Journal of Strategic Information Systems 27 (2018) 22–42

Contents lists available at ScienceDirect

Journal of Strategic Information Systems

journal homepage: www.elsevier.com/locate/jsis

Exploring the relationships between IT competence, innovation capacity and organizational agility

T. Ravichandran

Lally School of Management, Rensselaer Polytechnic Institute, Troy, NY 12180, United States

ARTICLE INFO

Article history:
Received 5 June 2015
Received in revised form 30 June 2017
Accepted 5 July 2017
Available online 20 July 2017

Keywords:
IT strategy
Agility
IT competence
Complementarities

ABSTRACT

Business environments today are characterized as being very dynamic and hyper competitive. Organizations in these environments have to be agile in order to adapt their strategies and actions to be successful. While it is recognized that information technology can enable firms to be agile, there is a limited understanding of the mechanisms through and the contexts in which Information Technology (IT) enhances agility. This study examines two key antecedents of organizational agility, namely the IT competence of a firm and its innovation capacity and, examine their independent and joint effects on agility. We test our model using data collected from large firms in the US. The results provide strong support for our model. We found that firms with superior IS capabilities coupled with an aggressive IT investment orientation create digital platforms that enable them to be agile. We also found that the innovation capacity of the firm has a positive relationship with organizational agility and that firms with higher innovation capacity are better able to leverage their digital platforms to enhance agility. Our results indicate that organizational agility has a strong positive impact of firm performance. We interpret and discuss these results and their theoretical and practical implications.

© 2017 Elsevier B.V. All rights reserved.

Introduction

Organizations today face changes in their environments that require them to adjust and adapt their actions and strategies very quickly. In this hypercompetitive environment, organizational agility has become an important firm competence that can have profound impacts on performance (D'Aveni and Gunther, 1994). Empirical studies suggest that firms capable of responding quickly and with innovative actions to changes in their business environments have been able to improve their performance (Ferrier, 2001). While a growing body of research has examined the nature of such actions and their effects on firm performance (Ferrier and Lyon, 2004; Ferrier et al., 1999), research on the resources and capabilities that enable firms to be agile is still nascent.

In the information systems (IS) literature, conceptual work has alluded to the role of information technology in enabling firms to be agile (Sambamurthy et al., 2003). Information technology creates digital options for firms that allow them to respond effectively to shifts in the business environments. Firms that have digitized their business processes have options that could be exercised in creating new channels for accessing customers, building real-time integration with supply chain partners, gaining efficiencies in internal operations, and offering new digital products or services (Wheeler, 2002). For example, Cisco which has digitized its business processes has linked its suppliers and contract manufacturers in a supply web that

E-mail address: ravit@rpi.edu

http://dx.doi.org/10.1016/j.jsis.2017.07.002
0963-8687/© 2017 Elsevier B.V. All rights reserved.

is capable of quickly responding to shifts in demand (Tapscott et al., 2000) and many commercial banks depend on their digitized processes to create and deliver new products to their customers (Ross and Beath, 2002).

Recent empirical studies have examined a myriad of factors that enable firms to be agile. Roberts and Grover (2012) posited and found that a firm's IT infrastructure can enable it to sense and respond to customer needs effectively thereby enhancing its agility. Lu and Ramamurthy (2011) found that IT infrastructure capability, synergy between IT and the business and a proactive IT stance could enable firms to be agile. Tallon and Pinsonneault (2011) argued that a firm's strategic IT alignment will impact its agility and that this relationship will be moderated by IT flexibility. Others have examined agile behaviors in specific IS activities such as systems development (Lyytinen and Rose, 2006) and how the existence of inflexible legacy systems hinder firms from becoming agile (van Oosterhout et al., 2006).

Collectively, these studies have examined how information systems capabilities and the characteristics of the digital platforms impact agility. However, not much work has been done in exploring the necessary complementary organizational capabilities that enable firms to leverage their digital platforms effectively. While many firms have developed digital platforms, not all of them have been successful in leveraging these platforms to be agile. Digital platforms provide an opportunity for firms to be agile. However, the extent to which these resources are leveraged effectively could depend on other capabilities of the organization. In particular, a firm's capacity to innovate is critical in enabling it to leverage its digital platforms to rethink its activity systems to become agile. In this research, we seek to contribute to the literature by examining if and how the IT competence and the innovation capacity of a firm independently and jointly enable a firm to be agile. While past research has argued that both IT and firm innovativeness are drivers of firm renewal and adaptation, limited research has examined if and how these competencies are complements and the effects of such complementarities. Theorizing about such complementarities holds the potential of furthering our understanding of the mechanisms through which firms become agile.

This line of enquiry fills critical gaps in theorizing in the literature. First, while the performance effects of digital platform capabilities have been examined and mixed results found, the mechanisms through which such platforms enable firms to perform well is still under researched. In this study, we argue for the need to examine mediating firm competencies such as agility that could link digital platform capabilities to firm level outcomes. We further theorize that such competencies are created through complementary interactions between digital platform capabilities and other non-IT capabilities, specifically the firm's innovation capacity. Second, there is a need to develop and test models that link functional level capabilities to higher order competencies to develop a better understanding of the heterogeneity in firm competencies such as agility. In this study, we develop and test a nomological network that links IS functional capabilities, non-IS organizational capabilities, higher order firm competencies and firm performance in one model and empirically test this model.

Theoretical background

Capability based view of agility

Grant (1996) presented an architecture where task level capabilities aggregate to process level and functional capabilities, which in turn combine to create unique firm competencies. Competencies essentially then are the higher order capabilities that enable firms to accomplish a given organizational goal (Teece et al., 1997; Teece, 2007), preferably in a manner superior to competitors. This somewhat hierarchical structure proposed by Grant implicitly suggests a nomology that relates functional capabilities to higher order rent yielding competencies.

Organizational agility represents a competence that allows firms to adapt to contingencies posed by the environment (Lu and Ramamurthy, 2011; Roberts and Grover, 2012; Tallon and Pinsonneault, 2011). In dynamic environments, where the value of a chosen plan of action might be uncertain, firms could improve their performance by their ability to adjust their activity systems to enhance their rent yielding potential. Such flexibility requires both inherent flexibility in the resources available for deployment by the firm as well as flexibility in deploying the resources (Sanchez, 1995).

In this paper, we argue that IT enables firms to enhance the flexibility of firm resources. We further argue that a firm's innovation capacity provides them the flexibility to configure resources into activity systems that could be rent yielding. This complementary view suggests that firms that have superior IT competence have the potential to be agile but this effect is likely to be enhanced when firms also have a higher innovation capacity. In a similar vein, we also argue that innovative firms are more likely to be agile when they also have higher IT competence.

IT can enhance the inherent flexibility of other firm resources (Sanchez, 1995). For example, use of technologies such as computer aided manufacturing has made manufacturing capacity flexible and the use of automation tools for design have made product development more modular and flexible (Sanchez, 1995). Similarly, the use of warehouse management systems has enabled firms to deploy their warehouse capacities flexibly and the Internet has opened new market channels that are inherently more flexible than traditional channels. Moreover, firms that have digitized their processes could increase their business degrees of freedom when confronted with market opportunities and threats (Gosain et al., 2004). For example, extensive business process digitization allows American Airlines to aggressively respond with price changes to specific routes when competitors announce promotional fares on routes served by American and, digitization of customer boarding processes allows Delta Airlines to be more responsive to customer service needs (Ross and Beath, 2002). Similarly, Dell can dynamically alter the mix of price, promotion and products it offers based on the component inventory levels in its supply

chain (Magretta, 1998). Such a capacity to match demand to supply is in large part because of the IT platforms that link Dell and its partners in a supply web and the extensive digitization of business processes that allows information sharing and coordination (Roberts and Grover, 2012). Moreover, a flexible IT infrastructure enables firms to connect with business partners easily, enable quick deployment of applications and tools and in general permit firms to use informational resources effectively (Gosain et al., 2004).

