Capability Hierarchy in Electronic Procurement and Procurement Process Performance: An Empirical Analysis

Abhay Nath Mishra[1]
Robinson College of Business
Georgia State University
Atlanta, GA 30303
Email: amishra@gsu.edu

Sarv Devaraj
Mendoza College of Business
University of Notre Dame
Notre Dame, IN 46556
Email: sdevaraj@nd.edu

Ganesh Vaidyanathan
School of Business & Economics
Indiana University
South Bend, IN 46634
Email: gvaidyan@iusb.edu

[1] Corresponding author

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Abstract

This paper examines the interrelationship between two hierarchically-structured functional capabilities pertinent in the organizational procurement process, and the impact of these capabilities on procurement process performance. These functional capabilities operate at different levels in an organization's procurement process. We draw upon resource- and knowledge-based views of the firm to theorize that in this hierarchy of information technology-enabled procurement capabilities, the higher-level capability – procurement integration competence – enables firms to develop and deploy a lower-level capability – digital procurement competence. Further, we theorize that the lower-level capability impacts procurement process performance directly and completely mediates the relationship between higher-level capability and performance. Thus, although performance is impacted directly only by the lower-level capability, the higher-level capability facilitates the development and use of the lower-level capability. Our research model is tested using survey data from a large sample of 412 manufacturing firms. The results provide strong support for the proposed research model. In particular, we find that as hypothesized, the impact of procurement integration competence on performance is completely mediated by digital procurement competence. Our results suggest that when examined at the procurement process level, the impact of higher-level capabilities may be manifested completely through the lower-level capabilities. Theoretical and practical implications of the research are discussed.

Keywords: Capability hierarchy, digital procurement competence, electronic procurement, procurement capabilities, procurement integration competence, second-order construct

1. Introduction

"Purchasing is by far the largest single function at AT&T. Nothing we do is more important." (An executive vice president of AT&T quoted in Monczka et al. 2002)

The procurement function has been identified as a key focus area for contemporary firms to remain cost-effective and competitive in an environment characterized by increasing global competition and declining profit margins (Barratt and Barratt, 2011; Frohlich, 2002; Hill and Scudder, 2002; Monczka et al., 2002; Tazelaar and Snijders, 2013). This is particularly true for manufacturing firms which spend up to 80% of their revenues on the procurement of products and services (Zenz and Thompson, 1994). Realizing the importance of procurement, and in an attempt to improve their operations proactively to respond to cost and revenue pressures, manufacturing firms have taken several steps to streamline the procurement function and the entire value chain (Hill et al., 2009; Johnson and Whang, 2002; Peleg et al., 2002). One such measure comprises the implementation of technological innovations, such as electronic procurement. Several firms, such as Dell, GE, Cisco systems, IBM and Walmart have implemented electronic procurement and obtained significant economic payoffs. The use of e-procurement applications has allowed these firms to attain a wide range of benefits including reduced cycle time and cost, improved accuracy, better coordination with partners, and enhanced financial performance (Barua et al., 2001; Frohlich, 2002; Mishra et al., 2007; Rai and Tang, 2010).

Although the procurement process and the use of innovative information technologies have been examined in significant detail in extant research (Hill et al., 2009; Mithas et al., 2008; Rabinovich et al., 2003; Rai et al., 2006; Rosenzweig, 2009), relatively little research attention has been paid in operations literature to capabilities that facilitate performance enhancements in processes (Hayes et al., 2005; Menor et al., 2007; Schroeder et al., 2002). An emphasis on organizational capability, defined as an organization's ability to perform repeatedly and reliably a task which is related to its capacity for creating value (Grant, 1996; Helfat and Peteraf, 2003), is essential to disentangle value creation mechanisms in business processes. As innovative information systems are increasingly applied in novel ways in interconnected business processes to

create value, organizations craft and draw upon new capabilities that need to be examined in detail. It is important to note that these capabilities are pertinent at different levels. For instance, some capabilities may apply at the level of the entire process, such as, logistics, inventory management and procurement, whereas others may be applicable at the level of a focused task, such as searching, ordering, invoicing and restocking. Additionally, some capabilities may be technology-enabled while others may either be antecedents to or consequences of such capabilities.

These distinctions among capabilities, the bedrock of value creation in various business processes, have not been emphasized in extant literature in operations management. Researchers have suggested that extant literature in operations has focused on linking operations structure and information infrastructure, and needs to move beyond these concerns to examine how capabilities enable firms to gain advantages in business processes (e.g., Barney and Arikan, 2001; Menor et al., 2007). Additionally, the relationship between these capabilities and how they impact performance is lacking in the literature (Clark, 1996; Menor et al., 2007; Rai et al., 2006). As a result of the sparse focus in the literature on capabilities and the relationships between them, scholars and practitioners lack insights on how firms create, deploy and leverage capabilities at various levels; how these capabilities are interrelated and work in conjunction with each other; and how these capabilities are related to process performance (Menor et al., 2007; Salvato and Rerup, 2010). Because developing process capabilities is a long-term endeavor, it is important for managers to analyze and recognize where and how to invest valuable financial resources to develop and leverage these capabilities.

In this paper, we address the gap in the literature by providing a capability-focused examination of electronic procurement. A focus on capabilities relevant in electronic procurement is appropriate for two important reasons. First, although Internet technologies increasingly play a crucial role in supporting the procurement process, and a number of firms have adopted and benefitted from them, Internet use or its impact is still not uniform in firms (Dong et al., 2009). In fact, there is considerable heterogeneity in the capabilities of firms and the extent and manner in which they implement e-procurement applications (Kioa and Zapf, 2002;

Mishra et al., 2007). Thus, it is important to understand how firms differ in their procurement requirements, processes and capabilities, and how such differences impact performance (Ramsay, 2001).

Second, it is important to examine the interrelationship between various capabilities in the electronic procurement context because firm capabilities can be built at different, hierarchically structured levels. Unbundling capabilities at various levels, and empirically tracing the links between them and process performance can provide insights on how capabilities impact performance and where the sources of performance advantages lie in the firm (Salvato and Rerup, 2010; Schreyögg and Kliesch-Eberl, 2007). Although several scholars have issued research calls to examine how various capabilities may streamline firm processes and enhance performance (e.g., Boyer et al., 2005; Malhotra et al., 2005; Sambamurthy et al., 2003), and despite theoretical work on capability hierarchy (Collis, 1994; Grant, 1996), empirical research on the hierarchy of functional capabilities and its impact on performance is sparse in the literature.

We posit that there are hierarchies among organizational procurement capabilities wherein higher-level capabilities enable the creation and use of lower-level capabilities in a related, technology-enabled context. We identify a key higher-level capability, procurement integration competence, which enables the creation and use of a lower-level capability, digital procurement competence. The lower-level capability is technology-enabled, closer to the actual procurement activities performed, and impacts performance directly. We estimate our research model with data obtained from a large-scale survey of 412 manufacturing firms in the context of procurement of production goods.

This paper contributes to the literature in several ways. First, we develop an IT-enabled functional capability hierarchy that conceptualizes higher-level and lower-level procurement capabilities, and examines their impact on procurement process performance. Considering that the functional capability hierarchy has been sparsely studied in the literature, and that current theorizing has not considered the possibility of capability hierarchies within a business process or function, with process-level capabilities conceptualized at one level, this paper helps foster research in a new domain that is at the intersection of operations

management (OM), information systems (IS) and strategic management. Second, while extant literature has suggested higher-level capabilities as a source of firm-level performance (Grant, 1996; Rai et al., 2006; Sambamurthy et al., 2003), lower-level capabilities and their deep structures have not been examined in detail (Sirmon et el., 2007). In this paper, we conceptualize hierarchically structured procurement process capabilities and theorize that the impact of the higher-level capability on process-level performance is experienced through the lower-level, technology-enabled capability. This is a novel conceptualization and provides opportunities for significant new research and extensions. Finally, this work provides a multidisciplinary perspective on procurement process capabilities, which has been sparse in the literature, but is essential for grasping how firms can develop and deploy interlinked capabilities to obtain long-term performance advantages at the process level (Barney and Arikan, 2001; Ethiraj et al., 2005; Heim and Peng, 2010; Menor et al., 2007; Rai et al., 2006; Setia et al., 2008).

2. Literature Review and Theory

The conceptual foundations for our study draw upon prior research in OM, IS, and strategic management. Our literature review indicates that a robust body of research in IS and OM has examined the operational aspects of IT use in the procurement process and its performance implications. Much of this research is focused around two broad themes: 1) IT use enables firms to streamline the procurement process and the value-chain to obtain significant process efficiencies (Cachon and Fisher, 2000; Mithas et al., 2008), and 2) IT use enables firms to locate new products and sources of supply that can lower prices of inputs (Peleg et al., 2002). Prior literature in strategic management explicates the relationship between various capabilities and firm performance. We first discuss extant research that examines the role of IT in procurement and then present resource- and knowledge-based views as theoretical lenses underlying our research model.

