resource competence can also enable strategic-level agility in a firm by creating strategic synergies across business units and functions, which influences firm performance. An integrated IT infrastructure makes it easier for the firm to strategically integrate new service components and, thus, allows firms to make disruptive and incremental modifications to business processes for new business initiatives (Fink & Neumann, 2009). In contrast, a non-integrated IT infrastructure can severely restrict a firm's strategic business choices. Likewise, human IT resources are vital in enabling strategic-level agility. For example, IT planning skills can help a firm strategically prioritize its various IT-deployment activities (Ravichandran & Lertwongsatien, 2005). Such an IT-planning capability is vital when trying to align IT resources with new business strategies. Furthermore, IT-based knowledge management facilitates learning in a firm so it can better understand its current status among its competitors. It can help the firm obtain deep insights into the current economic environment, market competition, and future trends. Thus, with IT-based knowledge management, firms can be better prepared for their future strategic movements.

In all, a firm's IT resource competence based on its current IT resources enables agility at the strategic level. In turn, this IT-enabled strategic-level agility enables its competitive strategic movements and, thus, leads to its superior firm performance (Hitt et al., 1998; Sambamurthy et al., 2003). We represent this IT-enabling process using the mediating process. Therefore, strategic-level agility also mediates the positive effects of IT resource competence on business performance. Based on these arguments, we propose:

Hypothesis 2: Strategic-level agility mediates the relationship between IT resource competence and firm performance.

3.4 Industry Contingency: Manufacturing versus Service

Drawing on the environmental contingency perspective, we further argue that the role of agility enabled by IT at the operation and strategic levels differs across manufacturing and service settings. As Roth and Menor (2003) point out, business processes in traditional manufacturing firms affect consumers mainly through their products, which are usually physical goods. In manufacturing settings, business competence is usually restrained by physical constraints, such as location, resource availability, and delivery time. Thus, traditionally, manufacturing firms experienced great pressure to achieve operational optimization, such as cost reduction, productivity improvement, and quality products. To achieve such operational superiority, manufacturing industries introduced many techniques of operational leanness and flexibility, such as just-in-time manufacturing (JIT), total quality management (TQM), and lean manufacturing (Yusuf et al., 2004).

Contemporary manufacturing firms, however, now experience new business challenges in both production and sales predominantly because of business globalization, diverse and complex customer preferences, and cultural and regulation differences among their global sites and/or global partners. Moreover, the manufacturing industry's adopting e-commerce transformed the industry's business model. E-commerce allows manufacturing firms to connect directly with their customers without any intermediaries (e.g., wholesalers and retailers), which requires manufacturing firms to add service features (Andal-Ancion, Cartwright, & Yip, 2003)—a phenomenon that Neely (2009) calls servitization (Neely, 2009). As a result of this trend, manufacturing firms evolved from being mere product providers to being solution providers. Thus, their business focus changed from operating transactions to seeking business partnerships for strategic movements. Manufacturing firms that cannot confront these industrial changes fail to sustain their market competitiveness (Kim & Mauborgne, 2005). Kim and Mauborgne (2005) argue that firms in the highly mature and standardized business environment need a strategic departure from their existing competences and business practices. Hence, in contemporary manufacturing settings, strategic-level agility has become more significant for attaining superior firm performance, while operation-level agility has lost value. Therefore, when considering IT's enabling role for the strategic-level agility, the importance of IT-enabled agility processes at the strategic level should be more salient under manufacturing settings.

In contrast, service firms have traditionally focused on achieving superior strategic capabilities in developing and delivering new services to meet evolving and diversifying customer preferences

(Braganza & Korac-Kakabadse, 2000). However, service firms now experience new areas of business challenges, including the great pressure of improving operational productivity (Chase & Apte, 2007). Unlike manufacturing where tasks usually involve well-defined processes based on predefined specifications and are facilitated by some form of automation, service industries are likely to face more challenges and uncertainties at the operational level. Accordingly, researchers on service operations have addressed the significance of operational capabilities in current fast-changing service industries (Chase & Apte, 2007; Roth & Menor, 2003). In the highly competitive and already mature insurance market, for example, Progressive, an automobile insurer in North America, achieved successful growth (from US$1.3 billion in 1991 to US$9.5 billion in 2003 in sales) mainly through its operational innovation in claims processing (i.e., the onsite claiming and approval process (Hammer, 2004)). In addition to such operational innovations, a firm must continually improve its operations to make its operations flexible, which is necessary to effectively respond to the high variability of customer demands in service industries (Verdü-Jover et al., 2004). Moreover, because IT is becoming a digitized platform of business operations, a firm's operational intelligence furnished by superior customer-information processing is becoming more important, particularly for service-oriented firms.

The traditional perspective on strategic capabilities in service settings, therefore, is being challenged. Since service firms have various customer and user communication channels to detect emerging market requirements (Roth & Menor, 2003), they may generate strategic maneuvers easily and frequently. Their strategic initiatives, however, would fail without operation-level capabilities to apply their strategies through daily routines and adapt the strategies to ever-changing market requirements (Bharadwaj & Sambamurthy, 2005). Hence, in contemporary service settings, operation-level agility is becoming more significant in realizing business value. Therefore, when considering IT's enabling role for operation-level agility, the importance of IT-enabled agility process at the operation level should be more salient under the service settings.

In all, due to the emerging business trends and unique market challenges that manufacturing and service industries face, IT-enabled operation-level agility has become more important in contemporary service settings, while IT-enabled strategic-level agility has become more important in contemporary manufacturing settings. Based on these arguments, we propose:

Hypothesis 3: The value of IT-enabled operation-level agility on firm performance in service settings is higher than in manufacturing settings.

Hypothesis 4: The value of IT-enabled strategic-level agility on firm performance in manufacturing settings is higher than in service settings.

4 Research Method

To test the proposed hypotheses, we conducted a large-scale survey with firms in both manufacturing and service industries in the United States. The survey method is an effective approach to collect data and discover relationships among research constructs with theoretically defined research model and measurements (Sekaran & Bougie, 2013). As a quantitative research methodology, the survey method helps confirm or reject hypotheses with certain confidence (Huff, 2009). This method allows greater anonymity and wide access to geographically and environmentally dispersed samples, which reduces biasing error (Frankfort-Nachmias & David, 1996). Hence, organizational behavioral research has frequently used the survey method (Stone, 1987). We developed our research model based on theory and proposed hypotheses to test. Our research also requires the diversified industrial settings and large samples so that the results can be generalized. Therefore, we believe this method fits our research.

4.1 Construct Operationalizations

We operationalized the principal research constructs and control variables based on our conceptual development and the relevant literature. First, in our conceptualization, firm performance refers to a firm's comparative superiority in its business. Thus, we operationalized this construct as perceived comparative performance, such as profitability and market share, which research has considered a good indicator of business superiority (e.g., Ravichandran & Lertwongsatien, 2005; Tippins & Sohi, 2003).

Second, we conceptualized operation-level agility as a multidimensional higher-order construct comprising three operation-level capabilities (i.e., market-responding capability, operational reconfigurability, and supplier-management capability). Since each of these three operational capabilities represents a unique portion of operation-level agility and since they aggregately cause this high-level operational capability, we modeled operation-level agility as a multidimensional construct that has a formative relationship with its three subconstructs (Edwards, 2001; Petter, Straub, & Rai, 2007)[1]. Like operation-level agility, we also conceptualized strategic-level agility as a multidimensional higher-order construct comprising three strategic-level capabilities (i.e., strategic-decision flexibility, strategic-execution capability, and organizational-learning capability). Since each of these three strategic capabilities represents a unique portion of strategic-level agility and since they aggregately cause this high-level strategic capability, we also modeled strategic-level agility as a multidimensional construct that has a formative relationship with its three subconstructs (Edwards, 2001; Petter et al., 2007).