Digital platforms and agility

The process of creating digital platforms that provide firms such flexibility is a time and path dependent process. As new technologies emerge, opportunities for exploiting these technologies to create business advantage arise. However, firms need to have the managerial vision to understand the implications of emerging technologies (Armstrong and Sambamurthy, 1999; Ravichandran and Liu, 2007), the capacity to deal with the risks of investing in emerging technologies and the capabilities to plan for, deploy and support the use of the technologies to successfully exploit them for business gains (Wang et al., 2012). Moreover, not all firms with the intention to adopt and deploy emerging technologies are able to do so because of the constraints imposed by their existing IT resource endowments and are subject to the asset stock accumulation barriers (Dierickx and Cool, 1989; Piccoli and Ives, 2005; Wang et al., 2012). While emerging technologies may be readily available to firms from the market, the ability to utilize them effectively is predicated on the availability of precursory assets. Under this condition, known as interconnectedness of asset stocks (Dierickx and Cool, 1989), only the firm that has acquired or developed the precursory resources can begin the asset accumulation process. For example, firms that have not integrated internal process using ERP systems might find it challenging to exploit the benefits of supply chain and customer relationship management systems. Similarly, firms such as Wal-Mart that have extensively digitized their supply chain management and warehousing processes might be better positioned to exploit the capabilities of new technologies such as RFID. Thus, creating the digital platforms is both dependent on past actions and decisions with respect to IT as well as the ability to look ahead and proactively renew existing IT assets and, the capability to deploy, operate and support the IT systems in the organization (Wang et al., 2012).

Complementary organizational capabilities and agility

While IT competence provides firms the options to be agile, the extent to which these options are exercised could depend among other things on the innovation capacity of the firm. Research in strategic management and organization theory has long considered innovativeness as an important firm capability that drives organizational change and renewal (Dougherty, 1992; Linder et al., 2003). Empirical studies have shown that innovative firms can leverage their technological resources better than less innovative firms (Danneels, 2002). Digital platforms can be leveraged to rethink the business model of a firm as has been done by firms that have successfully net enabled their organizations (Wheeler, 2002; Amit and Zott, 2001). In fact, innovative firms such as Amazon and Yahoo continuously experiment with many aspects of their business model in a bid to be agile (Rindova and Kotha, 2001). Such continuous morphing involving both managerial innovations and transformation of activity systems characterize agile firms (Sanchez, 1995; Rindova and Kotha, 2001). We argue that innovative firms are more likely to engage in such adaptations and hence, firm innovativeness is an important complementary capability that could explain variance in organizational agility.

However, an innovative firm has to also create the context where such IT-enabled adaptations to the activity systems lead to competencies that are value enhancing. In fact, many firms attempted to incubate their e-business initiatives separately from the rest of the organization because of the potential disruptions that these new business models might cause to their existing business practices. Practitioner experiences suggests that such decoupling creates its own problems in terms of an inability to leverage the assets and competencies of the core organization effectively, the challenges in transitioning the incubated new initiatives back to the organization and integrate the clicks and bricks businesses effectively (Gulati and Garino, 1999; Steinfield and Harry Bouwman, 2002). Overall, emerging research in this area suggests that in addition to the innovativeness of the firm one has to also examine how the innovation initiatives are coupled with the core organization to better understand if and how successful a firm is in leveraging its assets and capabilities to create new growth options. Since our focus is on how firms leverage their digital platforms to become agile, we include the nature of coupling between the IT enabled initiatives and its core business in our theorizing. We conceptualize a firm's innovation capacity to be a function of both its innovativeness and how IT-enabled new initiatives are coupled with the rest of the organization.

Research model

The research model in Fig. 1 depicts that digital platforms, created through a firm's IS capabilities and its IT investment orientation, positively impact organizational agility. Innovation capacity is posited to have a direct effect on organizational agility and to moderate the effect of digital platform capabilities on organizational agility. The model also depicts a direct link between organizational agility and firm performance and, firm size, firm age and industry sector as control variables. The relationship between agility and firm performance has been examined in the past IS research (Lu and Ramamurthy, 2011; Tallon and Pinsonneault, 2011). Given that this relationship is well established in the literature, we do no theorize

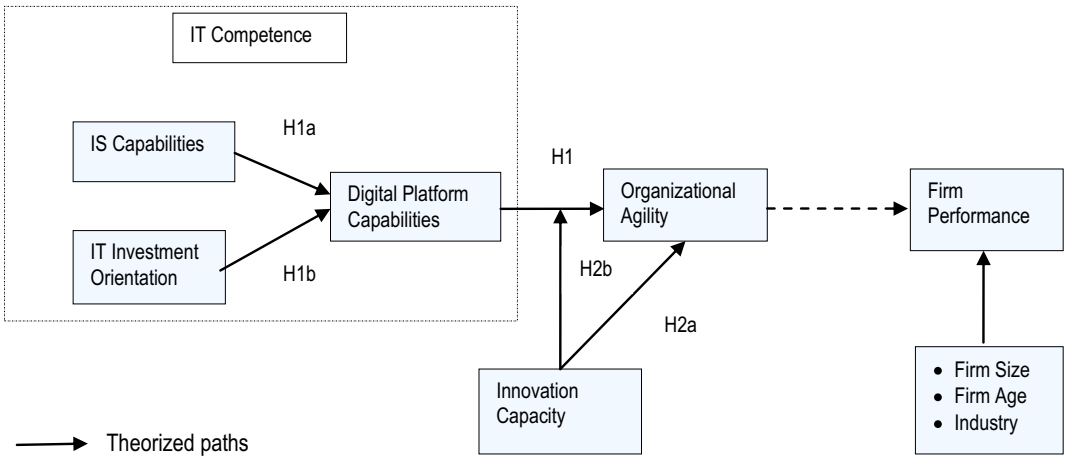

Fig. 1. Research model.

about it in the paper, but include it as part of the model, for the sake of completeness. We first define the constructs in the model and then develop the hypotheses underlying the research model.

Organizational agility

While the notion of agility has received attention in the literature, there is also significant variation in the domain of this construct. Table 1 presents an illustrative summary of the definitions of organizational agility in the IS literature. Sambamurthy et al. (2003) in conceptualizing agility in terms of customer, operational and partnering dimensions emphasized a firm's capacity to respond with speed in understanding and meeting customer needs, streamlining the operational processes of the firm and in establishing external relationships. Overby et al. (2006) delineated agility in terms of sensing and responding capabilities and argued that firms exhibit different types of agility depending on their sensing and responding processes. Lu and Ramamurthy (2011) defined agility in terms of market responsiveness and operational adjustment ability and Tallon and Pinsonneault (2011) defined agility to be a composite of customer, operational and partnering agility. Roberts and Grover (2012) reviewed the literature, found varying definitions of agility and chose to conceptualize customer agility as a dynamic capability encompassing sensing and responding capabilities. Others have operationalized agility in terms of speed with which supply chains respond to shifts in demand (Narasimhan and Das, 1999) and sought to distinguish agility from concepts such as leanness (Narasimhan et al., 2006). Still others have argued that in addition to agility at the operational level, strategic flexibility should be part of the conceptualization of agility (Rindova and Kotha, 2001).