2.1 IT use in the procurement process and the value-chain

A significant amount of research has examined the impact of IT and information use in procurement and value-chain. The basic thesis of this stream of research is that by enabling better information sharing, IT can wring

inefficiencies out of procurement and value-chain processes. Improvements suggested and demonstrated in the literature include shorter lead-time, improved visibility, on-time delivery, lower costs, improved quality of products, lower inventory, faster order fulfillment and improved order accuracy (Barratt and Barratt, 2011; Mishra et al., 2007). For instance, electronic data interchange (EDI) has been shown to reduce cycle time and cost by improving the quality, speed and business value of transactions (Mukhopadhyay et al., 1995). Srinivasan et al. (1994) find that sharing frequent and accurate information between buyers and suppliers results in improved shipment performance. Mukhopadhyay and Kekre (2002) quantify the impacts of electronic integration and show that both suppliers and customers benefit from it. Ahmad and Schroeder (2001) find that the use of EDI is related to improvements in delivery time performance. Further, researchers have suggested that IT use enables better coordination between buyers and suppliers, facilitates seamless integration of information through the use of standards and data synchronization and enhances information processing capabilities (Bala and Venkatesh, 2007; Bensaou, 1997). For instance, Hill and Scudder (2002) find that in the food supply industry, EDI use enables deeper collaboration between firms and their suppliers. Frohlich (2002) finds that e-integration – integration between firms through the use of Internet – impacts operational performance. Researchers have also found significant positive relationships between organizational use of Internet technologies and its impact on buyer-supplier relationships and firm performance (Devaraj et al., 2007; Dong et al., 2009). Concurrently, a stream of research has emphasized the market-like benefits of e-procurement and consequential lower price of inputs (Jap and Mohr, 2002; Peleg et el., 2002).

Extant research has also found insignificant impacts of IT use in procurement and supply-chain. For example, Walton and Marucheck (1997) did not find the use of EDI to be related to delivery performance. Rabinovich et al. (2003) found that the use of operational practices such as just-in-time (JIT), rather than the use of enterprise-wide information systems, leads to performance as measured by inventory management, lead times and turnover ratios. McAfee (2002) conducted a longitudinal natural experiment on the adoption of enterprise resource planning (ERP) systems and found that performance decreased in some measures and

increased in others immediately after the implementation. However, all the performance outcomes improved several months after the implementation. In summary, despite some ambivalent results, there is significant evidence in the literature that IT use in the procurement process and the value-chain has positive impacts on performance.

It is evident that although prior research has examined IT use in the procurement process and value chain management in considerable depth, it has focused primarily on the operational aspects (Carr and Smeltzer, 1997; Menor et al., 2007; Ramsay, 2001). As business processes acquire strategic importance, it has become critical for researchers to examine capabilities that will enable firms to exploit IT in these processes and the consequences of such use (Barney and Arikan, 2001; Setia et al., 2013), because capabilities are central for an organization to conceive, choose and implement strategies (Collis, 1994). Despite the critical role IT plays in value-chain processes, theoretical and empirical research on how IT capabilities are created and applied in processes and how they can impact performance at the process level is still limited in the literature (Rai et al., 2006). We next provide a synopsis of the prior literature in the resource- and knowledge-based views which are germane to such investigations.

2.2 Resource-based view

The basic tenet of RBV is that the possession, development and unique deployments of resources and capabilities create performance advantages for firms. These advantages tend to be sustainable if the underlying capabilities resist imitation through time compression diseconomies, historical uniqueness and causal ambiguity (Barney, 1991).[2] A large body of literature has provided support for these arguments by linking organizational resources and capabilities to performance at the *firm* level. Recently, researchers have advocated the application of RBV at the organizational *process* level (Banker et al., 2006; Ray et al., 2004; Schroeder et al., 2002; Setia et al., 2008). The rationale is that many of the capabilities are applied at the process level in firms and their first impact is experienced at the same level. Further, while these capabilities

[2] A comprehensive review of RBV is beyond the scope of this paper. See Wade and Hulland (2004) and Kraaijenbrink et al. (2010) for reviews.

may provide performance advantages in some processes, they may be unrelated to performance in other processes or may even be negatively related (Kohli and Devaraj 2003; Melville et al. 2004; Ray et al. 2004). For instance, the capability of a firm to bring innovative products to the market quickly may be an asset for the new product development process (NPD), but may impact manufacturing, inventory management and customer relationship management processes adversely. Hence, aggregation across different processes and examination of performance at the firm level may mask their real impact. Restricting the scope of our examination to procurement process enables us to isolate the impact of IT on one process.

A significant, yet relatively under-explored, development in the RBV literature has been the notion of hierarchy of capabilities (Collis, 1994; Grant, 1996; Sirmon et al., 2007). Two levels of capabilities have been propounded in the literature: higher-level dynamic capabilities and lower-level functional (also called operational by some scholars) capabilities. Lower-level functional capabilities allow firms to perform functions, such as distribution, logistics, and marketing, while higher-level dynamic capabilities enable firms to systematically and reliably adapt lower-level capabilities to dynamic environments (Fortune and Mitchell, 2012; Grant, 1996; Hoops and Masden, 2008; Sirmon et al., 2007). Dynamic capabilities focus on change, renewal and transformation of existing capabilities to create new products, serve new markets and create other large-scale changes based on market needs and trends. The key distinction between the two capability levels is that relevant decisions for high-level capabilities, in comparison to those for low-level capabilities, are less structured; signify more cognitive load; require more information processing from various sources, such as internal staff, suppliers, industry reports, consultants and product development engineers; and demand wider knowledge and skills. Pavlou and El Sawy (2006) have examined this hierarchy in the context of NPD and found evidence supporting the conceptualization that dynamic NPD capabilities impact functional NPD capabilities, which in turn, impact competitive advantage in NPD. They also propose an IT-based antecedent capability of the dynamic NPD capabilities in their research.

We believe that this literature is limited in two ways: 1) while examining capability hierarchy, the literature typically creates general categories and labels for higher-level dynamic capabilities and lower-level functional capabilities, however, hierarchically-structured capabilities can be present within the broad spectrum of functional and dynamic capabilities themselves. It is important to study the deeper structures in these capabilities as insights from such studies will enable researchers to more thoroughly understand the source of value creation in firms. In this study, we focus on hierarchies within functional capabilities. We posit two levels of functional capabilities. The *higher-level functional capabilities*, henceforth also called operational capabilities, can apply at the function level, whereas lower-level functional capabilities, henceforth also called task-level capabilities, can apply at individual task-levels. 2) The order of capability formation does not always proceed in one direction, i.e., operational capabilities do not always causally follow task-level capabilities. When new technologies create opportunities to enhance a business process, a firm can exploit its existing operational capabilities and integrate the new technologies in various tasks, thereby creating and developing technology-enhanced task-level capabilities. Hence, from a temporal perspective, once the organization has developed high-level functional capabilities, it can exploit them to create lower-level task capabilities when an IT application is implemented to streamline the process tasks. The ability of firms to assimilate new technologies in their operations and create technology-enabled task-level capabilities relies on this sequence of events. Figure 1 illustrates the capability hierarchy as conceptualized in extant literature and contrasts it with our conceptualization.

[Insert Figure 1 about here]

Functional capabilities constitute firm-specific sets of skills, knowledge and routines that are hierarchically structured in a specific context; used regularly; often lack substitutes; and are difficult to replicate. These capabilities can be a source of competitive advantage (Ethiraj et al., 2005; Sirmon et al., 2007) by enabling solutions to problems through configuring operational resources (Wu et al., 2010). Functional capabilities are involved in the production and distribution of existing products and services, and

reflect a firm's ability to perform various functions more effectively and efficiently (Fortune and Mitchell, 2012; Salvato and Rerup, 2010; Menor et al., 2007).

In his seminal work, Grant (1996) conceptualized capabilities as a firm's ability to perform a discrete productive task repeatedly. He hinted at the existence of levels of capabilities within the realm of functional capabilities themselves. According to him, task-level capabilities enable a firm to perform specific, narrow and repetitive tasks efficiently. These task-level capabilities are then integrated to obtain functional capabilities such as marketing, product development and logistics. The latter signify integration across different tasks and encompass the lower-level capabilities. Hinting at capability levels, Sirmon et al. (2007) also suggest that resource combinations, or capabilities, can be designed to perform less complex, repetitive tasks or higher-order functions that may require integration. Prior literature suggests that the development of capabilities follows these sequential steps because higher-level capabilities are dependent on lower-level capabilities, as it is the integration of the latter that facilitates the creation and use of the former (Eisenhardt and Martin, 2000).