Third, we conceptualized a firm's IT resource competence as a higher-order latent capacity that reflects on existing organizational IT resources as its subconstructs, which include IT infrastructure (tangible), IT planning skills (human), and IT-based knowledge management (intangible). Unlike the two levels of agility, we define IT resource competence as a reflective higher-order construct because we consider the proposed three subconstructs as outcomes of a firm's competence on its IT resource investment and implementation rather than as its cause dimensions (Petter et al., 2007).

Last, we considered two control variables for our research model. We controlled a potential effect of market turbulence on the actual payoff of firms' investments and maneuvers. We operationalized this variable as frequent and quick changes in customer preference, marketing practices, and new products (Pavlou & El Sawy, 2006). We also controlled a potential effect of firm size on our dependent variable because it would offer either organizational synergy or managerial diseconomies (Tanriverdi, 2005). We used the number of employees to measure the size of our samples (Ravichandran & Lertwongsatien, 2005).

4.2 Measurement Development

For our measurement development, we made every possible attempt to use existing measurements that have good psychometric measurement properties. We modified existing items to suit the context of the study. To ensure the construct validity of the modified and self-developed items, we performed Moore and Benbasat's (1991) conceptual validation procedure. We conducted three rounds of a structured sorting process. In each round, we invited three to four new judges comprising academic staff and industry managers. Based on the sorting results, we made changes to the survey instrument after each round. The final item placement scores (IPS) for our measurement items reached over 90 percent. Table 1 shows the final measurement items of all research constructs and their sources.

Table 1. Measurement Items and Sources

Measurement Items	Sources
Firm performance 1. Our customer retention rate is high relative to all other direct competitors. 2. Our sales growth rate is high relative to all other direct competitors. 3. Our profitability is high relative to all other direct competitors. 4. Our return on investment rate is high relative to all other direct competitors.	Adopted from Tippins & Sohi (2003)
Market responding capability 1. Our organization's capability in obtaining real-time information about changes of market is strong. 2. Our organization's capability enables us to respond quickly to our market requirements. 3. Our organization's capability in delivering products and services on time is strong. 4. Our organization's capability enables us to quickly meet market demands.	Adapted from Grewal & Tansuhaj (2001)

[1] Formative constructs require 1) causality direction from subconstructs to the latent construct, 2) non-interchangeability, 3) no covariance assumption, and 4) no requirement of the same antecedents and consequences among the subconstructs (Petter et al., 2007). Our operationalization of operation-level agility considered the three operational capabilities (i.e., market-responding capability, operational reconfigurability, and supplier-management capabilities) as non-interchangeable because they represent distinctive dimensions of operation-level agility, such as customer-oriented capability, internal process-oriented capability, supplier-oriented capability. Hence, they do not require covariance and same antecedent/consequence assumptions. Moreover, the three operational capabilities combine to produce organizational agility at the operation level, which means that the subconstructs cause their latent construct (Edwards, 2001). The same arguments apply to strategic-level agility. In particular, each of the three subconstructs of strategic-level agility (i.e., strategic-decision flexibility, strategic-execution capability, and organizational-learning capability) represents three distinct strategic capabilities.

Table 1. Measurement Items and Sources

Operational reconfigurability 1. Our organization can quickly reallocate our operational resources (e.g., technology, human, and process) to deal with emerging changes. 2. Our organization can effectively combine existing resources to address emerging challenges. 3. Our organization can timely redesign business processes to accommodate emerging challenges. 4. Our organization can easily reconfigure our processes to handle emerging changes.	Derived from Pavlou & El Sawy (2006)
Supplier management capability 1. Our organization can change volume allocation among our suppliers. 2. Our organization can acquire services and products from potential suppliers when we need them. 3. Our organization can influence suppliers' ability to implement required changes. 4. Our organization can quickly change suppliers as we need it.	Adapted from Swafford et al. (2006)
Strategic decision flexibility 1. Our organization is capable of developing strategic choices. 2. Our organization is capable of switching gears at the strategic level to cope with opportunities. 3. Our organization is capable of changing strategies to keep up with business opportunities. 4. Our organization is flexible to make strategic choices.	Derived from Beer and Eisenstat (2000)
Strategic execution capability 1. Our organization is capable of realizing strategic changes. 2. Our organization is capable of making strategic investments based on strategic decisions. 3. Our organization can effectively leverage our resources to execute new strategies. 4. Our organization is capable of realizing new capabilities to fulfill our long-term goals.	Derived from Weill et al. (2002)
Organizational learning capability 1. Our organization is able to search relevant knowledge. 2. Our organization is able to acquire new knowledge. 3. Our organization is able to assimilate new knowledge. 4. Our organization is able to apply new knowledge.	Adopted from Bhatt & Grover (2005)
IT infrastructure 1. The technology infrastructure needed to electronically link our business units and business partners is present and in place today. 2. The capacity and speed of our network adequately meets our current business needs. 3. The speed of corporate data access meets our current business needs.	Adapted from Ravichandran & Lertwongsatien (2005)
IT planning skills 1. Our IT manager continuously examines the innovative opportunities that IT can provide. 2. Our IT manager is adequately informed on the strategic use of potential IT by competitive forces (e.g., buyers, suppliers, and competitors) in our industry. 3. Our IT manager has an adequate long-term picture of the coverage and quality of potential IT systems.	Adapted from Karimi et al. (2001)
IT-Based knowledge management 1. Our IT systems effectively and efficiently facilitate capturing important business knowledge. 2. Our IT systems effectively and efficiently support coding (or packaging) important business knowledge. 3. Our IT systems effectively and efficiently leverage distributing important business knowledge. 4. Our IT systems effectively and efficiently promote sharing important business knowledge.	Adopted from Kankanhalli et al. (2001)
Industry type • A categorical variable of manufacturing versus service industry	Adopted from Frohlich & Westbrook (2002)
Market turbulence 1. In our kind of business, customers' product preferences change a lot over time. 2. Marketing practices in our industry area are constantly changing. 3. New product introductions are very frequent in our market.	Adopted from Pavlou & El Sawy (2006)
Firm size • Number of employees	Adopted from Ravichandran & Lertwongsatien (2005)
* We measured all survey items (except industry type and firm size) on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).	

4.3 Survey Procedure

We targeted our samples according to a series of criteria congruent with the study's context (Stone, 1987). We referred to the North American Industry Classification Systems (NAICS) to define the industry categories of our target samples and followed the manufacturing and service categorization scheme that Frohlich and Westbrook (2002) suggest. Considering the context of our research (i.e., IT-enabled agility and firm performance), we focused on industries that rely heavily on IT to support their business operations. Moreover, we excluded companies with fewer than ten employees from our sample because such small companies may not provide an appropriate setting for investigating high-level capabilities in their operations, strategic movements, and IT service.

After defining the target samples, we conducted a large-scale survey using a Web-based tool. We sent survey invitations to business executives (e.g., presidents, chief executive officers, chief operating officers, business directors) of sample firms in the target industries. We randomly invited around 1,000 executives in an industrial respondent pool to participate in th3 survey. We used random sampling because it helps eliminate sample bias (Cooper & Schindler, 1998; Stone, 1987).

5 Results

We used the partial least squares method to structural equation modeling (PLS-SEM) to test our hypotheses primarily due to the formative nature of the key constructs (Chin, 1998). We used a total of 195 complete data samples to test the hypotheses—the number that remained after we removed small companies, incomplete data, and other inappropriate data, such as responses from non- or different managerial positions (e.g., chief information officer)[2]. The final samples represent six manufacturing-industry types (n = 79) (consumer products (47), communications equipment (12), chemicals (8), computers/hi-tech (7), automotive (3), and biological products (2)) and five service-industry types (n = 116) (healthcare services (59), banking/insurance (38), consulting (16), marketing (2), and accounting (1)). Table 2 shows the demographics of the final samples for this research.