Drawing from these studies, we conceptualize agility as a firm's capacity to respond with speed to environmental changes and opportunities and define it in terms of three dimensions: customer responsiveness, operational flexibility and strategic flexibility. Given the varying perspectives on agility in the literature, we chose aspects that are commonly emphasized by all the studies. Customer responsiveness pertains to the ability to assess customer needs and preferences and respond speedily with product and service offerings. Operational flexibility pertains to the capacity of the firm to streamline processes and improve the speed of product development, supply chain and logistics processes. Strategic flexibility pertains to a firm's capacity to identify and enter new markets and redefine the scope of its business.

These three dimensions are interrelated and agile firms would exhibit higher capability on all three dimensions as each capability is reinforcing of the other. For example, it would be difficult for a firm to be responsive to the market if it is not able to have its extended enterprise including its supply chain partners, act with speed and understanding of market needs or if its core operational processes are inflexible. Moreover, as fundamental shifts in the business landscape occurs, without strategic flexibility firms might not be able to respond to market needs since that might require fundamental changes to the business models of the firm. Dell, known for its agility because of its customer responsiveness and operational flexibility, has faced challenges to its growth and profit margins because the market has shifted more towards mobile devices from the corporate computing segment. Dell in being agile has revamped its product portfolio and its core business model by partnering with retailers such as Wal-Mart and Staples to service the consumer market (Kay, 2007). Without the strategic flexibility to adapt its core business model, Dell's operational flexibility and customer responsiveness may not be sufficient to maintain its growth and profits.

IT competence and organizational agility

As discussed earlier we conceptualize IT competence as a capability reflected in how a firm is able to create digital platforms. Digital platform capabilities are reflected in the flexibility of the IT infrastructure of the firm and the scope of the

Table 1
Illustrative summary of IS research on organizational agility.

Reference	Conceptualization of agility	Approach	Key findings
Sambamurthy et al. (2003)	The ability to detect and respond to opportunities with speed and surprise. This can be differentiated into customer, partnering, and operational agility	Conceptual	Presents a broad framework that argues that a firm's IT competence provides it digital options, which in the presence of entrepreneurial alertness allow firms to be agile
Overby et al. (2006)	The ability of firms to sense environmental change and respond readily	Conceptual	Presents a framework that examines capability imbalance in sensing and responding and its implications for agility. Also posits that IT can directly and indirectly through creating digital options, impact agility
van Oosterhout et al. (2006)	Swiftly change businesses and business processes beyond the normal level of activity	Case study	Legacy systems can constrain an organization from being agile whereas agile IT architectures can enable firms to achieve the desired level of agility. Identifies several contextual factors that contribute to agility gaps in organizations
Goodhue et al. (2009)	Business agility	Case study	Enterprise systems need not constrain firms from being agile. Identifies strategies for firms to develop systems agility both when they have enterprise systems as well as when they do not
Tallon and Pinsonneault (2011)	The ability to detect and respond to opportunities and threats with ease, speed, and dexterity	Survey	Strategic IT alignment has a positive effect on agility; agility has a positive effect on firm performance and this is moderated by environmental volatility
Lu and Ramamurthy (2011)	Firm wide capability to deal with changes that arise unexpectedly in the business environment. Two types of organizational agility: market capitalization agility and operational adjustment agility	Survey	IT capability has a positive effect on both types of organizational agility and IT spending has a positive effect on operational adjustment agility but not on market capitalization agility
Roberts and Grover (2012)	Customer agility which is conceptualized as "degree to which a firm is able to sense and respond quickly to customer-based opportunities for innovation and competitive action"	Survey	Customer-based knowledge creation and customer-based process execution positively impact agility, which in turn impacts the competitive actions taken by firms

application platforms that have been adopted by the firm. Several technologies have been identified that when adopted provide firms the options to sense and respond (Roberts and Grover, 2012). These platforms provide the foundation for the further digitization of the enterprise and for the effective exploitation of emerging information technologies. For example, Cisco revamped its IT infrastructure through its ERP implementation, which provided the basic platform for its further digitization efforts and its success in completely transitioning to a web-based IT infrastructure (Nolan et al., 2001). It is this capability that has enabled Cisco to be agile in linking with its supply chain partners or quickly integrating the many firms it acquires in its quest to grow through strategic acquisitions. Similarly, firms such as Harrah's have been successful in creating an appropriate IT infrastructure and business intelligence systems that enable the firm to be quick in identifying customer needs and tailoring products, services and loyalty programs better than other players in the highly competitive casino industry (Loveman, 2003).

Developing digital platforms that can provide flexibility without raising the risk of long-term rigidity is an important strategic priority in many firms (Mooney and Ganley, 2007). Towards this end, firms have found that moving from legacy IT platforms to Internet platforms provides higher flexibility in digitizing processes. Digital options are expected to be higher when more business processes in an organization are digitized, which Sambamurthy et al. (2003) refer to as digital process capital. Moreover, when digital platforms are used to create knowledge repositories and enable knowledge sharing within and across organizations, digital options are enhanced, which Sambamurthy et al. (2003) refer to as digitized knowledge capital. Thus, the greater the number of processes that are digitized and greater the variety of applications that have been deployed to digitize processes in the firm, the greater the digital platform capabilities. For example, firms that have adopted enterprise applications such as ERP, CRM, knowledge management and business intelligence systems might have higher digitized process and knowledge capital than those that might have adopted a subset of these applications. Moreover, dependencies among these platforms in terms of data sharing and process standardization might inhibit firms that have not adopted some foundational applications from effectively benefiting from other applications. Therefore, IT platforms do vary in terms of the capabilities they offer firms. IT platforms characterized by a flexible infrastructure combined with a greater scope in the applications deployed are likely to provide superior capabilities.

Firms that have created these digital platforms have the capacity to both sense market trends and customer needs and, the ability to react quickly. Digital platforms allow firms to connect with a diverse set of external entities, form weak ties and span structural holes in interorganizational networks (Chi et al., 2010). Such ties expose firms to new information, increase their awareness of opportunities and in general, enable firms to sense their environments better. Such awareness is a precursor for competitive actions (Chen, 1996) and digital platforms by enhancing awareness can enable firms to be responsive to shifts in their competitive environments.

In addition, digital platforms allow firms to respond effectively to opportunities they sense. Since digital platforms enhance the inherent flexibility of the firm resources (Sanchez, 1995) they enable firms to deploy their resources in new ways to respond to market opportunities. For example, the use of digital assets to substitute for physical assets or enhance the performance of physical assets creates options for firms in terms of how the physical assets such as plant capacity or inventories are used. Moreover, responding to market shifts requires harnessing and coordinating resources within and across the extended enterprise, which becomes easier when firms are integrated through digital platforms. Roberts and Grover (2012) argue that digital platforms act as magnifiers that enhance other coordination activities within and across firm boundaries.

Firms seeking to be agile often create new business models. For example, using digital platforms retail firms such as Lands End implemented mass customization that allowed them to sell custom tailored apparel in a cost effective manner (Ives and Piccoli, 2003). The ability to match demand with supply that comes with mass customization allows this firm to be highly responsive to shifts in demand patterns and customer trends. However, this also increased the complexity of the business, which necessitated the effective use of digital platforms to manage. Other firms have leveraged their digital platforms to create and offer new information-based products and services in their attempt to respond to market needs. Flexible IT infrastructures and extensive digitization of business processes, makes it feasible for a firm to create IT-based business innovations at a lower cost than its competition because the firm can adapt its systems and business processes to accommodate changing conditions cost-effectively. Moreover, such digital platform capabilities provide the basis for organizations to rapidly develop or enhance products or services in a competitive market (Kayworth et al., 2002). This potential value can be converted to real business value when management exploits the flexibility of the infrastructure to develop competencies such as agility. Thus, we posit:

H1. Digital platform capability will have a positive relationship with organizational agility.