To the best of our knowledge, no prior work has expressly theorized that higher-level capabilities can lead to lower-level capabilities, but a vast amount of literature has implied it. For instance, the literature on absorptive capacity suggests that organizations with knowledge in one domain can easily create subsequent knowledge in related domains[3] and apply it to accomplish tasks (Cohen and Levinthal, 1990). Absorptive capacity is defined as "a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends." Absorptive capacity is domain-specific and path dependent, which implies that prior related knowledge sensitizes an organization to related new information, and enables its use in productive tasks. Experiences with functions, such as, manufacturing, marketing and supply chain management provide a firm with the necessary skills and knowledge to facilitate recognition and exploitation of innovations and creation of new capabilities to accomplish tasks (Cohen and Levinthal, 1990; Hoops and Masden, 2008). Additionally, the

[3] A related domain signifies an area that is similar – not exactly the same – where existing firm knowledge can be exploited to create value. This related domain can be the same process when activities need to be performed differently or a different adjacent process (e.g., for a customer-facing process, other customer-facing processes) or a similar product line, or a similar technology, etc.

presence of capabilities in a given domain primes the development of novel linkages and allows firms to generate novel combinations of knowledge in a new but related domain (Kogut and Zander, 1992). It follows that firms with high levels of functional capabilities possess absorptive capacity in functional areas, such as marketing, supply-chain, and logistics, and can apply it to create new capabilities and innovate in a related domain. Thus, it is entirely possible, and rather likely, that such high-level functional capabilities temporally precede lower-level IT-enabled functional capabilities in a related context.

This new and related context can arise after the implementation of a technological innovation such as e-procurement. New innovations can facilitate the refinement and application of existing capabilities in firms' tasks (Hoops and Masden, 2008). In other words, when technological innovations are implemented, firms that possess absorptive capacity can exploit existing knowledge and apply it to develop new capabilities to accomplish procurement tasks. Cohen and Levinthal (1990) posit that firms with higher expertise levels and absorptive capacity are likely to be more sensitive to the emerging technological opportunities and more proactive toward applying capabilities in processes. Sense and response capabilities have been found significant for IT innovation and process performance (Setia et al., 2013). Following Cohen and Levinthal (1990), a firm that possesses higher-level capabilities, which are broader and more general, will be able to sense exploitation opportunities due to the knowledge and experience it enjoys and will find it easier to develop lower-level capabilities once a technological innovation has been implemented (Sirmon et al., 2007). These latter capabilities can enable firms to apply firm knowledge in tasks and respond to the opportunities created. Knowledge, therefore, is the focal constituent of value creation in organizational processes.

2.3 Procurement Knowledge as a Capability

Drawing upon the absorptive capacity literature, it is evident that the knowledge an organization possesses via higher-level capability endows it with skills and experience to create lower-level capabilities that can be exploited. Absorptive capacity and existing knowledge may play a critical role in the procurement process capability hierarchy to understand how the latter may be shaped in a firm. We draw upon the knowledge based

view of the firm, which is an extension of the resource-based view of the firm, and asserts that the integration of knowledge is the key function performed by the firm (Grant, 1996; Kogut and Zander, 1992). It suggests that the knowledge of a firm is its most important and strategic asset because it is grounded in organizational routines, identity, policies, systems and processes, is difficult to imitate, and can produce long-term sustainable advantages (Alavi and Leidner, 2001). This is particularly true of procedural knowledge which tends to be more implicit and buried in a firm's processes and how it conducts its business. Such knowledge is challenging for other firms to copy or acquire easily.

Knowledge has been viewed from several perspectives in extant literature, such as a state of mind, an object, a process, a condition of having access to information and a capability (Alavi and Leidner, 2001). There is a small but growing literature that treats *knowledge as a capability*. For instance, Davenport and Prusak (1998) describe knowledge as a capability for using experience, information, and expert insight to evaluate new experiences and information. Ray et al. (2004) argue that IT knowledge is an important capability that firms can exploit to develop and use firm-specific applications that improve performance. Gaimon (2008) argues that knowledge embedded in a firm's business processes represents its capability. Further, knowledge has also been conceptualized as a capability that has the potential to influence future action (Carlsson et al., 1996) and a capacity to use information rather than merely a capacity for action (Watson, 1999). In fact, the mere availability of knowledge may not suffice; it is the ability of the firm to generate new knowledge and apply knowledge to take action that forms the basis of competitive advantage. In recent work, Tanriverdi (2005) has suggested that knowledge management, defined as a firm's ability to create, transfer, integrate and leverage related knowledge, is a capability.

The view of knowledge as a capability, as opposed to a resource, recognizes that capabilities are firm-specific; embedded in the organization and its processes and routines (Makadok, 2001); difficult to imitate easily; and an important predictor of firm performance (Tanriverdi, 2005). For instance, procurement process knowledge is procedural in nature, entrenched in an organization's specific needs and policies, and hence is

rather hard to transfer or appropriate away. The conceptualization of knowledge as a capability is justified on the criterion espoused by Makadok (2001). Knowledge *does* enhance the value and productivity of other resources such as physical assets and intangible resources. For instance, although resources such as ERP, CRM and CPFR systems are valuable in their own right, knowledge can enhance the value of these resources by enabling the organization to exploit them more effectively in firm-specific routines and processes. Past experience and knowledge define and constrain a firm's knowledge search and capability development in the future. The ability of a firm to use related knowledge allows it to achieve cost efficiencies through more efficient operations (Mithas et al., 2011; Tanriverdi, 2005). Additionally, knowledge and experience also influence managerial and organizational cognition, which ultimately affects a firm's ability to manage knowledge and seek new knowledge (Tripsas and Gavetti, 2000; Cohen and Levinthal, 1990). Because experience is closely related to a firm's prior knowledge, actions and successes, it influences the acquisition and development of future knowledge and capabilities.

In the context of procurement process and the use of Internet technologies to accomplish the procurement function, we examine two hierarchically-structured functional capabilities. The first capability, procurement integration competence, signifies an operational capability in the procurement process that a firm develops and applies broadly to synthesize internal requirements and external relationships. The second capability, digital procurement competence, signifies a task-level capability that enables a firm to exploit the technology to accomplish specific tasks after the implementation of the e-procurement solution.

2.4 Procurement Integration Competence and Digital Procurement Competence

A considerable amount of literature suggests that organizational capabilities are centered around two foci – internal and external knowledge, relationships, activities and routines (Barratt and Barratt, 2011; Klein and Rai, 2009; Teece et al., 1997). The literature in absorptive capacity has consistently reinforced the twin dimensions of internal and external knowledge and their mutually reinforcing and beneficial impact on innovation (Cohen and Levinthal, 1990; Cassiman and Veugelers, 2006). In the operations literature, Barratt and Barratt (2011)

suggest that internal and external supply chain linkages impact the ability of organizations to streamline various processes and performance metrics such as visibility. In the IS literature, Sambamurthy and Zmud (1999) suggest that firms can exploit synergies through the consolidation of internal firm-wide capabilities or through partnerships and relationships, which is an external source of capability. The underlying principle for these assertions is that internally and externally focused knowledge and capabilities may work in tandem and their *synthesis* may be necessary to solve significant problems (Nickerson and Zenger, 2004).

Drawing upon extant research, we posit two dimensions for procurement integration competence – internal process knowledge and external relationship knowledge, and three dimensions for digital procurement competence – internal procurement digitization, external online search digitization and external online ordering digitization. The focal constructs, procurement integration competence and digital procurement competence exist separately and are at a deeper and more embedded level than the dimensions. The content domain of these constructs and their interrelationships follow.

2.5 Procurement Integration Competence and Its Associated Dimensions

Procurement integration competence is an organizational capability rooted in the procurement process. It enables organizations to be aware of their specific, customized and varied procurement requirements, and to enter into relationships with suppliers to satisfy their idiosyncratic material requirements. While procurement is an integral aspect of a firm's existence and every firm develops knowledge specific to its circumstances, some firms procure a wide variety of input goods which may have elaborate specifications and components that are arranged in a sophisticated way. Such firms must respond to significantly different procurement requests, and may find themselves in situations that necessitate interacting, exchanging information and transacting with a large number of suppliers. It follows then that such firms must gather and process information about internal material requirements and external suppliers, and integrate them. The capability signifies integration and synthesis of internal knowledge with the knowledge about and relationship with suppliers, and allows firms to make decisions such as "Which suppliers to choose?"; "Which input material should be purchased from which

supplier?"; and "Which supplier should supply what amount?" It also makes other resources such as logistical resources including the physical fleet and organizational trustworthiness more valuable. It is important to note that IT is not a requirement to assemble this capability as Zara has aptly demonstrated that traditional, non-technology intensive methods can be leveraged effectively to develop this competence.