Table 2. Demographics of the Final Samples (n = 195)

Characteristics	Types / categories	Count	Percentage
Industry: manufacturing	Consumer products	47	24.10%
	Communications Equipment	12	6.15%
	Chemicals	8	4.10%
	Computers / hi-tech	7	3.59%
	Automotive	3	1.54%
	Biological Products	2	1.03%
Industry: service	Healthcare services	59	30.26%
	Banking / insurance	38	19.49%
	Consulting	16	8.21%
	Marketing	2	1.03%
	Accounting	1	0.51%
Employees	11–50 employees	38	19.49%
	51–250 employees	46	23.59%
	251–1000 employees	22	11.28%
	More than 1000 employees	89	45.64%
Revenue (US $)	Less than 10 million	53	27.18%
	10–50 million	36	18.46%
	51–500 million	39	20.00%
	501–1 billion	13	6.67%
	More than 1 billion	54	27.69%

[2] Although we initially also gathered data from IT executives (n = 53), we used only the samples from the business executives for our model tests mainly because we thought the business executives better represent the principal constructs of the proposed model, especially the two levels of agility and firm performance. To check any selection bias, we repeated all analyses using the combined data set that involving both the business and IT executive samples (n = 248) and achieved the identical results.

5.1 Measurement Model Evaluation

One can determine convergent validity of the reflective measures in three ways: 1) the item reliability of each measure, 2) the composite reliability of the construct, and 3) the average variance extracted (AVE) of the construct. Results reported in Table 3 indicate that all measures demonstrated adequate convergent validity (i.e., over .70 for reliability and over .50 for AVE) (Fornell & Larcker, 1981).

Table 3. Results of Convergent Validity Test for Research Constructs

Constructs	Mean (S.D.)	Item reliability	Composite reliability	AVE
Firm performance (FP)			.88	.65
FP1	5.32 (1.39)	.70		
FP2	4.69 (1.42)	.86		
FP3	4.58 (1.42)	.83		
FP4	4.56 (1.36)	.84		
Market responding capability (MR)			.90	.69
MR1	4.72 (1.38)	.79		
MR2	4.44 (1.44)	.83		
MR3	4.97 (1.52)	.83		
MR4	4.67 (1.40)	.89		
Operational reconfigurability (OR)			.94	.79
OR1	4.38 (1.50)	.86		
OR2	4.70 (1.33)	.89		
OR3	4.31 (1.44)	.89		
OR4	4.39 (1.50)	.91		
Supplier management capability (SM)			.87	.63
SM1	4.53 (1.26)	.76		
SM2	5.12 (1.27)	.84		
SM3	4.78 (1.521)	.76		
SM4	4.67 (1.51)	.81		
Strategic decision flexibility (SD)			.93	.78
SD1	5.06 (1.26)	.80		
SD2	4.88 (1.25)	.92		
SD3	4.89 (1.22)	.93		
SD4	4.74 (1.38)	.87		
Strategic execution capability (SE)			.93	.77
SE1	4.84 (1.27)	.87		
SE2	4.86 (1.34)	.88		
SE3	4.74 (1.28)	.90		
SE4	4.89 (1.25)	.86		
Organizational learning capability (OL)			.94	.80
OL1	5.33 (1.29)	.88		
OL2	5.46 (1.29)	.90		
OL3	5.25 (1.30)	.92		
OL4	5.17 (1.36)	.87		
IT infrastructure (IF)			.93	.81
IF1	4.48 (1.62)	.82		
IF2	4.39 (1.68)	.93		
IF3	4.40 (1.63)	.94		
IT planning skills (PS)			.95	.87
PS1	4.07 (4.56)	.93		
PS2	4.08 (1.49)	.94		
PS3	4.21 (1.59)	.92		
IT-enabled knowledge infrastructure (KI)			.96	.85
KI1	4.19 (1.44)	.91		
KI2	4.06 (1.39)	.92		
KI3	4.12 (1.39)	.94		
KI4	4.13 (1.40)	.91		
Market turbulence (MT)			.88	.71
MT1	4.45 (1.74)	.81		
MT2	4.99 (1.42)	.87		
MT3	4.79 (1.71)	.85		

One infers discriminant validity when the square root of each construct's AVE is higher than the correlation of the construct to other latent variables (Fornell & Larcker, 1981). As Table 4 shows, all the diagonal values (i.e., the square root of each construct's AVE) were higher than their correlations with other constructs. This result implies that each of the constructs shared greater variance with its own block of measures than with other constructs representing a different block of measures (Chin, 1998). Therefore, this result satisfies discriminant validity for the measures used in this study.

Table 4. Results of Discriminant Validity Test for Research Constructs

Constructs	FP	MR	OR	SM	SD	SE	OL	IF	PS	KM	MT	SZ
Firm performance (FP)	**.81**											
Market responding capability (MR)	.53	**.83**										
Operational reconfigurability (OR)	.42	.64	**.89**									
Supplier management capability (SM)	.30	.50	.47	**.79**								
Strategic decision flexibility (SD)	.50	.70	.72	.51	**.88**							
Strategic execution capability (SE)	.50	.65	.68	.53	.78	**.88**						
Organizational learning capability (OL)	.34	.61	.55	.47	.66	.69	**.89**					
IT infrastructure (IF)	.20	.31	.36	.26	.32	.37	.42	**.90**				
IT planning skills (PS)	.24	.34	.24	.28	.25	.32	.38	.45	**.92**			
IT-based knowledge management (KM)	.20	.38	.30	.29	.28	.33	.38	.54	.72	**.93**		
Market turbulence (MT)	.20	.19	.20	.20	.19	.20	.19	.23	.28	.29	**.84**	
Firm size (SZ)	.00	-.11	-.24	-.05	-.13	-.02	-.07	.05	.08	-.03	.05	**1.00**

* Diagonal elements in this correlation matrix of research constructs are the square root of the average variance extracted (AVE).

Based on these validity results for the directly observed research constructs[3], we developed the higher-order constructs (i.e., operation-level agility, strategic-level agility, and IT resource competence). Following Chin (1998), we formed these higher-order constructs using the factor scores of their subconstructs. In this study, we operationalized operation-level and strategic-level agility as the formative multidimensional constructs. Following Petter et al. (2007), we validated their formative relationships with their subconstructs. First, the weightings of all three higher-order items for each of both operation-level and strategic-level agility (i.e., the factor scores of their subconstructs) were significant (at least at the .05 level). The significant weightings of the three subconstructs confirmed their unique contributions to their higher-order constructs (i.e., operation-level and strategic-level agility) (Petter et al., 2007). Second, we also examined the variance inflation factor (VIF) scores of the subconstructs. The VIF scores of the subconstructs of operation-level agility (1.40~1.85) and strategic-level agility (2.06~2.94) satisfied the recommended condition. On the other hand, the validity of IT resource competence as a reflective higher-order construct was confirmed with its reflective loadings (.76~.90), composite reliability (.88), and AVE (.72).

[3] We further conducted supplemental analyses to address a potential for multicollinearity using the variance inflation factor (VIF). The VIF scores of all the principal constructs are between 1.518 and 3.584. Therefore, we conclude that our model is free from the multicollinearity concern. Harman's single-factor analysis was also conducted to test a potential for common-method variance. The exploratory factor analysis (EFA) of our principal constructs discloses nine distinct factors (with Eigen value of over 1), which explains similar amounts of the total variance of 73%, ranging from 6.10% to 11.74%. This result indicates that our data do not suffer from common-method variance.

5.2 Hypotheses Tests

We calculated estimated path effects and associated t-values using the bootstrapping routine in SmartPLS 2.0 (Ringle, Wende, & Will, 2005). Using the entire data set (n = 195), we first tested the mediating effects of operation-level and strategic-level agility between IT resource competence and firm performance (H1 and H2) by following Shrout and Bolger's (2002) mediation test approach. Next, we tested the idiosyncratic values of IT-enabled operation-level agility and strategic-level agility under different industrial settings (H3 and H4) using a subgroup analysis approach (Chin, 2003; Venkatraman, 1989).