Drawing from Grant's architecture of capabilities, we posit that the creation of digital platform capabilities is likely to be dependent on IS functional capabilities and its IT investment strategy. IS functional capabilities are the routines within the IS department that enable it to create the IT platforms needed for the organization. While a variety of IS capabilities have been identified in the literature, we limit our focus to the capabilities in the core functional areas such as planning, systems delivery, IS support and IS operations. We do this because the emphasis on functional capabilities is consistent with prior research where Grant (1996) observed, "capabilities can be identified and appraised using a standard functional classification of the firm's activities" (p. 120). Building on the notion that capabilities are determined by organizational routines, we adopt a process focus and define IS capabilities in terms of the quality and sophistication of IS processes.

Firms make choices about how technology resources are deployed, taking into account the strategic thrusts of the organization. IS planning is an important process that enables organizations to identify business priorities and ensure that IS goals and initiatives are aligned with business priorities. It is likely that with sophisticated IS planning, a greater convergence between IS and business managers on IT priorities can be achieved (Boynton et al., 1994). Such convergence enables the synergistic integration of IT and business knowledge (Boynton et al., 1994), which in turn improves the identification and development of appropriate IT platforms (Reich and Benbasat, 1990). In addition to making choices about targeting IT resources, firms have to successfully develop and implement technology solutions and ensure their effective utilization in order to provide the digital options. Ability to develop high-quality applications in a timely and cost-effective manner is a critical capability that is likely to affect technology deployment (Rockart and Hofman, 1992). In addition, a mature IS support process can ensure that systems are effectively utilized by end users. Since, firms cannot reap benefits from IT platforms unless they are effectively used, IS support could determine how successful a firm is using the IT platforms to be agile.

For many organizations, continuity of business operations is dependent on efficient and reliable IS operations. When firms seek to leverage their IT platforms to respond to shifts in the environment, their tolerance to system failures and business disruptions because of IT platform downtimes is low. For many firms today, system failures can lead to significant business disruptions and losses. For example, losses to the tune of $6.5 million per hour in the case of a brokerage operation, $2.6 million per hour for a credit-card sales authorization system and $14,000 per hour in automated teller machine (ATM) fees are expected if respective systems are shut down (Radding, 1999). Moreover, ineffective IS operations has the potential to damage carefully built reputations for quality and reliability in product and service offerings as was seen when system outages impacted Charles Schwab's on-line trading systems (Dalton, 1999). Thus, we posit:

H1a. Information systems functional capability will have a positive relationship with the digital platform capability.

Carr (2003) pointed out that IT investment risks increase when firms seek first mover advantage by being quick to invest in emerging technologies. Technologies when first introduced are often immature, impose significant knowledge barriers that early adopters have to overcome, lack the complementary services that are required to assimilate and use the technology effectively. Moreover, historically technology costs decline with time and early investors in emerging technologies often pay higher prices for the technology. Firms aggressively investing in emerging technologies not only recognize these risks and costs but also might have the tolerance to deal with such risks. These firms might seek the first mover advantage that could arise with the use of a technology. It is logical that firms capable of tolerating the risks of investing in emerging

technologies are more likely to have the options to leverage technology in pursuit of first mover advantages. In fact, Otim et al. (2012) found that transformative IT investments could reduce the downside risks of firms seeking first mover advantage under some conditions.

On the other hand, firms that do not have high tolerance for such risks might adopt a more defensive posture when investing in IT. These firms might tend to be fast followers who seek to learn from the aggressive IT investors but attempt to derive the performance improvements that a new technology might offer. Some studies have found that firms that are more efficient in utilizing their IT investments are likely to have the incentive to be aggressive in investing in IT (Barua et al., 1991). However, other studies have argued that the declining technology costs should be weighed against the first mover advantages when investing in IT (Demirhan et al., 2005) and, that the competitive intensity of the industry would have to be considered in such decisions (Dewan and Mendelson, 1998; Zhu et al., 2004). These studies suggest that conservative IT investors tend to be cost focused and seek to use the technology in a more defensive role. These firms are typically slower to use IT as a resource in response to changes in their environment, in part because of the time lags and path dependencies involved in building effective IT platforms. Thus, while firms that adopt a less aggressive posture in IT investing can eventually build IT platforms, these firms would have lesser degrees of freedom than aggressive IT investors would at the same point in time. This is consistent with options thinking in technology investing which is premised on the notion that since the likely opportunities for future managerial actions are not clearly known at any point in time, firms that have invested to create options are likely to have the flexibility to act when the need arises (Dai et al., 2007). Thus, we posit:

H1b. An aggressive IT investment orientation will have a positive relationship with digital platform capability.

Innovation capacity and organizational agility

Innovative firms and less innovative firms differ greatly in their risk propensity, attitude toward uncertainty, and acceptance of new technology. Highly innovative firms are more likely to engage in learning and experimenting, are able to cope with high uncertainty and are more prone to taking risks (Hurley and Hult, 1998). Thus, innovative firms are more likely to leverage digital platforms to respond to opportunities and threats faced by them.

In addition to innovativeness, firms could differ in terms of how they incubate innovations. While some scholars have argued that new initiatives are more likely to be successfully commercialized if they are separated from the core organization (Christensen, 2013), more recent studies have called for better integration of the new initiatives with the rest of the organization to enable their success (Govindarajan and Trimble, 2005). This is particularly true in the case of IT-enabled innovations such as the creation of new business models, new channels to access the markets or digital products and services, because such innovations require the firm to leverage existing firm resources in new and novel ways. Moreover, unlike radical product innovations that might be driven by scientific inventions and R&D efforts, IT enabled innovations often stem from business units and require the use of emerging and new technologies to rethink the activity systems of the firm. Large firms have resource advantages that if properly leveraged could lead to success in innovation efforts such as new business models. However, such resource leverage has to be achieved without the culture, norms and business practices of the core organization impeding the new initiatives. Tight coupling between the new initiatives and the core organization along with close intervention by the senior executives in the management of the innovation efforts are needed to balance these tensions (Govindarajan and Trimble, 2005).

Thus, the innovation capacity of a firm is both dependent on its innovativeness and the arrangements it creates when launching new initiatives that enable the firm to effectively leverage existing resource endowments of the firm. Fig. 2 depicts a framework that characterizes innovation capacity in terms of two dimensions namely, firm innovativeness and the nature of coupling between new initiatives and core activities of the organization. The upper right cell depicts firms that have high innovation capacity because they have an organizational climate that enables innovative behavior and they are capable of leveraging the resources of the core organization because of the tight coupling of the new initiatives with the core activities of the firm. The upper left and lower right cells depict firms that have moderate innovative capacity. In the former, while the firm fosters a climate where innovative behavior is encouraged, its ability to leverage firm resources might be limited because of the loose coupling. In the later, firms may be less innovative but have the ability to leverage the resources of the organization to supports initiatives. The lower left cell has low innovation capacity as firms in this cell are less innovative and lack the ability to leverage firm resources effectively because of the loose coupling of the new initiatives with the core activities of the firm.