We posit that procurement integration competence is a higher-level functional capability, or an operational capability. Although grounded in procurement process, its focus is not on individual tasks such as generating a request for quotation (RFQ) or completing a payment transaction. It affords an organization the ability to gather information about internal requirements and key suppliers, to integrate this knowledge and to leverage the synthesized knowledge in the entire procurement process to satisfy its unique needs for input goods. In sum, the implicit focus of procurement integration competence is much broader than any one well-defined procurement activity performed repetitively (Grant, 1996).

High procurement integration competence suggests that a firm has been able to integrate internal process knowledge about its unique sourcing requirements and external relationship knowledge about suppliers who may be able to satisfy these requirements. Further, it also indicates that the firm has been able to establish close relationships with suppliers. While each of the two individual dimensions, on its own, may be valuable, the focal construct exists at a deeper level and signifies that the individual dimensions have been synthesized (Law et al., 1998).

2.5.1 Internal process knowledge: Internal process knowledge is a significant capability that manifests a firm's deep understanding and knowledge of its varied input materials and procurement requirements. Firms with high internal process knowledge benefit from the extensive knowledge they have acquired about procurement, and are able to develop sophisticated knowledge structures which aid further capability creation (Cohen and Levinthal, 1990; Grant, 1996). The experiences with and the knowledge obtained from different procurement scenarios in the past enables firms to create associations with requirements in situations when they need a new input material. Thus, the sophisticated knowledge base and the intellectual capital created

through the understanding of idiosyncratic input materials and procurement requirements create an option for future action and knowledge use. Firms such as GE, Boeing, Foxconn and Honda that manufacture a large number and variety of products and interact with a large number of suppliers possess this capability, which other firms may find difficult to acquire or imitate in a short amount of time.

2.5.2 External relationship knowledge: External relationship knowledge is a capability that establishes a firm's ability to share, assimilate and apply relationship-oriented knowledge about suppliers. Buyer-supplier relationship knowledge, inter-organizational cooperation and their virtues for organizations have received much attention in extant literature (e.g., Barratt and Barratt, 2011; Dyer and Singh, 1998; Subramani, 2004). It has been argued that by enabling collaboration between partners, such relationship knowledge results in enhanced benefits such as higher cooperation, better product quality, satisfied customers, lower costs and increased market share (Cheung et al., 2011). These relationships and their significance have been explained using the relational view, which suggests that such relationships are embedded in routines and processes, and a source of "rent" (Bala and Venkatesh, 2007; Dyer and Singh, 1998). Relationship knowledge is a significant aspect of the organization culture, which needs to be cultivated over time, and cannot be acquired or copied in a short period. In other words, firms are likely to vary widely in their ability to collect, assimilate and employ relationship knowledge about suppliers. Japanese manufacturers such as Toyota and Honda are renowned for their deep relationship knowledge about suppliers whereas many of their American counterparts are not. Cisco and Dell have crafted extended value networks, guided by relational knowledge about partners, which creates significant performance advantages for them (Saraf et al., 2007).

2.6 Digital Procurement Competence and Its Associated Dimensions

Digital procurement competence is a capability that is grounded in the extent of organizational IT use in procurement tasks. It refers to the value-adding ways in which a firm is exploiting IT, both non-Internet- and Internet-enabled, in procurement activities. Firms with high digital procurement competence can leverage their existing IT infrastructure and applications and prior experience and knowledge to streamline the procurement

process (Frohlich 2002; Klein and Rai, 2009; Mishra et al., 2007). The ability to share documents such as component features, specifications, change orders and future requirements, and to avoid misrepresentation, communication errors and delays creates process efficiencies. In response to specific contingencies faced, the IT infrastructure, applications and policies in place, and the availability of procurement-related knowledge, firms develop idiosyncratic digitization capabilities, and it may not be easy for them to copy or acquire capabilities developed by other firms in a short span of time. Therefore advantages arising from organizational digitization capability are less likely to be dissipated away through imitation (Barney, 1991).

The procurement process entails both intra- and inter-organizational activities. These activities can be digitized, and digital procurement competence obtained, through the integration of both Internet- and non-Internet-based technologies. We posit that digital procurement competence is a lower-level task capability. The activities targeted for automation and enhancement are well-defined, the goal of the technology is well-understood, and the focus and span of activities targeted by the technology is narrow. For instance, the focus could be to search for input materials and qualified suppliers who can supply these materials. High digital procurement competence indicates that a firm has been able to use non-Internet- and Internet-enabled technologies to digitize internal and external activities. While the digitization of each may be beneficial, the digitization of both internal and external dimensions enables firms to share information seamlessly within and beyond their boundary, and also enhances transactional efficiencies. Such integration facilitates information transfer and sharing across multiple technological platforms, whose presence is a reality in modern manufacturing firms.

2.6.1 Internal procurement digitization: It refers to the manner in which a firm is using information technology to digitize the part of the procurement process that is internal to the firm. Internal digitization facilitates the flow of consistent information in an organization. The uniformity of information achieved through interconnected applications and common infrastructure enables the firm to streamline internal procurement tasks, eliminate inefficiencies and achieve intra-firm collaboration.

2.6.2 External online search digitization and external online ordering digitization: External digitization refers to the value-adding ways in which a firm is using Internet-based applications to digitize the portion of the procurement process wherein the focus is external to the firm. We focus on search and ordering because these are two important activities in the procurement process. Researchers have suggested that firms can improve performance by searching for and locating new products and sources of supply that can provide products and services at lower prices; and by streamlining the procurement process and the value-chain and obtaining significant process efficiencies (Jap and Mohr, 2002; Mishra et al., 2007; Peleg et al., 2002). These capabilities reflect the effective application of Internet technologies in the search and ordering activities in a firm. Higher levels of online search and ordering capabilities suggest that a firm is using Internet technologies effectively to search for products and competent suppliers and to order products and services online.

Our research model, represented in Figure 2, illustrates the procurement capability hierarchy and its impact on procurement process performance. Procurement integration competence and digital procurement competence serve as key higher- and lower-level capabilities respectively. Consistent with recent research, performance is examined at the process level (Banker et al., 2006; Dong et al., 2009; Ray et al., 2004).

[Insert Figure 2 about Here]

2.7 Procurement Integration Competence and Digital Procurement Competence

Procurement integration competence suggests that a firm's internal process knowledge and external relationship knowledge have been synthesized and integrated, and are used for satisfying its unique sourcing requirements. The internal process and external relationship knowledge allow a firm to recognize the value of new procurement-related technological innovations, assimilate them and apply them toward productive uses, i.e., in completing procurement tasks, efficiently. In other words, firms with high procurement integration competence possess absorptive capacity in the procurement domain, which allows them to integrate new technology with existing practices and to use it to complete procurement tasks. Cohen and Levinthal (1990) suggest that firms with absorptive capacity are likely to have higher aspirations levels in the domain of the

technical environment because they tend to be more knowledgeable about and sensitive to the availability of opportunities. Additionally such firms tend to be highly capable and can capitalize this opportunity in the new technological domain due to their prior experience and knowledge (Cohen and Levinthal 1990). Thus, through enhanced absorptive capacity, procurement integration competence provides both, motivation and ability, the key ingredients essential in determining firm strategy and behavior (Grewal et al., 2001), to develop and deploy digital procurement competence.

As discussed earlier, firms with high procurement integration competence have to respond to a wide variety of procurement requests, and interact, negotiate, exchange information and transact with a large number of suppliers. The necessity to respond to a large number and variety of demands engenders the need for efficiency more acute. Digital procurement competence may enable such firms to achieve efficiency in a wide variety of interactions within the firm and with members of the value-chain. The necessity to procure a large number and variety of products and the breadth of procurement situations to which such firms have to respond, provide them with the *motivation* to digitize the procurement process. Such firms have the potential to achieve higher benefits through digitization than other firms. Additionally, although enhanced information exchange, streamlined interaction and better coordination with close suppliers can be accomplished using other means, digital procurement competence facilitates information exchange and collaboration with suppliers more efficiently and effectively (Devaraj et al., 2007; Klein and Rai, 2009; Rai et al., 2006), providing firms with additional motivation to digitize the procurement process.

Firms with high procurement integration competence can also leverage their internal process knowledge and external relationship knowledge to digitize the entire procurement process. Their experience and knowledge provide them with the *ability* to integrate IT solutions with existing organizational infrastructure and practices. Their prior experiences and knowledge enable them to create associations with different requirements and the features offered by IT solutions quickly to enable digitization capability.