According to Shrout and Bolger (2002), first, if an independent variable is theoretically related with a dependent variable, one must demonstrate evidence for the direct path. Second, the independent variable must relate to the mediator. Third, the mediator must relate to the dependent variable after controlling for the independent variable. Fourth, one must demonstrate evidence for the indirect path. Fifth, to claim full mediation (like our case), the relationship between the independent variable and the dependent variable should be null in the presence of the mediator. Finally, the strength of mediation using effect ratio needs to be assessed especially for the case of no strong evidence of suppression by the mediator. Table 5 shows the results of our mediation test.

Table 5. Results of Direct and Mediating Effect Test (n=195)

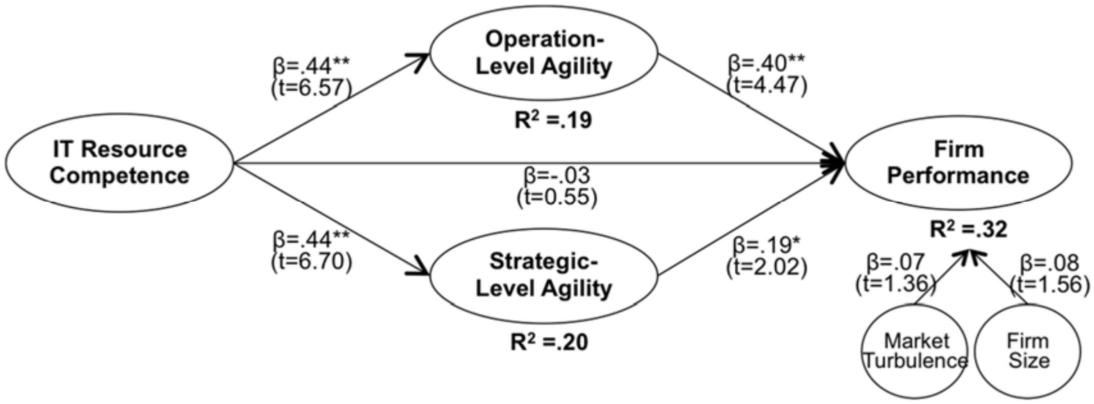
Mediation path	**Step 1: estimate bivariate X → Y path (*c*)**	**Step 2: estimate bivariate X → M path (*a*)**	**Step 3: estimate M → Y path with X → Y held constant (*b*)**	**Step 4: estimate indirect X → M → Y path (*a*×*b*)**	**Step 5: estimate X → Y path with M → Y held constant (*c'*)**	**Step 6: assess strength of mediation using effect ratio**
Operation-level agility	β_c = .22** (t = 3.31)	β_{oa} = .45** (t = 7.01) SE = .06	β_{ob} = .54** (t = 8.99) SE = .06	$\beta_{oa} \times \beta_{ob}$ = .24** (t = 5.51)	$\beta_{c'}$ = .00 (t = .08)	P_{OM} = 1.11 (> 1.00)
Strategic-level agility	β_c = .22** (t = 3.31)	β_{sa} = .48** (t = 8.58) SE = .06	β_{sb} = .50** (t = 7.59) SE = .07	$\beta_{sa} \times \beta_{sb}$ = .24** (t = 5.71)	$\beta_{c'}$ = .05 (t = 1.00)	P_{SM} = 1.10 (> 1.00)

X = IT resource competence (independent variable)
Y = firm performance (dependent variable)
M = operation-level agility or strategic-level agility (mediating variable)
β_o = path coefficient for operation-level agility
β_s = path coefficient for strategic-level agility
SE = standard error of β
Step 4. $t = \beta_a x \beta_b / \sqrt{\beta_b^2 SE_a^2 + \beta_a^2 SE_b^2}$
Step 6. $P_M = (a \times b)/c$
** p < .01, * p < .05

The step 1 test results in Table 5 show the significant direct effect of IT resource competence on firm performance (at the 0.01 level). The test results of step 2 and step 3 also show the significant relationships among IT resource competence, both operation-level and strategic-level agility, and firm performance (at the .01 level). In step 4, we tested the significances of the indirect paths (i.e., the mediation paths) using Sobel's (1982) standard errors test. In step 5, the relationship between IT resource competence and firm performance became insignificant (i.e., null) when we introduced each of operation-level agility and strategic-level agility. However, since the residual direct effect of the mediation path of strategic-level agility ($\beta_{c'}$ = .05) was still positive although insignificant, we further assed the strength of mediation. For both mediation paths, the mediation strengths were over 1.00, which is strong evidence of suppression. Therefore, the two levels of agility fully mediated the link between IT resource competence and firm performance. The results indicate that IT resource competence is a significant enabler of both operation-level and strategic-level agility and, in turn, that the two levels of IT-enabled agility significantly lead to higher firm performance. Therefore, the H1 and H2 were supported.

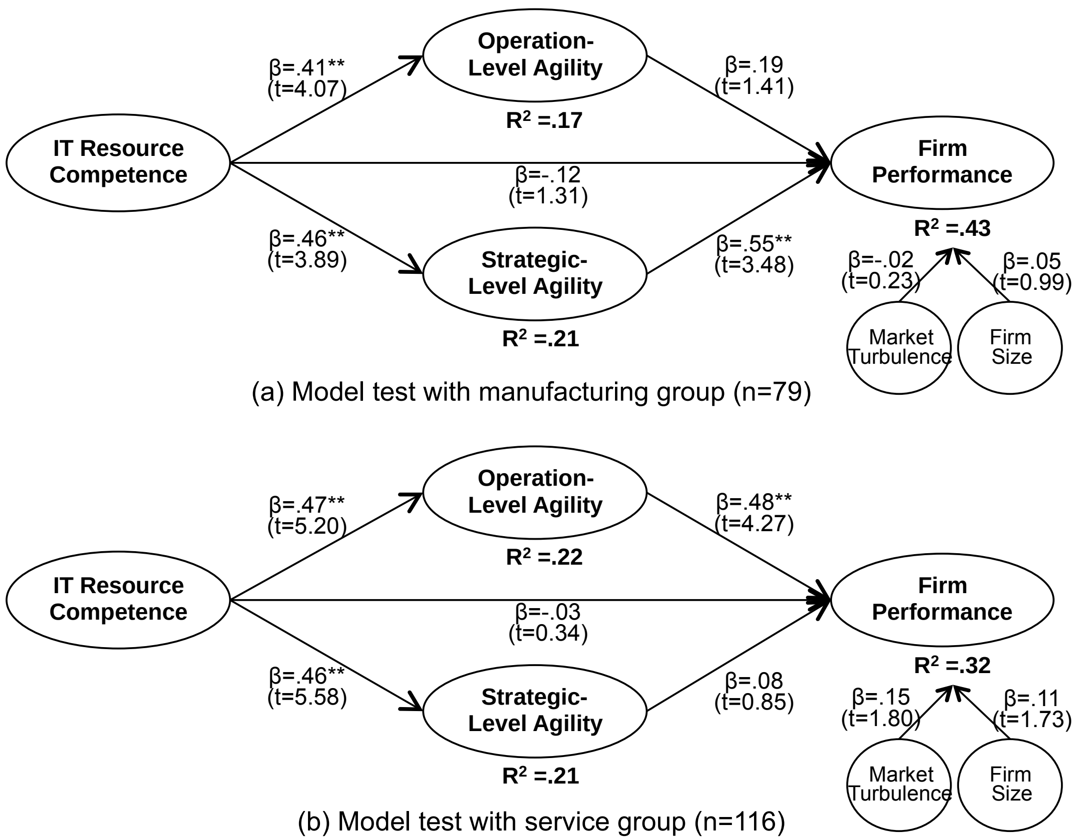
Figure 2 shows the results of our full model analysis using the entire dataset, which are consistent with the above mediation test results (i.e., the significant mediation effects of the two levels of agility and the insignificant residual direct effect that became negative when introducing the two levels of agility).