Agile firms tend to match their asset stocks to the demands imposed on them by their environments. This often entails repurposing existing assets or combining them in novel ways to create new activity systems and business models. While initial attempts to develop IT-enabled business models isolated them as new ventures decoupled from the core organization, firms soon realized the need to exploit synergies between their existing and new business models (Gulati and Garino, 1999) and derive the benefits of integrating the traditional and electronic channels, to serve customers well. Such integration has not been easy for firms because it requires the ability to orchestrate complementary interactions among key business processes and resources (Barki and Pinsonneault, 2005) and overcome inherent conflicts between traditional work practices and those necessitated by the new business models. However, firms able to accomplish such complementary interactions are

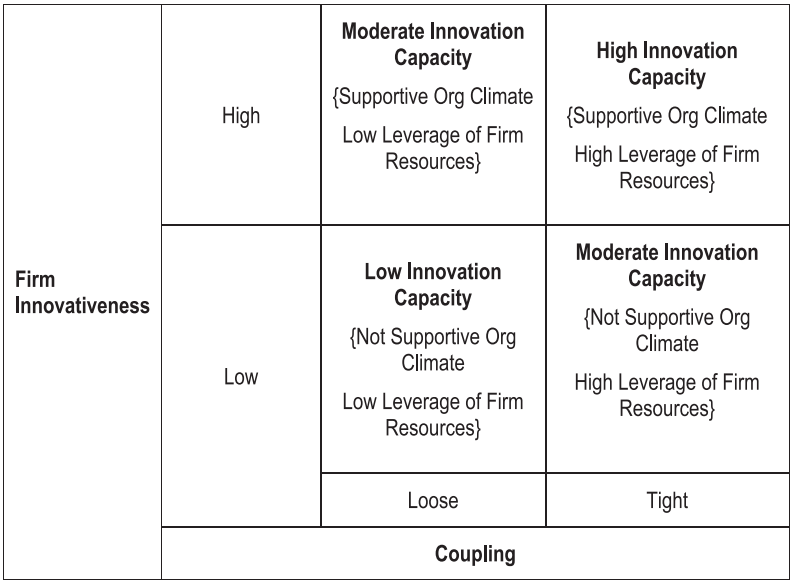

Fig. 2. Innovation capacity framework.

likely to enhance their capability to respond to changes in their business environment quickly and create competitive advantage (Oh et al., 2006).

Firms with higher innovation capacity are more likely to accomplish such complementary interactions for two reasons. First, the organizational climate in innovative firms that does not inhibit risk taking allows these firms to experiment and pursue different course of actions. Such experimentation is necessary to identify appropriate rent yielding complementary interactions among firm resources. For example, firms such as Yahoo and Amazon constantly experiment with and test new ideas and business practices in their quest to be agile and responsive to customer needs and to the shifting business landscape (Rindova and Kotha, 2001). Moreover, firms with higher innovation capacity might be more open to new ideas and hence better positioned to identify market opportunities and bring new products to markets faster than their competitors. Second, the tight coupling of new business models with the rest of the organization makes it easier for firms with high innovation capacity to assemble the resource bundles needed to bring new products and services to markets or to rethink their business models. Thus, we posit:

H2a. Innovation capacity of a firm will have a positive relationship with organizational agility.

While innovative firms might have the incentives to repurpose firm resources to create new activity systems or business models, this process is easier when the resources are inherently flexible. As discussed earlier, the inherent flexibility of firm resources is enhanced by digitization. Thus, firms with higher innovation capacity are more likely to covert the potential value of such flexibility into realized outcomes such as enhanced organizational agility. Hence, we posit:

H2b. Innovation capacity of a firm will positively moderate the relationship between digital platform capability and organizational agility.

Empirical study

Data for testing the research model was collected though a mail survey of large firms in the US.[1] The names and titles of senior IS executives in the Fortune 1000 firms were obtained from several sources such as corporate directories to create a mailing list of 710 firms. Three mailings were undertaken each spaced apart by three weeks. 129 responses were received resulting in a response rate of 18.2%.

The profile of the respondents was compared with those in the mailing list on variables such as organization size and IS department size. The chi-square analysis revealed no systematic response bias. Chi-square tests comparing early and late respondents on organization size, industry and IS department size, also revealed no significant response bias. The organiza-

[1] The study was conducted in 2004–2005. This period is after the enterprise platforms and doc com era but before cloud, social networks and other technologies became widely used.

Table 2
Descriptive statistics of the sample and respondents.

Factors	Proportion of sample (N = 129)
Industry sectors	
Manufacturing	64.34%
Banks	3.87%
Financial Services	3.87%
Insurance	10.07%
Retail	6.20%
Transportation	3.87%
Utilities	3.87%
Others	3.87%
Firm size (Number of employees)	
<5000	47.1%
5001–10,000	10.7%
10,001–25,000	15.7%
>25,001	18.6%
Missing Data	7.1%
IS department size (Number of employees)	
<100	34.4%
101–250	22.9%
251–500	12.9%
501–1000	11.4%
>1001	18.5%
IS budget	
<25 Million	15.7%
26–50 Million	38.6%
51–100 Million	14.3%
>100 Million	20.0%
Missing Data	11.4%
Respondent's position	
CEO/President	4.3%
CIO	42.9%
Senior Vice President	11.4%
Vice President	31.4%
Director	15.7%
Manager	7.1%

tions responded represented diverse industry groups. 65% of the responding firms were in manufacturing, 17.8% were in the financial services, banking and insurance industries, 6.2% in retail and 7.8% in transportation and utilities. The mean size of the responding organization was 17,221 employees. The average size of the IS department in these organizations was 665 employees. Table 2 summarizes the profile of the firms and the respondents in our sample.

The survey was targeted at the senior mangers' in the IS department as they are likely to be the most informed about the strategic issues pertaining IT use in the organization. A significant proportion (85.7%) of the respondents were either Chief Information Officers or Vice Presidents of the IS department. The job titles of the other respondents (Senior VP, VP of Technology, Director of Information Technology) also indicate that they were senior IS executives. 89.9% of respondents indicated that they were within two levels from the highest position in their organization's hierarchy.

Measures

The scales for the various constructs were adapted from prior literature. In cases where validated scales did not exist, we used the conceptual descriptions of the constructs and their domain provided in past studies to develop the scales. Appendix A provides a summary of the scales used and the supporting literature.

Firm performance was measured using a five item scale adapted from Ravichandran and Lertwongsatien (2005), that assessed the extent to which a firm's market share has increased in the past three years in the major product markets it participates and, the firm's performance on cost, productivity, profitability and overall financial performance compared to that of its major competitors. In addition to these perceptual measures, we also collected data about the ROS, ROA and sales growth for the firms in our sample and used these as performance indicators in our analysis.

An implicit element in the conceptualization of agility is that it is a relative construct. Whether a firm is more or less agile is dependent on the firm's ability to act in comparison to its rivals in the industry. This is because firms in the industry might set norms with respect to customer responsiveness or speed of adjusting operations that define expectations of stakeholders in the industry. Firms that fall short of these norms might not be perceived as agile while those that exceed might be. Thus, a comparative assessment, where a firm's agility is assessed relative to that of the industry leaders is perhaps warranted.

To measure the three dimensions of agility we asked the respondents to compare their organization to the top three firms in their industry and respond to the various items pertaining to agility. Customer responsiveness was measured using a five item scale that assessed how successful the firm has been compared to the top three firms in its industry in identifying customer requirements and tailoring products and services that meet customer needs, identifying customer groups who are not served by current product offerings and being responsive to customer service requests. We adapted items from the scales for customer sensing and customer responding capability (Roberts and Grover, 2012) to develop the scale for customer responsiveness. Operational flexibility was measured by assessing how successful the firm was, compared to the top three firms in its industry, in improving the speed of its supply chain and logistics activities, product development and how successful the firm was in streamlining its processes. This scale was developed based on the conceptual discussions of operational flexibility presented in Sambamurthy et al. (2003). Strategic flexibility was measured using a five-item scale that assessed how successful the firm has been in identifying and entering new markets, speed of responding to new business opportunities, redefining the scope of the business and responding to competitors' product and service strategies. This scale was developed based on the conceptual discussions in Rindova and Kotha (2001).