In addition, due to their long-term and collaborative inclination, such firms are more likely to engage in problem-solving activities with partners that result in enhanced learning and process changes (Bensaou and Venkatraman, 1995). Gerwin (1993) has suggested that a significant amount of external learning takes place through collaborative relationships with suppliers. Such learning can be in the form of expanded knowledge about orders, schedules, operations and strategies and expand the knowledge base of firms, which is instrumental in capability creation (Dyer and Singh, 1998). In the context of procurement, external learning provides firms with the ability to integrate suppliers' IT systems with their own IT systems. In this vein, Devaraj et al. (2007) have found that information sharing with suppliers is significantly related to e-business capabilities in firms. Benefiting from procurement integration competence, several firms such as GE, Cisco, Dell and Toyota have achieved high digital procurement competence. Therefore:

> ***H1****: Procurement integration competence will be positively related with digital procurement competence.*

2.8 Digital Procurement Competence and Procurement Process Performance

Digital procurement competence suggests that an organization is using IT extensively to accomplish organizational procurement tasks. It suggests that a firm is exploiting the technology for both internal and external coordination. As Sirmon et al. (2007) suggest, leveraging capabilities to accomplish tasks is essential to achieve better performance; mere possession is insufficient. Drawing on knowledge-based view and knowledge management capabilities, Tanriverdi (2005) argues that IT capabilities have a significant impact on the productive processes of a firm when they serve as coordinating mechanisms. Further, drawing upon, and extending theory on absorptive capacity, Zahra and George (2002) suggest that realized absorptive capacity – the transformation and exploitation of absorptive capacity – has significant positive implications for the recognition of opportunities and harvesting existing knowledge and capabilities into a firm's operations. Digital procurement competence affords a consistent view of procurement information within the firm, thereby reducing redundancies and extra inventory, and enabling efficient sourcing operations (Dong et al. 2009). Digital procurement competence enables firms to lower procurement costs by locating input goods of

comparable or better quality at lower prices. It further enables firms to locate suppliers who can manufacture good-quality products and exchange information electronically, resulting in lower coordination costs, administrative costs, reject rate and lead time. Digital procurement competence enables firms to replace error-prone manual processes by efficient electronic processes. It also facilitates electronic information sharing with suppliers, which lowers uncertainty, reduces inventory and obsolescence and enables better coordination and movement of input goods (Barua et al., 2004; Malhotra et al., 2005). Considerable prior research has found support for the impact of digitization capabilities on process performance. For instance, Frohlich and Westbrook (2002) found that web-based demand and supply chain integration impacts delivery time and inventory turnover; Banker et al. (2006) found that manufacturing capabilities impact plant performance; and Ray et al. (2004) found that knowledge capability impacts customer service performance. Exemplar firms such as Wal-Mart, IBM, Dell and Cisco are known to have obtained substantial process efficiencies due to their high digital procurement competence. Hence,

H2*: Digital procurement competence will be positively related with procurement process performance.*

3. Research Design and Methods

To test our research model, we collected survey data from a large sample of manufacturing firms from four industries, with SIC codes 35, 36, 37 and 38. These firms manufacture industrial machinery and equipment, electrical and electronic machinery, transportation equipment, and measuring, analyzing and controlling instruments. In the absence of secondary data on study constructs, we decided to collect survey data.

3.1 The Sampling Frame, Data Collection and Checks for Bias

We sought the cooperation of the Institute of Supply Management (ISM) to collect our data.[4] Our sample frame consisted of a mailing list obtained from ISM. From this list, we selected a stratified random sample of 2,000 firms. The four industries mentioned earlier were represented in the same proportion in our sample as in the ISM database. Respondents in our sample were in managerial ranks, with their most common titles being

[4] ISM (www.ism.ws) is the premier association of procurement professionals with more than 40,000 members in the U.S.

procurement manager, purchasing manager, inventory manager and procurement director. The initial survey package mailed to the respondents included the questionnaire, a personalized cover letter explaining the purpose of the study and seeking the cooperation of participants, a letter from the CEO of ISM requesting members to participate in this study and a business return envelope. Five weeks after the first mailing, we mailed a follow-up questionnaire and a reminder. We received 318 and 125 responses in the first and the second round, respectively. Eight surveys were returned because of an incorrect address. Further, eleven surveys were incomplete and could not be used in the study. The final usable sample contained 424 usable responses, for a response rate of 21. 2 %. Table 1 provides the sample characteristics.

[Insert Table 1 about here]

We took several steps to lower the potential impacts of biases on our results. To minimize the key informant bias, we sent surveys to only those professionals who were directly involved in the procurement of production goods. Respondents in our sample have an average tenure of 11.3 years. They are likely to have insights into the procurement process and organizational capabilities, and their responses are likely to be well-informed due to their rank and long tenure. To address issues related to counteracting motivational barriers, we promised total confidentiality of the information provided to all the participants, and assured them that we would report only aggregate results in any publication. Kolmogorov-Smirnov test indicated that there was no systematic bias between the responses obtained from two sampling rounds. Kruskal-Wallis test indicated that there was no systematic bias between the responses obtained from different industries. In other words, industry or sampling round is not likely to impact our results significantly. Hence we merged the samples across different sampling rounds and industries. Further tests, such as two-sample t-test performed to compare firm sizes indicated that firms in our sample were not statistically different from those in the population. We used multi-dimensional outlier detection method using Mahalanobis distance. The square of the Mahalanobis distance can be interpreted as chi-square statistic with the degrees of freedom equal to the number of variables. Tabachnick and Fidell (1996) have suggested that a conservative estimate of $p < 0.001$ be used in this test so that too

many sample points are not excluded from analysis. We were left with 412 observations at this point that we used in all further analyses. Table 2 reports the descriptive statistics and correlations between constructs.

[Insert Table 2 about here]

Additionally, because we had access to one key respondent in every firm, we attempted to lower the potential impact of common method bias. Following the recommendations of Podsakoff et al (2003), we: 1) allowed responses to be anonymous and assured respondents that there were no right or wrong answers, 2) attempted to have simpler and more direct questions through iterative pilot testing for respondents' ease of understanding, and 3) used different scale end points for variables. These steps facilitate lowering of common method bias (Podsakoff et al., 2003). Further, we conducted the Harman's one factor test to assess the impact of bias (Podsakoff and Organ, 1986). Principal components analysis (PCA) resulted in 6 components which accounted for 67.6 % of the total variance, and the first component accounted for only 23.26 % of the variance, hence there is no evidence of a general factor accounting for more than 50% of the variance. The generalized test suggested by Podsakoff et al. (2003) also did not detect the presence of common-method bias. Based on these tests, we concluded that common method bias is not a significant threat in this research.

3.2 Instrument Design, Development and Refinement

After reviewing the prior literature in operations management, information systems, and strategic management to identify the relevant constructs, we developed a preliminary research model and survey questionnaire. In order to ground our research in pragmatic considerations, we also conducted field interviews with procurement managers in a large city in the Southwest United States. Our interviews revealed that firms differ significantly in their procurement capabilities and their understanding of how these capabilities are interrelated. Based on our interviews, we refined our model and the questionnaire. Faculty members actively involved in supply-chain research and five doctoral students reviewed this questionnaire for wording, content and understandability. The survey was modified based on the feedback obtained. These steps ensured face and content validity of

the items. The modified questionnaire was pilot-tested with ISM members and improved iteratively three more times, before being used in the actual survey. The final survey instrument is reported in the Appendix.

Measures were adopted or adapted from prior literature when they were available and appropriate. In the absence of existing scales, theoretically-grounded new scales were developed specifically for this study. Several constructs were measured with multiple indicators coded on a seven-point Likert scale. External relationship knowledge was measured using four items. These items were adapted from prior work (e.g., Bensaou, 1997; Bensaou and Venkatraman, 1995; Dyer and Singh, 1998). Internal process knowledge was measured using three items. These items were developed for this study. Internal procurement digitization was operationalized with five items which measure the extent to which the firm is using IT in value-adding ways in the procurement process. External online search digitization was measured using two items – the extent of Internet use in product search and identification of suppliers, and external online ordering digitization was measured using four items – the extent of Internet use in negotiation, completing transactions, document exchange and financial settlement. The percentage scale was used to measure the last two constructs. Similar measures have been used in prior literature (Devaraj et al., 2007). Procurement process performance was measured as the total number of performance indicators where the firm has experienced improvements (See Appendix). Item parceling, which is a common practice when indicators are coarsely categorized, was used to create the measure (Bandalos, 2002). These metrics were chosen based on a review of prior literature on procurement and the impact of IT use on procurement (e.g., Monczka et al., 2002; Mukhopadhyay et al., 1995). Pursuant to the guidance of scholars (e.g., Armstrong and Sambamurthy, 1999; Piccoli and Ives, 2005), we analyzed procurement process performance of firms relative to others in their industry to assess their performance in comparison to competitors. This approach enabled a competitive assessment of firm performance.