To test H3 and H4 (the contingent value of the two levels of IT-enabled agility in manufacturing and service settings), we adopted the subgroup analysis for path comparisons by dividing the samples by their industry type (Chin, 2003; Venkatraman, 1989) (i.e., manufacturing (n = 79) and service (n = 116) industries). Figure 3 shows the results of the subgroup test.



** p < .01, * p < .05

Figure 2. Results of Full Model Analysis with Entire Dataset (n = 195)



** p < .01, * p < .05

Figure 3. Results of Subgroup Test

As Figure 3 shows, in manufacturing settings, only strategic-level agility was a significant determinant of firm performance (at the .01 level); in service settings, only operation-level agility was a significant determinant of firm performance (at the .01 level). The two levels of agility explained 43 percent of the variance of firm performance in manufacturing settings and 32 percent in service settings. Following Chin (2003), we tested the statistical difference of the path coefficients of the two levels of agility for each of the industry groups (also see Sia et al., 2009). Table 6 shows the results.

The results in Table 6 confirm the significant difference of the effects of operation-level and strategic-level agility on firm performance under the different industry settings. In particular, the effect of operation-level agility on firm performance was significantly stronger in service settings than in manufacturing settings (at the .05 level). On the other hand, the effect of strategic-level agility on firm performance was significantly stronger in manufacturing settings than in service settings (at the .05 level). Therefore, H3 and H4 were supported.

Table 6. Results of Path Comparisons

Paths	Manufacturing group (N_m = 79)	Service group (N_s = 116)	Path comparison results
Operation-level agility → firm performance	β_m = .19 (SE = .16)	β_s = .48** (SE = .11)	$\|\Delta\beta\|$ = .29* (t = 1.99, p < .05) Significantly stronger effect in service settings
Strategic-level agility → firm performance	β_m = .55** (SE = .16)	β_s = .08 (SE = .12)	$\|\Delta\beta\|$ = .47** (t = 2.96, p < .01) Significantly stronger effect in manufacturing settings

$t = (\beta_m - \beta_s) / [S_{spooled} \times \sqrt{(1/N_m + 1/N_s)}]$
$S_{sooled} = \sqrt{\{[(N_m - 1)^2/(N_m + N_s - 2)] x SE_m^2 + [(N_s - 1)^2/(N_m + N_s - 2)] x SE_s^2\}}$
β_m = path coefficient of manufacturing group
β_s = path coefficient of service group
SE_m = standard error of β_m, SE_s = standard error of β_s
N_m = sample size of manufacturing group, N_s = sample size of service group
** p < .01, * p < .05

To better understand the idiosyncratic value of the IT-enabled agility building processes in different industry settings, we further examined the mediation effects of two levels of agility under the manufacturing and service settings and found that, in manufacturing settings, only strategic-level agility was a significant mediator between IT resource competence and firm performance (mediation effect = .25, t = 2.17, p < .05). On the other hand, in service settings, only operation-level agility was a significant mediator (mediation effect = .23, t = 3.20, p < .01). Interestingly, in manufacturing settings, IT resource competence had a slightly higher effect on strategic-level agility than on operation-level agility ($|\Delta\beta|$ = .05). In service settings, IT resource competence had a slightly higher effect on operation-level agility than on strategic-level agility ($|\Delta\beta|$ = .01). These findings appear to be consistent with H3 and H4.

6 Discussion and Contributions

The results of our hypothesis tests indicate that a firm's IT resource competence, which the three IT components (i.e., IT infrastructure, IT planning skills, and IT-based knowledge management) reflect, contributes to superior firm performance. Our results from a mediation test further indicate that the mediated IT-enabled agility at the operation and strategic levels causes this positive effect.

The findings support the IT resource-based view that a firm's competence to deploy effective IT resources and, thus, to provide its requisite IT services leads to superior performance (Bharadwaj, 2000; Mata et al., 1995). The findings are also consistent with the IT-enabled capability-building perspective that a firm's IT resources are sources of its high-level dynamic capabilities and, thus, lead to the firm's competitive performance (Sambamurthy et al., 2003; Tippins & Sohi, 2003). In particular, the findings provide empirical evidence for the conceptual premise that IT enables organizational agility at various levels in firms (Sambamurthy et al., 2003). The findings also indicate that the IT-enabled agility is a full mediator between IT and firm performance, which further highlights the importance of IT-enabled capability-building processes in achieving organizational competitiveness.

Further analyses with segregated industry datasets, however, showed that strategic-level agility was significantly stronger in determining firm performance in manufacturing than in service settings. Moreover, as we hypothesized, operation-level agility was significantly stronger in determining firm performance in service settings than in manufacturing settings. These findings appear to diverge from conventional wisdom regarding the roles of operational and strategic capabilities in specific industrial settings. Traditionally, manufacturing industries emphasized operation-level capabilities, such as leanness, production flexibility, and speed of operational processes (Dove, 1992; Yusuf et al., 2004). In contrast, service settings seldom highlighted operation-level capabilities and instead favored strategic-level capabilities (Meredith & Francis, 2000). As the business environments of the two industries evolved, however, the importance of operation-level capabilities in service settings and strategic-level capabilities in manufacturing settings generated considerable interests (e.g., Chase & Apte, 2007; Miles & Snow, 2007; Roth & Menor, 2003). Hence, our findings may prove to be meaningful especially when considering emerging challenges in global and digital business environments. With regards to the current difficulties in U.S. manufacturing firms in particular, operation-level agility is likely a necessary but not sufficient success factor. For example, Nokia's strategic inability to move its business focus from traditional mobile phones to smartphones and smartpads has led to its losing significant market share in recent years. In contrast, the business failures in U.S. service industries (e.g., finance industries) in recent years shows that strategic-level agility alone is not enough for service firms' success. Instead, research has highlighted a need for more efforts to improve operational processes in service industries (Chase & Apte, 2007; Roth & Menor, 2003). In line with the new industrial trends and challenges, researchers have turned to the role of IT in specific industrial settings (Bradley, Pridmore, & Byrd, 2006; Kearns & Lederer, 2004). Our findings (i.e., that strategic-level agility has stronger influence in manufacturing firms and that operation-level agility demonstrates stronger influence in service firms) provide new insights regarding IT's role as an enabler of these high-level organizational capabilities that idiosyncratically impact firm performance under different environments.

This study makes several contributions to the literature. First, it contributes to research on agility creation by refining agility at the operation and strategic levels. Several studies have investigated agility by defining it as sensing and responding capabilities in general (Overby et al., 2006; Trinh, 2012). While several studies have also investigated specific functional agility, such as workforce agility, partnering agility, market agility, customer agility, and business process agility (e.g., Lu & Ramamurthy, 2011; Muduli, 2013; Roberts & Grover, 2012; Tallon & Pinsonneault, 2011), few studies have tried to refine agility at different levels of sensing and responding. Drawing on Sull's (2009) preliminary conceptualization of agility at different levels, we advance the understanding of agility by proposing that firms should realize sensing and responding capabilities at the two different levels of organizational decision making and execution to achieve superior performance. At the operation level, the combination of market-responding capability, operational reconfigurability, and supplier management capability is responsible for sensing and responding to short-term, routine changes in the environment. Agility at the operation level is necessary to handle any immediate challenges and opportunities. In contrast, at the strategic level, the combination of strategic flexibility, strategic execution capability, and organizational learning is concerned with sensing and responding to long-range, strategic shifts. Based on conceptually refining agility in these ways, we show, using a large-scale survey, that organizational competence based on available IT resources in a firm is the significant driving force of the two levels of agility, which leads to superior performance. The study serves a conceptual and empirical base of future studies in the relevant areas of organizational agility.