Firm innovativeness was measured using a five-item scale that assessed the extent to which the organization encourages creativity and risk taking, seeks out innovative ideas from its employees and, the extent to which the firm has been at the cutting edge of technological innovations in its industry. This scales was adapted from a sale for innovative culture proposed by Hurley and Hult (1998). Coupling between IT enabled initiatives and the core organization was measured using a single item scale with anchors that ranged from "totally separate" to "fully integrated". The respondents were asked to rate how integrated their IT enabled initiatives such as e-business were with the operations of the rest of the organization. Consistent with our conceptualization of innovation capacity as a function of both firm innovativeness and coupling, we derived the value for innovation capacity as the product of innovativeness and coupling.

Consistent with the conceptualization that digital platform capabilities are reflected in the technological assets of the firm we use two dimensions to measure this construct, IT infrastructure flexibility and application platform scope. IT infrastructure flexibility was measured using a five-item scale that assessed the connectivity and standardization of the networks and computer platforms in the organization, the shareability of corporate data across the organization and the modularity of the application systems (Duncan, 1995; Ravichandran and Lertwongsatien, 2005). Application platform scope was measured by assessing the number of enterprise application platforms that have been deployed. Respondents were asked to indicate whether their firm has deployed each of the following application platforms: enterprise resource planning systems, supply chain management systems, data warehouses and knowledge management systems, business intelligence applications, mobile computing applications and electronic commerce applications.

IS capability was assessed on four key functional areas of the IS unit namely, planning, development, operations and support. Each dimension was measured using multi-item scales adapted from prior studies (Ravichandran and Lertwongsatien, 2005) that tapped into the attributes of these four IS processes. IT investment orientation was measured using a one dimensional response matrix that described the firm's tolerance to technology investment risks and its swiftness in investing in emerging information technologies.

Firm age was measured as the age since inception of the firm and firm size was measured as the natural log of the number of employees in the firm. Industry sector was coded with manufacturing firms as 1 and service firms as 0.

The survey instrument was pre-tested first with a team of IS doctoral students and faculty and then with a convenience sample of 12 senior IS executives. Feedback from this was used to refine the wording of the items in the instrument.

Statistical analysis and results

Scale validation

To validate the scales a factor analysis was conducted using Partial Least Squares. We modeled each construct as a reflective construct measured by the corresponding items in its scale following guidelines provide by Petter et al. (2007). A scale has adequate convergent validity when all its items load highly on the construct. To determine the item loadings, a model with all the constructs measured with multi item scales was constructed and analyzed with no relationships among the constructs specified. The resulting loadings and the correlations among the constructs were used to assess the internal consistency, convergent validity and discriminant validity of the scales. Table 3 presents the results of scale validation. It is seen that all item loadings are high and above minimum recommended levels of 0.50. Moreover, the t values indicate that all loadings are significant at $p < 0.001$ level suggesting that the constructs exhibit high convergent validity. The diagonal values in this table indicate the square root of the average variance extracted by each construct, which is a measure of the variance shared by the scale items and the construct they measure. The off-diagonal values indicate the correlations among the constructs. A rule for assessing discriminant validity is that the square root of the average variance extracted be larger than the correlations among the constructs. It is seen that for each construct, the diagonal values are greater than the off-diagonal values indicating that all constructs exhibit discriminant validity. The table also indicates the internal consistency ratio (ICR), which is a measure of the construct reliability. It is seen that all constructs have an ICR greater than the minimum recommended value of 0.70 indicating that the constructs have acceptable reliability.

Table 3
Validation of scales for multi-item sub-constructs and descriptive statistics.

Constructs and item loadings[a]	Number of items	Mean	SD	ICR	1	2	3	4	5	6	7	8	9	10
1. Operating performance (0.79, 0.91, 0.86, 0.89, 0.67)	5	4.734	1.314	0.916	**0.830**									
2. Firm innovativeness (0.85, 0.91, 0.89, 0.87, 0.76)	5	4.626	1.369	0.932	0.280	**0.856**								
3. Customer responsiveness (0.81, 0.78, 0.79, 0.74, 0.80)	5	4.168	1.069	0.889	0.240	0.405	**0.784**							
4. Operational flexibility (0.78, 0.63, 0.72, 0.72, 0.77, 0.80)	6	4.236	1.064	0.878	0.221	0.417	0.490	**0.740**						
5. Strategic flexibility (0.82, 0.92, 0.87, 0.87, 0.89)	5	4.123	1.113	0.924	0.348	0.458	0.669	0.557	**0.867**					
6. IT infrastructure flexibility (0.85, 0.74, 0.76, 0.62, 0.65)	5	4.614	1.166	0.848	0.232	0.383	0.507	0.447	0.361	**0.730**				
7. IS planning sophistication (0.83, 70, 0.83, 0.82)	4	4.611	1.158	0.874	0.334	0.424	0.377	0.376	0.472	0.302	**0.797**			
8. Systems delivery capacity (0.80, 0.80, 0.87, 0.70, 0.80, 0.80)	6	4.109	1.238	0.912	0.277	0.364	0.387	0.423	0.430	0.513	0.546	**0.797**		
9. IS support maturity (0.71, 0.89, 0.85, 0.87, 0.73)	5	4.273	1.391	0.907	0.261	0.288	0.348	0.425	0.374	0.350	0.491	0.612	**0.814**	
10. IS operations sophistication (0.74, 0.72, 0.78, 0.73, 0.76, 0.83, 0.81)	7	5.030	1.171	0.909	0.169	0.177	0.333	0.392	0.200	0.466	0.299	0.387	0.509	**0.768**

[a] The significance of the item loadings were assessed using bootstrapping. The t values for all item loadings were significant at least at the $p < 0.001$ level.

Structural model analysis

The structural model was assessed using PLS.[2] Given the large number of manifest variables and the complexity of our research model, we adopted an aggregation approach for consolidating the manifest items of a latent variable into a smaller number of composite indicators (Bagozzi and Heatherton, 1994; Williams and Hazer, 1986). To construct a composite indicator for each sub-construct, we used the average score of the constituent manifest items corresponding to that sub-construct. In our model, organizational agility is modeled as a reflective construct with sub-constructs customer responsiveness, operational flexibility and strategic flexibility as indicators. Digital platform capability is modeled as a formative construct with sub-constructs IT infrastructure flexibility and application platform scope as indicators and, IS capability is modeled as a reflective construct with sub-constructs planning, development, operations and support capabilities as indicators. Innovation capacity is modeled as a reflective construct with the product of firm innovativeness and coupling as its indicator. Firm performance is modeled as a reflective construct with sub-construct operating performance as its indicator. Firm size, firm age and industry sector are modeled as reflective constructs with one indicator each.

We first assessed the measurement model. Table 4 presents the weights and loadings for all the constructs in the model. It is seen that the weights and loadings are significant for all indicators. Table 5 presents the correlations among the latent constructs in the model and the square root of the average variance shared between these constructs and their indicators. The table also depicts the internal consistency ratio of the latent constructs. It is seen that the ICR for all the reflective constructs are higher than 0.70 indicating adequate reliability of the constructs. It is also seen that all off-diagonal values are smaller than the average variance extracted values in the diagonals indicating adequate convergent and discriminant validity among the constructs in the model.