4. Data Analysis and Results

The measurement model was estimated using partial least squares (PLS) implemented in SmartPLS 2.0. After establishing that the measurement model fits the data well, we examined the factor loadings to calculate the reliability of constructs and to assess construct validity. The reliability of constructs was measured using the composite reliability index. Composite reliability of constructs varied from 0.79 to 0.93. These values suggest that the instrument has adequate reliability (Nunnally, 1978). The loadings, reported in Table 3, varied from 0.50 to 0.94 and were significant ($p<0.01$), establishing convergent validity (Anderson and Gerbing, 1988). Discriminant validity was assessed by comparing the square root of AVE value for every construct and the square of correlation value between that construct and every other construct (Fornell and Larcker, 1981). Discriminant validity is supported for all the constructs (see Table 2). Convergent and discriminant validity together establish the validity of the scale (Anderson and Gerbing, 1988).

[Insert Table 3 about here]

4.1 Second Order Constructs

As mentioned earlier, we conceptualized the higher-level capability of procurement integration competence and the lower-level capability of digital procurement competence as reflective second-order constructs. The former comprises two first-order reflective constructs while the latter comprises three first-order constructs. Consistent with our conceptualization of these constructs, the first-order constructs are complementary, and can co-vary and interact with each other, making the second-order reflective construct an appropriate choice (Chin, 1998; Tanriverdi and Venkatraman, 2005).[5]

The second set of results in Table 4 shows the coefficients for the reflective second order constructs. Procurement integration competence has two first-order construct dimensions – internal process knowledge and external relationship knowledge. As can be seen from the Table, both these coefficients are positive and statistically significant at the 1% level. Further, digital procurement competence has three first-order construct dimensions – internal procurement digitization, external online search digitization, external online ordering

[5] Analyses were performed using both reflective and formative conceptualizations. Results didn't change qualitatively.

digitization. All three of these coefficients are positive and statistically significant at 1% level. Taken together, these results offer statistical support for the two reflective second-order constructs as conceptualized and modeled in this study. We further justify our choice of a second-order factor model through additional tests and checks reported in the section on alternative models.

[Insert Table 4 about Here]

4.2 Results

The results of the structural model are reported in Table 4. We observe that the path coefficient representing the relationship between procurement integration competence and digital procurement competence is 0.297 and it is statistically significant at the 1% level. Hence, we find strong evidence for hypothesis H1 suggesting that firms that have a high degree of procurement integration competence tend to also possess high digital procurement competence. In other words, in the context of procurement processes, we find evidence for a higher-level competency leading to a lower-level competency in our model. The second major relationship posited in this study is between digital procurement competence and procurement process performance. The path coefficient for this relationship is 0.398 and it is statistically significant at the 1% level. Thus, hypothesis H2 is also strongly supported. This suggests that the lower-level task capability has significant procurement performance implications. While the control variables for size of the firm measured in number of employees and revenue were positively related to performance, their effect was not statistically significant at the 10 % level. Finally, 19.1% of the variance in procurement process performance is explained by our research model.

4.3 Alternative Models

Testing of alternative constitutes an important, but oft-ignored, aspect of estimating structural equation models. This confirmation bias – the prejudice in favor of model being evaluated – limits theoretical development. Thus, we estimated an alternative model, which is also grounded in theory. Theoretically, it is possible for higher-level functional capability to directly impact both lower-level task capability and performance. Accordingly, we estimated a model that is consistent with partial mediation and compared the results with those from the

hypothesized model. We conducted two tests to validate our research model of complete mediation (see Subramani, 2004 and Rai et al., 2006 for details). The first test entailed creating a partial mediation model with links between procurement integration competence and procurement process performance, beyond the other links present in our research model. As reported earlier, R-squared for the completely mediated model was 0.191. We found the R-squared for the partially mediated model to be 0.193. The impact of an extra path and the difference in subsequent R-squared can be assessed using the f^2 statistic and the pseudo F statistic. We find that f^2 statistic is .0025 and pseudo F (1, 406) statistic is 3.86 for α=0.05, indicating that the f^2 statistic is insignificant. This suggests that the addition of an extra link between the higher-level capability and procurement process performance does not impact the R-squared value significantly.

The second test entailed establishing the significance of the mediation effects. As reported in the paper, the standardized coefficients between the links IV->M and M->DV are 0.297 and 0.398 respectively.[6] Further, the standard errors of these estimates are 0.1004 and 0.0962 respectively. The magnitude of the mediation effect can be calculated by multiplying the respective standardized coefficients between the links IV->M and M->DV (See Rai et al., 2006 for details). We find that the magnitude of the effect is 0.118206 and the standard error is 0.00263. This gives us a z statistic of 2.31, which is significant at $p < .01$.

These two complementary tests suggest that complete mediation is supported by the data and is preferable over partial mediation where we added the link between procurement integration competence and procurement process performance (Rai et al., 2006; Subramani, 2004).

Finally, we compared the hypothesized research model having second-order constructs with an alternative model having only first-order constructs. Prior literature on comparing first- and second-order factor models has suggested various criteria to be evaluated (Tanriverdi 2005, 2006): (1) significance of the coefficients for second-order factors (Tippins and Sohi, 2003), (2) significance to criterion variable of interest, and (3) model fit statistics (Tippins and Sohi, 2003; Tanriverdi, 2005). On the first criteria, all factor loadings

[6] IV – Independent Variable; M – Mediating Variable; DV – Dependent Variable.

for the second-order factors are statistically significant (as shown in Table 4). While the second-order model yields a significant relationship between digital procurement competence and process performance, the first-order model did not support a significant link between a first order construct - external online search digitization - and process performance. Finally, the model fit was very comparable between the first-order and second-order models. Under these circumstances, the second-order factor model should be preferred because it is a more parsimonious model (Diamantopoulos and Winklhofer, 2001; Tanriverdi, 2005). Based on an evaluation of the criteria listed above the second order model is more suitable.

5. Discussion

In this research, our goal was to examine the capability hierarchy in the context of electronic procurement and its impact on procurement process performance. Despite some theoretical work on capability hierarchy, and the widespread belief of its existence, little empirical work has been done to examine capability hierarchy in a business process. Our study was motivated by the observation that while functional capabilities can have a significant impact on process performance in firms, the business process capability hierarchy and the role of IT in this hierarchy have been studied rather sparsely and infrequently in the operations, strategy and information systems literature. We conceptualize a hierarchy of capabilities wherein the higher-level operational capability enables a firm to develop lower-level task capabilities in a related, technology-enabled context. To the best of our knowledge, this is among the first inquiries to provide such a conceptualization and empirically demonstrate the relationship between higher- and lower-level functional capabilities and performance through a large sample of firms. In doing so, this paper makes significant incremental contributions to the literature. The finding that higher-level operational capabilities may not be related directly to process performance, but make an impact through lower-level task capabilities is a significant insight that was not available in the literature before this paper. This is particularly interesting as prior research suggests that higher-level capabilities can impact performance directly, and indeed be more effective than lower-level capabilities.

However, because of our fine-grained focus on capabilities, we are able to establish that the dominant perspective in the literature may not have universal application.

An interesting aspect of our conceptualization of capabilities hierarchy is that higher-level capabilities can be developed independent of IT. For example, actively working with suppliers as partners, involving suppliers in long-range planning, coordinating closely with suppliers can all be accomplished without IT as well. Historically, there have been a large number of organizations that have accomplished above-mentioned feats without using IT, and in fact, there continue to be organizations where IT applications are successful because of the already existing good business and cultural practices. But, once these higher-level capabilities are in place, they facilitate the creation of technology-enabled lower-level capabilities in a related domain.

The research model proposed by us found strong support from the data. Both the hypotheses posited were supported at 1% level. We find strong support for the argument that higher-level procurement capabilities allow firms to develop and nurture lower-level task capabilities in related contexts that are enabled by information technologies. The latter capabilities enable firms to perform specific activities in a more efficient manner and influence performance at the process level.

Two interesting insights emerge from our results. We find that the impact of higher-level capability – procurement integration competence – on performance is completely mediated by the lower-level task capability – digital procurement competence. Thus, in a slight departure from the arguments espoused and findings reported in extant literature (Grant, 1996; Rai et al., 2006; Sambamurthy et al., 2003), we find that lower-level capabilities are more valuable for firms in certain processes. In fact, in the presence of strong lower-level task capabilities, the impact of higher-level operational capabilities may be manifested completely through the former. We do acknowledge that our context, grounded in the procurement process and e-procurement, may be partly responsible for this result. We suggest that perhaps, when examining performance at the fine-grained level of a business process, it is the capabilities that enable the firm to accomplish specific and focused tasks effectively and efficiently that impact process performance, and in fact,

the impact of broader operational capabilities may be manifested through them. We submit that the discussion on the relative impact of higher-level versus lower-level capabilities on performance cannot be devoid of the context, and may need further examination.