Second, this study contributes to the IT value literature by investigating the idiosyncratic values of IT-enabled agility at the operation and strategic levels under different industrial settings (i.e., manufacturing and service industries). Prior studies at the firm level have provided strong evidence for IT investments' and IT resources' positive impact on IT-enabled business processes, organization capabilities and firm performance (Melville et al., 2007; Overby et al., 2006; Schwarz, Kalika, Kefi, & Schwarz, 2010; Vickery, Droge, Setia, & Sambamurthy, 2010). However, prior studies have not focused on industry heterogeneity: instead, many studies have investigated IT and IT-enabled capabilities in a single or grouped industry setting (e.g., Chae, 2014; Melville et al., 2007). When considering the lack of consideration of such conditional values of organizational IT factors in different industrial settings (Kearns & Lederer, 2004; Melville et al., 2007), our findings can benefit both academics and practitioners. Traditionally, manufacturing firms concentrated on optimizing their operations (e.g., JIT, lean manufacturing) and, thus, their IT value position may focus on supporting their operational capabilities (Liu et al., 2013). On the other hand, service firms concentrated on developing their strategic service and, thus, their IT value position focus on IT's strategic value (Chae, 2014). As the business environments of the two industries evolved, however, these traditional perspectives on organizational value of IT and other relevant capabilities in different industry settings faced new challenges. Our study answers the call for studying industry heterogeneity. Our findings (i.e., that IT-enabled strategic-level agility has stronger influence in manufacturing firms and that IT-enabled operation-level agility demonstrates stronger influence in service firms) provides a useful and timely understanding on the value of IT-enabled organizational capabilities in manufacturing and services settings. Our theoretical development and findings may open a new area of discussion among academics.

This study has practical contributions to organizational deployment of IT resources and capabilities as well. First, this study indicates to that manufacturing firms need to focus more on the role of IT to enable strategic capabilities and gain strategic-level agility for further growth. It also suggests that service firms need to shift their focus to operational improvement and, thus, pay more attention to IT's role to gain operation-level agility. Many times, a firm's organizational inertia based on traditional or historical belief serves as a barrier to the firm's flexible movements (Shimizu & Hitt, 2004). To be agile in today's dynamic business environment, both the manufacturing and service firms need to depart from their traditional perspective on organizational competences and IT investments (Kim & Mauborgne, 2005). Second, this study provides guidance to practitioners seeking to invest their IT resources strategically to achieve agility at both the operation and strategic levels. In particular, our findings imply that a firm needs to achieve IT competence with a balanced investment in tangible, human, and intangible resources to create and improve the two levels of agility. Our findings further indicate the comparative values of IT competence in different industries.

7 Conclusions

In this study, we propose industry-specific relationships among IT resource competence, operation-level and strategic-level agility, and firm performance. We used survey data of medium- to large-size enterprises in manufacturing and service industries of the United States to validate our proposed hypotheses. In general, the results indicate that overall IT resource competence serves as the significant enabler of firm performance mainly through the two levels of agility. For the manufacturing and service industries, however, the two levels of IT-enabled agility showed distinct roles in determining firm performance. Strategic-level agility has a stronger influence in manufacturing firms, while operation-level agility demonstrates stronger influence in service firms. Our findings provide a new insight regarding industry-specific IT values' enabling core organizational capabilities. In particular, our findings show the value of IT-enabled operational capabilities in service firms and the value of IT-enabled strategic capabilities in manufacturing firms, which are timely and meaningful when considering current difficulties in the manufacturing and service industries.

We need further research to augment our findings. First, we used a cross-sectional research design in examining the proposed relationships. Such a snapshot approach may have limitations in terms of studying the causal relationships or time effects between research variables (Bharadwaj, 2000). As such, a longitudinal study or time-series analysis may provide a more accurate investigation of a firm's high-level capabilities, performance outcomes, and environmental dynamics. Second, using structured and uniformed measurements, the survey research method may not be well suited to capturing firms' contextual nuances and subtle behavioral patterns (Kraemer & Dutton, 1991). To augment these potential limitations, alternative research methods (e.g., a series of comparative case studies and field experimentation) would be useful (Frankfort-Nachmias & David, 1996; Myers, 1997). Third, the study's single-respondent survey method may not be the best approach to collect data on different areas or levels of organizational functions (i.e., IT resources versus agility). Separating survey questionnaires to ask about specific expertise associated with different positions may provide more generalizable findings (Lee et al., 2015). This multi-respondent approach can also improve data's validity by integrating respondents' varied observations or perceptions. Last, our binary approach to segregate the samples into manufacturing and service might oversimplify industry differences because each subcategory of manufacturing and service may have a wide range of variation in business processes and strategies. Accordingly, using aggregated dataset in our study might introduce potential bias because of possible firm heterogeneities among the different industry settings. Alternatively, one could define the industry type as a continuous scale by measuring the degree of manufacturing versus service features in one's firm sample.

Researchers could extend our study in several directions. First, we focused on the organization as our unit of analysis. However, in large organizations, some divisions may be more agile than others. Future studies could explore the topic at diverse firm levels (e.g., at the strategic business unit, department, or team levels). Second, we investigated only three types of IT resources: IT infrastructure, IT planning skills, and IT-based knowledge management. Future research could consider other types of IT resources and competences. Third, the main participating companies in the service industry were from the healthcare, banking, and consulting subindustries, while the main participating companies in the manufacturing industry were from the consumer products subindustry. The study results may reflect the trends in these fields. For example, a C-level executive in a highly operationalized healthcare institute who participated in this study might be subject to such trend in the field and, thus, report high operational-level agility and good performance. One could extend our study to compare the overall results against more traditional subindustries that these trends do not impact as much. Lastly, in this study, we tested our research model using subjective measures of our research constructs. Future research could use objective measures and secondary data to provide more objective findings. For example, one could measure firm performance as objective comparative performance by comparing a firm's ROI with its industry average (e.g., Villalonga, 2004). Likewise, one could measure the competence of IT resources using the actual speed of network and computing powers (e.g., Zhu & Kraemer, 2005).

References

Andal-Ancion, A., Cartwright, P. A., & Yip, G. S. (2003). The digital transformation of traditional businesses. *Sloan Management Review*, *44*(4), 34-41.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Beer, M., & Eisenstat, R. A. (2000). The silent killers of strategy implementation and learning. *Sloan Management Review*, *41*(4), 29-40.

Bharadwaj, A. (2000). A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly*, *24*(1), 169-196.

Bharadwaj, A., & Sambamurthy, V. (2005). *Enterprise agility and information technology management: The CIO's manifesto.* SIM Advanced Practices Council Publication.

Bhatt, G. D., & Grover, V. (2005). Types of information technology capabilities and their role in competitive advantage: An empirical study. *Journal of Management Information Systems*, *22*(2), 253-277.

Bogner, W. C., & Bansal, P. (2007). Knowledge management as the basis of sustained high performance. *Journal of Management Studies*, *44*(1), 165-188.

Bradley, R. V., Pridmore, J. L., & Byrd, T. A. (2006). Information systems success in the context of different corporate cultural types: An empirical investigation. *Journal of Management Information Systems*, *23*(2), 267-294.

Braganza, A., & Korac-Kakabadse, N. (2000). Towards a function and process orientation: Challenges for business leaders in the new millennium. *Strategic Change*, *9*(1), 45-53.

Braunscheidel, M. J., & Suresh, N. C. (2009). The organizational antecedents of a firm’s supply chain agility for risk mitigation and response. *Journal of Operations Management*, *27*(2), 119-140.

Chae, B. K. (2014). A complexity theory approach to IT-enabled services (IESs) and service innovation: Business analytics as an illustration of IES. *Decision Support Systems*, *57*, 1-10.

Chakravarty, A., Grewal, R., & Sambamurthy, V. (2013). Information technology competencies, organizational agility, and firm performance: Enabling and facilitating roles. *Information Systems Research*, *24*(4), 976-997.

Chase, R. B., & Apte, U. M. (2007). A history of research in service operations: What’s the big idea? *Journal of Operations Management*, *25*(2), 375-386.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295-336). Manwah, NJ: Lawrence Erlbaum Associates.