We argued that innovation capacity would moderate the relationship between digital platform capability and organizational agility. We followed the procedure laid out by Chin et al. (2003) to test the moderating effects in PLS. We created a latent construct that represents the interaction variables between the indicators of innovation capacity and those of digital platform capability. It is important to standardize the variables when testing interaction effects, to avoid computational errors caused by the correlation between the product indicators and their individual components (Smith and Sasaki, 1979). In this study, we standardized the indicators of all the constructs in the model by using their z scores.

[2] We use SmartPLS software for the analysis (https://www.smartpls.com/).

Table 4
Indicator weights and loadings.

Latent construct	Indicators	Weights	Loadings	T-value
Firm performance	Operating performance	1.00	1.00	–
Organizational agility (Reflective)	Customer responsiveness	0.371	0.881	34.458
	Operational flexibility	0.413	0.912	59.408
	Strategic flexibility	0.334	0.876	21.039
Digital platform capability (Formative)	IT infrastructure flexibility	0.770	0.918	8.849
	Application platform scope	0.410	0.685	3.742
Innovation capacity	Innovativeness × Coupling	1.00	1.00	–
IS capabilities (Reflective)	Planning sophistication	0.248	0.737	12.376
	Development capability	0.361	0.836	27.393
	Support maturity	0.296	0.825	21.529
	Operations capability	0.371	0.719	11.519
IT investment orientation	Investment aggressiveness	1.00	1.00	–
Innovation capacity × Digital platform capability	IT Infrastructure flexibility * Innovation capacity	0.677	0.742	15. 592
	Application platform scope * Innovation capacity	0.677	0.742	15.592
Firm size	Natural log of number of employees	1.00	1.00	–
Firm age	Number of years since inception	1.00	1.00	–
Industry sector	Manufacturing or service (1,0)	1.00	1.00	–

Table 5
Average variance extracted, internal consistency ratio and correlation among the constructs.

Constructs	ICR	1	2	3	4	5	6	7	8	9
1. Firm performance	–	**1.00**								
2. Organizational agility	0.922	0.319	**0.893**							
3. Innovation capacity	–	0.285	0.474	**1.00**						
4. Digital platform capability	–	0.241	0.538	0.480	**0.811**					
5. IS capabilities	0.864	0.276	0.501	0.446	0.598	**0.846**				
6. IT investment orientation	–	0.082	0.381	0.476	0.407	0.275	**1.00**			
7. Firm size	–	0.120	0.84	0.022	0.147	0.222	0.196	**1.00**		
8. Firm age	–	0.023	0.026	−0.139	0.058	0.070	0.144	0.120	**1.00**	
9. Industry sector	–	−0.157	−0.080	−0.046	0.050	−0.050	−0.102	−0.093	0.000	**1.00**

In testing moderated effects in PLS, we have to follow a hierarchical approach of comparing two models, one with only the main effects of the predictor and the moderator and the other with these effects and the interaction construct. The standardized path coefficient of the interaction construct tells us how the change in the moderator will change the effect of the main construct on the dependent variable. The R^2 of the two models should also be compared to assess the overall effect size of the moderating variable.

Fig. 3 depicts the results of the base model. It is seen that the model explains 12.7% of the variance in firm performance, 35.0% of the variance in organizational agility and 42.2% of the variance in digital options. The path coefficients in the model (Table 5) indicate that most paths are significant. As hypothesized, digital platform capability has a strong positive relationship with organization agility (0.418, t = 5.068) and both IS capabilities and IT investment orientation have strong positive relationships with digital platform capability (0.542, t = 8.694; 0.249, t = 3.147). These results lend support to our theoretical arguments that IT competency would explain substantial variance in organizational agility.

Examining the effects of innovation capacity on organizational agility it is seen that innovation capacity has a positive and significant direct relationship with organizational agility (0.273, t = 3.783). This suggests that for firms to be agile they need to be not only innovative but also have to integrate the innovation efforts to the core organization through appropriate organizational mechanisms.

As hypothesized we find that organizational agility has a positive relationship with firm performance (0.318, t = 3.370). The results also indicate that firm size and firm age do not have a significant direct relationship with firm performance. However, industry sector has a modest relationship with firm performance (−0.143, t = 1.406) indicating that services firms have higher operating performance than manufacturing firms do.

The results of the moderated effects model are depicted in Fig. 4 and Table 6. It is seen that the model explains a variance of 35.7% in organizational agility and 12.9% in firm performance. These yield effect sizes of 0.017 and 0.016,[3] which are small as per guidelines in the literature.[4] However, Chin et al. (2003) point out that small effect sizes are common and that the significance of the path coefficient of the interaction term should be examined in assessing the model. It is seen that the interaction term between innovation capacity and digital platform capability has a path coefficient of 0.132 which is statistically significant (t = 1.430) at $p < 0.10$ level. Thus, we find modest support for the moderated effects of innovation capacity.

[3] Effect Size = [R^2 Interaction Model − R^2 Base Model]/[1 − R^2 Base Model].
[4] Effect sizes are small if 0.02, medium if 0.15 and large if 0.35 (Cohen, 1988).

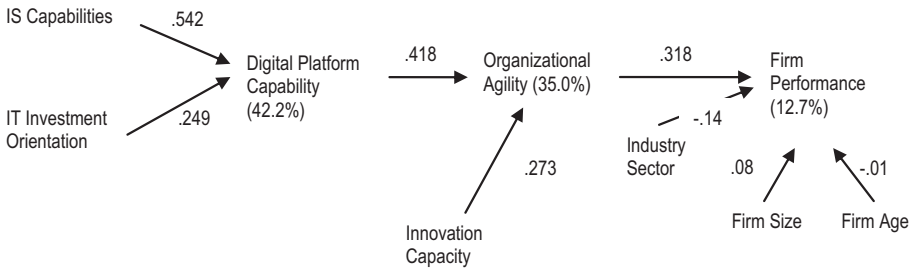

Fig. 3. Results of the base model.

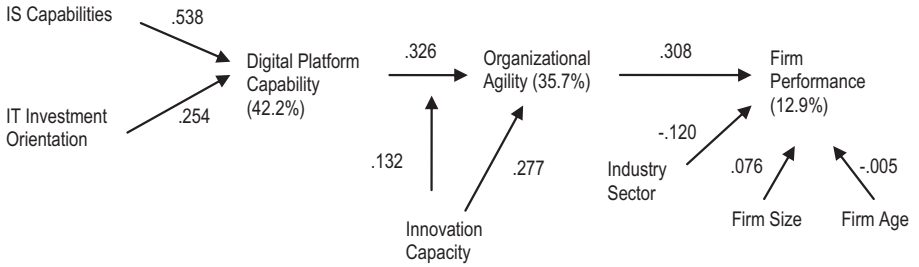

Fig. 4. Moderated effects of innovation capacity.

Table 6
Path coefficients and significance for the structural models.