A second interesting insight from our result is that IT-enabled task capabilities are created in the larger context of organizational functional capabilities. The knowledge that firms acquire about their idiosyncratic internal processes and their network of external business partners has a significant impact on their ability to create IT-enabled functional capabilities. The theoretical mechanism in the nomological net from higher-level functional capability to lower-level technology-enabled task capability to procurement process performance is absorptive capacity. It enables a firm to apply extant procurement knowledge acquired through day-to-day operations in a new domain, which is technology enabled, to perform tasks more efficiently, which eventually results in enhanced performance outcomes at the procurement process level.

Recent research discusses the spillover effects of IT in business processes (Tallon, 2012). This literature asserts that the effects of IT application in a business process may not be confined only to that process, but may have spillover effects on other downstream processes that may be adjacent to or farther away from the original process. In other words, the impact of IT on business processes is not a static process, but rather a dynamic process where first-order impacts are felt within the same process, but over time, spillover impacts may be experienced in other processes. This has direct application in our context as well. Lower-level and higher-level procurement capabilities may be dynamically related and may have direct as well as spillover effects. More specifically, lower-level task capabilities can impact process performance directly, but their spillover effects can be felt on higher-level capabilities in the same domain. Thus, technology-enabled, lower-level task capabilities, over time, can help the firm develop and exploit technology-enabled higher-level functional capabilities, which can materialize when the knowledge contained in these task-level capabilities is integrated effectively in the firm (Grant, 1996). Essentially, the relationship between lower-level and higher-level functional capabilities can be dynamic where lower-level capabilities in a domain may lead to

higher-level capability in that domain, which in turn may lead to lower-level capabilities in a related domain. In this study, however, we are focused on only the second of the two links and not the first two.

In examining the relationship between different levels of capabilities, we chose to conceptualize and implement capabilities as a second-order constructs. From a methodological standpoint, our analysis and robustness checks provide compelling support for second-order constructs for higher-level and lower-level capabilities in the context of procurement. Future studies in this domain can validate or refine these second-order constructs and relate them to various dimensions of procurement performance.

In summary, this study represents an interdisciplinary approach to examine the largely under-examined phenomenon of functional capability hierarchy, as instantiated in the organizational procurement process, by drawing upon and building on research in operations management, information systems, and strategy.

5.1 Limitations of the Research

Notwithstanding the careful attention paid to the design and execution of our study, we acknowledge some limitations. First, the firms included in our sample are primarily involved in manufacturing industrial machinery and equipment, electrical and electronic machinery, transportation equipment, and control instruments. As such, our results are strictly generalizable to similar firms. Further studies might examine the relationships proposed by this study in a larger or different cross-section of firms and industries. Empirical examinations in service and process manufacturing industries may be particularly insightful.

Second, while the measure for procurement performance used in this study is fairly rich, tapping into facets of cost, timeliness, and quality of procurement performance, it is conceivable that other measures of procurement performance may be affected in other settings. Future research may consider creating other measures reflecting a firm's procurement process performance and linking it to the financial performance measures at the firm level.

Third, this study examined capability hierarchy in the procurement process. We found support for the argument that higher-level functional capabilities impact lower-level task capabilities in the procurement process. Additionally, we found that the lower-level task capabilities completely mediate the impact of higher-level functional capabilities on procurement process performance. However, our data collection took place in a focused setting of procurement of direct materials in manufacturing firms. Our results may not generalize to other industries or other types of materials or other processes. Future research can examine whether the relationships posited and verified in our research are valid in other circumstances.

Finally, the data collected in this study are cross-sectional in nature. Future research can undertake a longitudinal study and examine capabilities and performance over a period of time. A study of this nature is more germane to uncovering causal relationships between capabilities at various levels and their impact on performance. Further, common-method bias is a recurring issue in survey-based research employing a single respondent. However, this problem is mitigated in our context for several reasons, including the long tenure of respondents, and the nature of questions that pertained to facts and organizational perceptions rather than psychological states and attitudes, which are more prone to problems of common-method bias. Several tests suggest that common-method bias does not influence our results significantly. Thus, managers' perceptions of procurement performance may not be much different from the actual performance (Zhu and Kraemer, 2005). Nevertheless, we recommend that future research circumvent this issue by surveying more than one key respondent and/or collecting data from other sources such as archival data.

5.2 Implications for Research and Practice

In light of the fact that functional capability hierarchy, the interrelationships between various capabilities and the impact of these capabilities on performance is lacking in the literature, this paper has four important implications for research. First, we believe that nuanced relationships between capabilities and the performance of various operational processes should be investigated in greater detail. More specifically, relationship between capabilities at different levels can be particularly insightful. Because the impacts of

functional capabilities are first felt on business processes (Mishra et al., 2007; Ray et al., 2004), it is essential that scholars examine such impacts at a more granular level – at the level of organizational business process (Heim and Peng, 2010; Rai et al., 2006). Second, the concept of functional capability hierarchy deserves the attention of researchers and managers, and provides a rich avenue for future research. At the lower level, functional capabilities should be grounded in the activities or tasks that firms perform. Concurrently, these lower-level capabilities should be tied to the broader organizational knowledge creation and utilization capabilities. Third, we believe that the concept of knowledge as a capability is still in its infancy and provides a significant opportunity to scholars for theoretical advancement. For instance, the concept of capability hierarchy can be applied in a wide variety of business processes, such as customer-relationship management, new product development, manufacturing, etc., to provide a detailed perspective on how various capabilities, some IT enabled and others not, may be related to one another and jointly impact the performance of such processes. Finally, it is important to remember that while we examined a hierarchy within functional capabilities, hierarchically structured capabilities can also be present within the broad spectrum dynamic capabilities. As researchers examine environmental uncertainty and its impact on a firm's operations, they will be well-advised to study the interrelationship between capabilities at different levels that enable the firm to manage the environmental turbulence and the impact of such capabilities of performance.

This research has significant implications for managers. Our results indicate that higher-level capabilities impact lower-level capabilities significantly. Even though higher-level operational capabilities may not directly impact performance, they are integral to the success of a firm as they enable the creation and exploitation of lower-level task capabilities. Without the operational capabilities, firms may find it difficult to use lower-level task capabilities. Because, higher-level capabilities are wider in scope and are more difficult for competitors to copy (Grant, 1996), it behooves managers to create and nurture such capabilities. These capabilities may serve as a precondition to the creation of lower-level capabilities. It is also critical that firms exploit these higher-level capabilities, create lower-level capabilities and apply them in specific contexts to

digitize both intra- and inter-organizational tasks to obtain performance benefits. Looking at the totality of our results, we would hasten to caution managers that both high and low level functional capabilities are important, yet their essence may be reflected differently. Without higher-level operational capabilities, the creation of lower-level task capabilities may not be possible, but without the latter, firms may not be able to take full advantage of the former.

Another managerial implication stems from the fact that higher-level capabilities can be developed independent of IT, though these higher-level capabilities facilitate the technology-enabled lower-level capabilities such as digitization in the context of the procurement process. This points to the need to start with a broader lens to understand processes and build competencies before investing in technology-based solutions. In other words, it is not technology for the sake of technology rather it is technology that is driven by higher-level competencies that lead to operational benefits.

5.3 Conclusion

As firms endeavor to enhance their performance by employing innovative technologies in various business processes, it becomes important for researchers to examine the capabilities that enable firms to obtain better process performance. In this paper, drawing upon the resource- and knowledge-based views of the firm, and the absorptive capacity literature, we proposed a capability hierarchy examining the relationship between a second-order higher-level functional capability, a second-order lower-level functional capability and procurement process performance. Our research model found strong validation from the data, providing support to our capability hierarchy conceptualization. The conceptualization developed in this study and our results provide a nuanced view of the relationship between hierarchically structured functional capabilities and organizational performance at the process level. We hope that this study stimulates further research to enrich our understanding of the ways by which firms can obtain performance benefits in operational processes.