Chin, W. W. (2003). A permutation procedure for multi-group comparison of PLS models. In M. Vilares, Tenenhaus, M., Coelho, P. Vinzi Esposito, V., & Morineau, A. (Eds.), *Proceedings of the International Symposium PLS* (pp. 33-43).

Chung, S. H., Rainer, R. K., Jr., & Lewis, B. R. (2003). The impact of information technology infrastructure flexibility on strategic alignment and applications implementation. *Communications of the Association for Information Systems*, *11*, 191-206.

Cooper, D. R., & Schindler, P. S. (1998). *Business research methods*. Boston, MA: Irwin/McGraw-Hill.

Copeland, D. G., & McKenney, J. L. (1988). Airline reservation systems: Lessons from history. *MIS Quarterly*, *12*(3), 353-370.

Davenport, T. H., & Short, J. E. (1990). The new industrial engineering: Information technology and business process redesign. *Sloan Management Review*, *31*(4), 11-27.

Dove, R. (1992). What is all this talk about agility? The 21st century manufacturing enterprise strategy. Prevision. *Japan Management Association Research*. Retrieved from www.parshift.com

Edwards, J. (2001). Multidimensional constructs in organizational behavior research: An integrative analytic framework. *Organizational Research Methods*, *4*(2), 144-192.

Feeny, D. F., & Willcocks, L. P. (1998). Core IS capabilities for exploiting information technology. *Sloan Management Review*, *39*(3), 9-21.

Fink, L., & Neumann, S. (2009). Exploring the perceived business value of the flexibility enabled by information technology infrastructure. *Information & Management*, *46*(2), 90-99.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39-50.

Frankfort-Nachmias, C., & David, N. (1996). *Research methods in the social sciences*. New York, NY: St. Martin's Press.

Frohlich, M. T., & Westbrook, R. (2002). Demand chain management in manufacturing and services: Web-based integration, drivers and performance. *Journal of Operations Management*, *20*(6), 729-745.

Grant, R. M. (1996). Prospering in dynamically-competitive environments: Organizational capabilities as knowledge integration. *Organization Science*, *7*(4), 375-387.

Grewal, R., & Tansuhaj, P. (2001). Building organizational capabilities for managing economic crisis: The role of market orientation and strategic flexibility. *Journal of Marketing*, *65*(2), 67-80.

Hammer, M. (2004). Deep change: How operational innovation can transform your company. *Harvard Business Review*, *82*(4), 84-93.

Hitt, M. A., Keats, B. W., & DeMarie, S. M. (1998). Navigating in the new competitive landscape: Building strategic flexibility and competitive advantage in the 21st century. *Academy of Management Executive*, *12*(4), 22-42.

Huff, A. S. (2009). *Designing research for publication*. Thousand Oaks, CA: Sage.

Johnson, J. L., Lee, R. P.-W., Saini, A., & Grohmann, B. (2003). Market-focused strategic flexibility: Conceptual advances and an integrative model. *Journal of the Academy of Marketing Science*, *31*(1), 74-89.

Kankanhalli, A., Lee, O.-K. D., & Lim, K.H. (2011). Knowledge reuse through electronic repositories: A study in the context of customer service support. *Information & Management*, *48*(2-3), 106-113.

Karimi, J., Somers, T. M., & Gupta, Y. P. (2001). Impact of information technology management practices on customer service. *Journal of Management Information Systems*, *17*(4), 125-158.

Kearns, G. S., & Lederer, A. L. (2004). The impact of industry contextual factors on IT focus and the use of IT for competitive advantage. *Information & Management*, *41*(7), 899-919.

Kim, W. C., & Mauborgne, R. A. (2005). *Blue ocean strategy: How to create uncontested market space and make the competition irrelevant*. Boston, MA: Harvard Business School Press.

Kraemer, K. L., & Dutton, W. H. (1991). Survey research in the study of management information systems. *The Information System Research Challenge: Survey Research Methods*, *3*, 3-58.

Lee, O.-K. D., Lim, K. H., Sambamurthy, V., & Wei, K. K. (2007). IT-enabled organizational agility and firms' sustainable competitive advantage. In *Proceedings of the International Conference on Information Systems*.

Lee, O.-K. D., Sambamurthy, V., Lim, K. H., & Wei, K. K. (2015). How does IT ambidexterity impact organizational agility? *Information Systems Research*, *26*(2), 398-417.

Lim, D. S. K., Celly, N., Morse, E. A., & Rowe, W. G. (2013) Rethinking the effectiveness of asset and cost retrenchment: The contingency effects of a firm's rent creation mechanism. *Strategic Management Journal*, *34*(1), 42-61.

Liu, H., Ke, W., Wei, K. K., & Hua, Z. (2013). The impact of IT capabilities on firm performance: The mediating roles of absorptive capacity and supply chain agility. *Decision Support Systems*, *54*(3), 1452-1462.

Lu, Y., & Ramamurthy, K. R. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS Quarterly*, *35*(4), 931-954.

Makadok, R. (2001). Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Management Journal*, *22*(5), 387-402.

Mata, F. J., Fuerst, W. L. & Barney, J. B. (1995). Information technology and sustained competitive advantage: A resource-based analysis. *MIS Quarterly*, *19*(4), 487-505.

Melville, N., Gurbaxani, V., & Kraemer, K. (2007). The productivity impact of information technology across competitive regimes: The role of industry concentration and dynamism. *Decision Support Systems*, *43*(1), 229-242.

Menor, L. J., Roth, A.V., & Mason, C. H. (2001). Agility in retail banking: A numerical taxonomy of strategic service groups. *Manufacturing & Service Operations Management*, *3*(4), 273-292.

Meredith, S. & Francis, D. (2000). Journey toward agility: The agile wheel explored. *The TQM Magazine*, *12*(2), 137-143.

Miles, R., & Snow, C. (2007). Organizational theory and supply chain management: An evolving research perspective. *Journal of Operations Management*, *25*(2), 459-463.

Miles, R. E., Snow, C. C., Meyer, A. D., & Coleman, H. J., Jr. (1978). Organizational strategy, structure, and process. *Academy of Management Review*, *3*(3), 546-562.

Mills, P. K. & Margulies, N. (1980). Toward a core typology of service organizations. *Academy of Management Review*, *5*(2), 255-265.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting and information technology innovation. *Information Systems Research*, *2*(3), 192-222.

Muduli, A. (2013). Workforce agility: A review of literature. *Journal of Management Research*, *12*(3), 55-65.

Myers, M. D. (1997). Qualitative research in information systems. *MIS Quarterly, 21*(2), 241-242.

Nazir, S., & Pinsonneault, A. (2012). IT and firm agility: An electronic integration perspective. *Journal of the Association for Information Systems*, *13*(3), 150-171.

Neely, A. D. (2009). Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research*, *2*(1), 103-118.

Nevo, S. & Wade, M. R. (2010). The formation and value of IT-enabled resources: Antecedents and consequences of synergistic relationships. *MIS Quarterly*, *34*(1), 163-183.

Newbert, S. L. (2007). Empirical research on the resource-based view of the firm: An assessment and suggestions for future research. *Strategic Management Journal*, *28*(2), 121-146.

Nie, W., & Kellogg, D. L. (1999). How process of operations management view service operations. *Production and Operations Management*, *8*(3), 339-355.

Overby, E., Bharadwaj, A., & Sambamurthy, V. (2006). Enterprise agility and the enabling role of information technology. *European Journal of Information Systems*, *15*(2), 120-131.

Pavlou, P. A., & El Sawy, O. A. (2006). From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development. *Information Systems Research*, *17*(3), 198-227.

Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in information systems research. *MIS Quarterly*, *31*(4), 623-656.

Ravichandran, T., & Lertwongsatien, C. (2005). Effect of information systems resources and capabilities on firm performance: A resource-based perspective. *Journal of Management Information Systems*, *21*(4), 237-276.

Ringle, C. M., Wende, S., & Will, A. S. (2005). *SmartPLS 2.0 M3* (beta). Germany: University of Hamburg. Retrieved from www.smartpls.de

Roberts, N., & Grover, V. (2012). Leveraging information technology infrastructure to facilitate a firm's customer agility and competitive activity: An empirical investigation. Journal of Management Information Systems, 28(4), 231-269.

Rogers, P., & Blenko, M. (2006). Who has the D? How clear decision roles enhance organizational performance. *Harvard Business Review*, *84*(1), 52-61.

Ross, J. W., Beath, C. M., & Goodhue, D. L. (1996). Developing long-term competitiveness through IT assets. *Sloan Management Review*, *38*(1), 31-42.

Roth, A. V., & Menor, L. J. (2003). Insights into service operations management: A research agenda. *Production and Operations Management*, *12*(2), 145-164.

Sambamurthy, V., Bharadwaj A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly*, *27*(2), 237-263.

Sambamurthy, V., & Zmud, R. W. (1999). Arrangements for information technology governance: A theory of multiple contingencies. *MIS Quarterly, 23*(2), 261-290.

Santhanam, R., & Hartono, E. (2003). Issues in linking information technology capability to firm performance. *MIS Quarterly*, *27*(1), 125-153.

Schwarz, A., Kalika, M., Kefi, H., & Schwarz, C. (2010). A dynamic capabilities approach to understanding the impact of IT-enabled businesses processes and IT-business alignment on the strategic and operational performance of the firm. *Communications of the Association for Information Systems*, *26*, 57-84.

Scott, G. M. (2005). Still not solved: The persistent problem of IT strategic planning. *Communications of the Association for Information Systems*, *16*, 904-936.

Sekaran, U., & Bougie, R. (2013). *Research methods for business: A skill building approach*. New York, NY: John Wiley & Sons.

Shimizu, K., & Hitt, M. A. (2004). Strategic flexibility: Organizational preparedness to reverse ineffective strategic decisions. *Academy of Management Executive*, *18*(4), 44-59.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*, *7*(4), 422-445.

Sia, C. L., Lim, K. H., Leung, K., Lee, M. K. O., Huang, W. W., & Benbasat, I. (2009). Web strategies to promote Internet shopping: Is cultural-customization needed? *MIS Quarterly*, *33*(3), 491-512.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological methodology* (pp. 290-312). Washington, DC: American Sociological Association.

Stone, E. F. (1987). *Research methods in organizational behavior*. Glenview, IL: Scott, Foresman and Company.

Sull, D. (2009). How to thrive in turbulent markets. *Harvard Business Review*, *87*(2), 78-88.

Sull, D. (2010). Competing through organizational agility. *The McKinsey Quarterly*, *1*, 48-56.

Swafford, P., Ghosh, S., & Murthy, M. (2006). The antecedents of supply chain agility of a firm: Scale development and model testing. *Journal of Operations Management*, *24*(2), 170-188.

Tallon, P. P., & Pinsonneault, A. (2011). Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Quarterly*, *35*(2), 463-486.

Tanriverdi, H. (2005). Information technology relatedness, knowledge management capability, and performance of multibusiness firms. *MIS Quarterly*, *29*(2), 311-334.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533.

Tippins, M. J., & Sohi, R. S. (2003). IT competency and firm performance: Is organizational learning a missing link? *Strategic Management Journal*, *24*(8), 745-761.

Trinh, T. P. (2012). Enterprise systems and organizational agility: A review of the literature and conceptual framework. *Communications of the Association for Information Systems*, *31*, 167-193.

Venkatraman, N. (1989). The concept of fit in strategy research: Toward verbal and statistical correspondence. *Academy of Management Review*, *14*(3), 423-444.

Verdü-Jover, A. J., Lloréns-Montes, F. J., & Garcia-Morales, V. J. (2004). The concept of fit in services flexibility research: An empirical approach. *International Journal of Service Industry Management*, *15*(5), 499-514.

Vickery, S. K., Droge, C., Setia. P., & Sambamurthy, V. (2010). Supply chain information technologies and organizational initiatives: Complementary versus independent effects on agility and firm performance. *International Journal of Production Research*, *48*(23), 7025-7042.

Villalonga, B. (2004). Intangible resources, Tobin's q, and sustainability of performance differences. *Journal of Economic Behavior & Organization*, *54*(2), 205-230.

Volberda, H. W. (1996). Toward the flexible form: How to remain vital in hypercompetitive environments. *Organization Science*, *7*(4), 359-374.

Wade, M., & Hulland, J. (2004). Review: The resource-based view and information systems research: Review, extension, and suggestions for future research. *MIS Quarterly*, *28*(1), 107-142.

Weill, P., Subramani, M., & Broadbent, M. (2002). Building IT infrastructure for strategic agility. *MIT Sloan Management Review*, *44*(1), 57-65.

Weiss, J. W., Thorogood, A., & Clark, K. D. (2006). Three IT-business alignment profiles: Technical resource, business enabler, and strategic weapon. *Communications of the Association for Information Systems*, *18*, 676-691.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*(10), 991-995.

Yusuf, Y. Y., Gunasekaran, A., Adeleye, E. O., & Sivayoganathan, K. (2004). Agile supply chain capabilities: Determinants of competitive objectives. *European Journal of Operational Research*, *159*(2), 379-392.

Zhu, K., & Kraemer, K. L. (2002). E-commerce metrics for net-enhanced organizations: Assessing the value of e-commerce to firm performance in the manufacturing sector. *Information Systems Research*, *13*(3), 275-295.

Zhu, K. & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research*, *16*(1), 61-84.

About the Authors

One-Ki Daniel Lee is an Associate Professor of the Department of Management Science and Information Systems at the University of Massachusetts, Boston. His research interests include IT-enable organizational agility, IT ambidexterity, organizational knowledge creation and management, agile project risk management, and IT governance. His work has appeared in several leading IS journals such as *Information Systems Research*, *Communications of the ACM*, *Information and Management*, *Knowledge Management Research and Practice*, and *Journal of Global Information Management*. He received his PhD from the City University of Hong Kong and his MS degree from the Korean Advanced Institute of Science and Technology.

Peng Xu is an Associate Professor of the Department of Management Science and Information Systems at the University of Massachusetts Boston. She received her PhD in Computer Information Systems from Georgia State University in 2004. Her research areas are business agility, software project management and knowledge management. Her work has appeared in several journals, including *Journal of Management Information Systems, European Journal of Information Systems, Requirements Engineering Journal, Communications of the ACM, Information and Management,* and many international conferences.

Jean-Pierre Kuilboer is a faculty of the Department of Management Science and Information Systems at the University of Massachusetts Boston. His areas of expertise include enterprise agility, data management, privacy and information security, and digital forensics. He is the author of “E-Business & E-Commerce Infrastructure” 2001. He has been recommended for a Shuman Fulbright award aimed at Privacy/Security & the European Union Program. He is an active member of research groups that aim at informing academia and industry through extended understanding of virtualization, cloud computing, Internet of Things, computer forensics, and information security. He received his PhD in Information Systems from the University of Texas Arlington and his MBA from the University of Louisiana Lafayette.

Noushin Ashrafi is a Professor of the Department of Management Science and Information Systems at the University of Massachusetts Boston. Her areas of expertise include enterprise agility, business intelligence, privacy and security, and health informatics. She has numerous journal publications and is the author of “Object Oriented System Analysis and Design”. She has conducted seminars in privacy and security as well as business intelligence in the US and abroad. She served as Fulbright Scholar exchange in Athens/Greece (2010-2011) and again at Johnsen Kepler University in Linz/Austria (2015-2016). She also served as Fulbright Specialist at Porto University in Portugal (Summer 2016.) She was the recipient of IBM (2010-2011) Healthcare Industry Skills Innovation award and IBM Watson cognitive technological capabilities award (2012-2013). She received her PhD and MBA Degrees from the University of Texas and her BA from SUNY.