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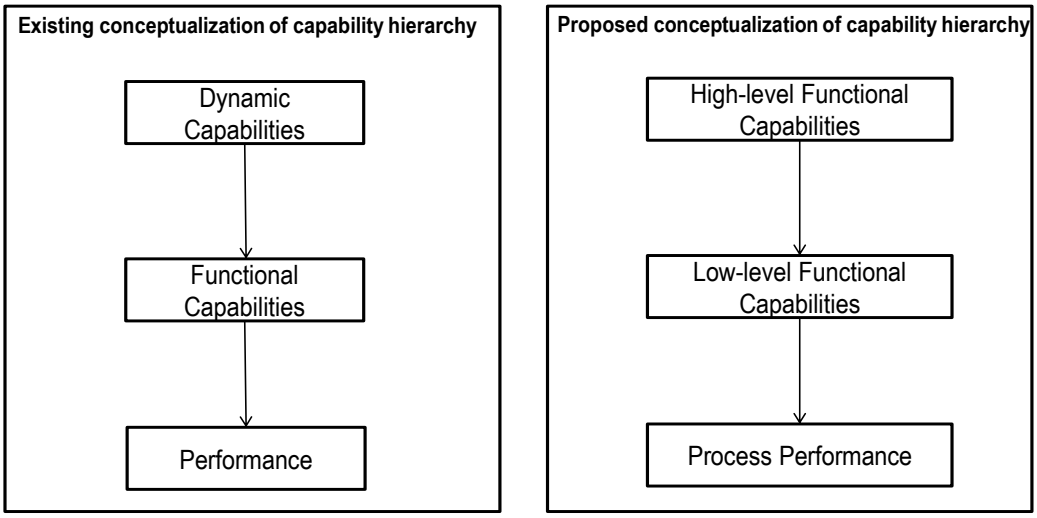

Figure 1: A Comparison of Existing and Proposed Capability Hierarchies

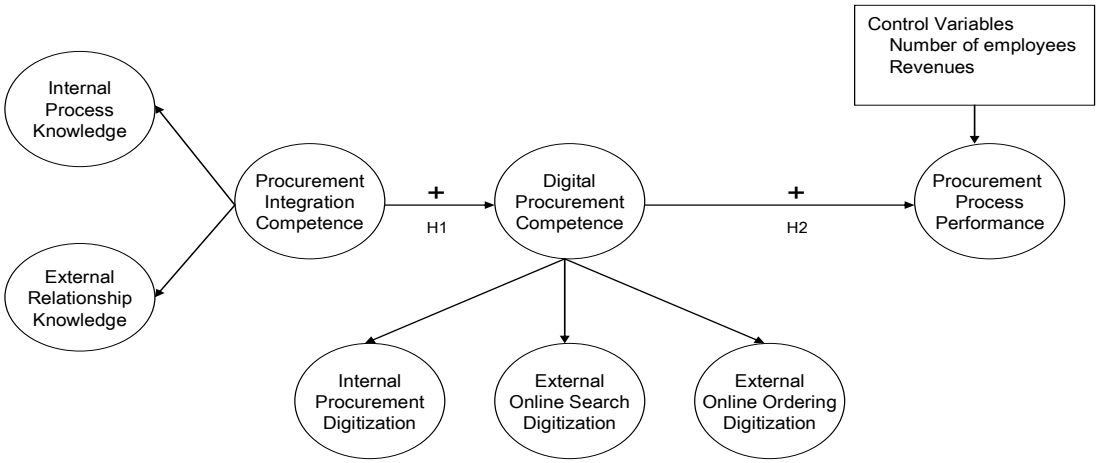

Figure 2: Research Model

Table 1: Sample Characteristics

1. Firm's Size – Revenues in Million $	Percentage
Less than 100 million	44.7
100 – 499 million	32.7
500 – 4999 million	14.6
Above 5000 million	8.0
2. Firm's Size – Number of Employees	
Less than 100	9.7
100 – 499	40.0
500 – 1000	14.9
1000 – 4999	20.8
Above 5000	14.6
3. Industry	
SIC code 35. Industrial & Commercial Machinery & Computer Equipment	30.6
SIC code 36. Electronic & Other Electrical Equipment & Components except Computer Equipments	28.4
SIC code 37. Transportation Equipment	22.6
SIC code 38. Measuring, Analyzing & Controlling Instruments; Photographic, medical & Optical Goods; Watches & Clocks	18.4

Table 2: Descriptive Statistics, Correlations among Constructs and Square-root of Average Variance Extracted

Constructs	Mean	S.D.	V1	V2	V3	V4	V5	V6
Internal process knowledge (V1)	12.20	3.21	**0.78**					
External relationship knowledge (V2)	18.85	3.69	.20**	**0.84**				
Internal procurement digitization (V3)	15.16	3.90	.02	.52**	**0.67**			
External online search digitization (V4)	0.28	0.24	.12	.16*	.23**	**0.93**		
External online ordering digitization (V5)	0.11	0.14	.11	.20**	.39**	.54**	**0.82**	
Procurement process performance (V6)	1.04	1.38	.07	.07	.26**	.21**	.42**	

**: p<.01; *:p<.05

Table 3: Construct Loadings and t-statistics

Second-Order Construct	First-Order Construct	Indicators	Loadings	t-stat
Procurement Integration Competence	Internal Process Knowledge	IPK1	0.777	2.96**
		IPK2	0.734	2.43**
		IPK3	0.821	3.72**

	External Relationship Knowledge	ERK1	0.721	7.16**
		ERK2	0.887	29.79**
		ERK3	0.879	28.92**
		ERK4	0.882	29.18**
Digital Procurement Competence	Internal Procurement Digitization	IPD1	0.681	8.35**
		IPD2	0.768	13.16**
		IPD3	0.504	4.52**
		IPD4	0.632	6.65**
		IPD5	0.718	11.15**
	External Online Search Digitization	EOSD1	0.929	34.96**
		EOSD2	0.940	50.63**
	External Online Ordering Digitization	EOOD1	0.842	13.96**
		EOOD2	0.861	16.42**
		EOOD3	0.833	12.08**
		EOOD4	0.733	11.34**

** significant at $p<0.01$

Table 4: Summary of Results

Path	Coefficient	Significance
H1: Procurement integration competence -> Digital procurement competence	0.297**	< 0.01
H2: Digital procurement competence -> Procurement process performance	0.398**	< 0.01
Control variable: Size -> Procurement process performance	0.107	NS
Control variable: Revenue -> Procurement process performance	0.130	NS
Percent Variance Explained (R-square) for Procurement Process Performance = 19.1%		
Second Order Coefficients		
Procurement integration competence -> Internal process knowledge	0.497**	< 0.01
Procurement integration competence -> External relationship knowledge	0.941**	< 0.01
Digital procurement competence -> Internal procurement digitization	0.635**	< 0.01
Digital procurement competence -> External online search digitization	0.682**	< 0.01
Digital procurement competence -> External online ordering digitization	0.884**	< 0.01

**: p<0.01; NS: Non-significant

Appendix: Survey Instrument

Scale range: 1 = Strongly disagree; 7 = Strongly agree

Dimensions of Higher-order capability: Procurement integration competence

1) External relationship knowledge (Composite reliability = 0.91)

1. We share confidential information with our suppliers.
2. We coordinate closely with our suppliers.
3. We involve our suppliers in our long range planning.
4. We actively work together with our suppliers as partners.

Source of items: Jap and Mohr 2002, Dyer and Singh 1998, Bensaou 1997, Bensaou and Venkatraman 1995

2) Internal process knowledge (Composite reliability =0.82)

1. Our production goods (raw materials) have a complex electronic or mechanical assembly of raw materials.
2. Overall specifications for the production goods we procure are simple. **(R)**[7]
3. A large number of our production goods are custom-designed to our specifications.

Source of items: Items developed for this study

Dimensions of Lower-order capability: Digital procurement competence

3) Internal procurement digitization (Composite reliability = 0.79)

1. We share procurement related information electronically within our firm.
2. Our firm has automated the ordering process for production goods (raw materials).
3. We depend heavily on paper documents during the entire procurement process. **(R)**
4. Our procurement application is highly integrated with other applications (e.g., inventory, logistics, manufacturing).
5. We can easily exchange and integrate data from our suppliers.

Source of items: Barua et al. (2004), Armstrong and Sambamurthy (1999)

4) External online search digitization (Composite reliability = 0.93)

All the items were measured using percentage scale.

Task	% accomplished on the Internet
Product search on the Internet	
Identification of new suppliers on the Internet	

Source of items: Items based upon Zenz and Thompson 1994, Monczka et al. 2002

5) External online ordering digitization (Composite reliability = 0.89)

Task	% accomplished on the Internet
Negotiations of terms with suppliers on the Internet	
Completion of procurement transactions on the Internet	

[7] Reverse coded item

Payment and financial settlement on the Internet

Document exchange on the Internet

Source of items: Items based upon Zenz and Thompson 1994, Monczka et al. 2002

Metrics of procurement process performance

i) Reduction in production goods procurement costs

ii) Reduction in lead-time

iii) Reduction in administrative expenses

iv) Reduction in the reject rates of goods procured

v) Reduction in the time to transmit change orders

Source of items: Items based upon the work of Mukhopadhyay et al. 1995, Zenz and Thompson (1994) and Monczka et al. (2002), as well as our interviews with procurement managers.

Control Variables

1) Size: Approximately how many employees work in your firm? _____

2) Revenue: Approximately what is the annual gross revenue of your firm? _____

Note: The natural logarithm was applied to the numbers reported by the respondents to diminish the impact of large variations in independent variables and to lower non-normality violations in the data.