Hypothesized paths and controls	Path coefficient and T statistic		Hypotheses supported
	Base model	Moderated model	
IS functional capability → Digital platform capability	0.542 (8.694)	0.538 (9.182)	H1a strongly supported
IT investment orientation → Digital platform capability	0.249 (3.147)	0.254 (3.284)	H1b strongly supported
Innovation capacity → Digital platform capability	0.273 (3.783)	0.277 (3.663)	H2a strongly supported
Digital platform capability → Organizational agility	0.418 (5.068)	0.326 (2.362)	H1 strongly supported
Organizational agility → Firm performance	0.318 (3.370)	0.308 (3.447)	Did not hypothesize, but strongly supported
Innovation capacity * Digital platform Capability → Organizational agility	–	0.132 (1.430)	H2b modestly supported
Firm size → Firm performance	0.077 (0.816)	0.076 (0.841)	–
Firm age → Firm performance	−0.004(0.817)	−0.005 (0.099)	–
Industry sector → Firm performance	−0.143 (1.406)	−0.120 (1.269)	–

Results with objective firm performance measures

To validate our results we tested the models with objective firm performance data collected from Compustat and Hoovers. We ran three models with ROS, ROA and sales growth as indicators of firm performance. All performance variables pertain to the year following the year of the survey. The results of these analyses were generally consistent with our original analysis. The relationships among the IT competence constructs and the relationship between digital platform capability and organizational agility were positive and significant. Consistent with our original results, innovation capacity had a positive relationship with organizational agility. Moreover, we found innovation capacity to moderate the relationship between digital platform capability and organizational agility.

Overall, we found that the nomological network proposed here fits the data quite well in all the four models examined. The consistency of the results across the different models enhances the validity of the findings reported here.

Robustness check

Our model depicts that digital platform capability mediates the effects of IS capabilities and IT investment orientation on organizational agility. To rule out any direct effect of IS capabilities and IT investment orientation on organizational agility we ran a model with direct paths linking these constructs in addition to the mediated paths. The results indicate that IT investment orientation did not have a direct relationship with organizational agility (0.119, t = 0.896) but IS capabilities had a significant direct relationship with organizational agility (0.246, t = 3.011). Incidentally, both these results are consistent with past findings (Lu and Ramamurthy, 2011). All other results were similar to those obtained in the original analysis.

The variance explained in organizational agility increased slightly from 35.0% to 39.2%. The direct effect of IS capabilities on agility is expected as many past studies have found IS capabilities to be an important antecedent of firm competencies (Ravichandran and Lertwongsatien, 2005; Lu and Ramamurthy, 2011). Moreover, Overby et al. (2006) proposed that IS capabilities could have both direct effects on agility and indirect effects through their effects on creating digital options. Our results are consistent with these propositions in the literature. The Sobol test for mediation indicates that the effect of both IS capability (Sobol Test Statistic: 4.168, $p < 0.000$) and IT investment orientation (Sobol Test Statistic: 2.412, $p < 0.013$) on organizational agility are fully mediated by digital platform capability.

The research model also depicts that organizational agility fully mediates the effects of digital platform capability on firm performance. We ran a model that included a direct path from digital platform capability to firm performance in addition to the mediated paths. The results indicate that digital platform capability did not have a direct relationship with firm performance (0.058, $t = 0.044$) and the variance explained in firm performance increased marginally from 12.7% to 13.5%. The Sobol test for mediation (Sobol Test Statistic: 2.989, $p < 0.002$) indicates that organizational agility fully mediates the relationship between digital platform capability and firm performance.

We also examined if innovation capacity has a direct impact on firm performance. This could be expected because innovative firms might do well because of other reasons than being agile. We tested a model with a direct path from innovation capacity to performance and found that this path was modestly significant (0.187, $t = 1.543$) and the variance explained in firm performance increased to 15.2%. However, the Sobol test for mediation indicates that the effects of innovation capacity on firm performance are largely mediated by organizational agility (Sobol Test Statistic: 2.591, $p < 0.009$). Nevertheless, the modest significance of the direct path is consistent with past findings that firm innovativeness can enhance performance (Danneels, 2002).

Overall, these analyses provide evidence of the robustness of the proposed model wherein the effects of IT investment orientation on organizational agility are fully mediated by digital platform capability and the effects of IS capabilities on agility are largely mediated by digital platform capability. These analyses also confirm that the effects of digital platform capability on firm performance is fully mediated by organizational agility and the effects of innovation capacity on performance are manifest through its effects in enhancing agility, and to a lesser extent, directly.

Common method bias

Since we collected, data from a single respondent, typical bias associated with such methods exists. In order to account for the possibility that method bias could exist, we followed procedures recommended by Podsakoff et al. (2003) and Podsakoff and Organ (1986) and performed statistical analysis to assess the severity of common method bias. First, a Harmon one-factor test (Podsakoff and Organ, 1986) was conducted on the seven conceptually crucial variables in our theoretical model including IS capability, IT investment orientation, digital platform capability, organizational agility, innovation capacity and firm performance. This result did not yield a unifactor solution and the maximum variance explained by any one factor was 14.27% indicating that common method biases are not likely to influence our results. Second, following the procedures used by Liang et al. (2007) we defined a method factor with indicators of all the seven theoretical constructs in our model and estimated a PLS model that included the structural model and the method factor. The basic idea behind this approach is that the variance in the observed values would comprise of three parts (1) variance explained by the theoretical construct, (2) measurement error and (3) variance explained by the methods used. By comparing the variance explained by the theoretical construct and those by the method factor in each observed variable, we can assess the extent to which common method bias might exist. Hence, we computed the variance explained for each indicator by the theoretical construct and compared it to that explained by the method factor. If the loadings of the indicators on the method factor were significant and if the variance explained by the method factor were comparable or greater than that explained by the theoretical construct, evidence of method bias exists. Our comparison indicated that for all indicators, the variance explained by the respective theoretical constructs were significantly greater than those explained by the method factor. Moreover, the loadings for none of the indicators on the method factor were significant. These results along with the other tests done above suggest that our results are robust and not contaminated by common method biases.

Discussion

In this study, we theorized that variance in organizational agility can be explained by both the IT competence of the firm and its innovation capacity. Our results validate our core theoretical arguments about the antecedents of agility. We found that both a firm's innovation capacity and its IT competencies impact agility. Consistent with our theorizing we also found that firms with higher innovation capacity were able to leverage their digital platform capability to a greater extent in enhancing their agility. Our results also indicate that agility has a positive effect on firm performance.

Antecedents of organizational agility

We found that digital platforms characterized by a flexible infrastructure, combined with the deployment of a range of enterprise software platforms, has a positive impact on organizational agility. While past studies have conceptualized the

effects of digital platforms on organizational agility (Sambamurthy et al., 2003), empirical evidence of this relationship is just emerging (Lu and Ramamurthy, 2011; Roberts and Grover, 2012). Our results by establishing the enabling role of digital platforms in agile firms adds to the growing body of research aimed at understanding the mechanism through which IT influences agility.

In addition to the digital platform capability, we posited and found that the innovation capacity of a firm determines how agile a firm is. While digital platforms provide an opportunity to create new business models or develop digital products and services, an organizational culture that tolerates experimentation and risk taking enables effective exploitation of the digital platforms in pursuit of market opportunities. The introduction of the e-book, Kindle, by Amazon is an example of an innovative firm leveraging its IT platforms to deliver a new product to the marketplace. Similarly, Google has nurtured an innovative culture where employees are encouraged to develop ideas to use its search engine and other core technologies to serve new market needs. In trying to leverage an IT platform to respond to market needs, firms typically assemble a set of IT and non-IT resources in interrelated activity systems that can offer it advantages in the marketplace. An organization where employees are encouraged to be innovative and take risks is more likely to think of new and different ways to link IT and non-IT resources to create these value systems. It is interesting that firms such as Amazon and Google chose to integrate their new product/service development with their core business to leverage their brand, web presence and customer base as well as enhance the complementarities between their traditional service offerings and the new products and services. Such dovetailing of new initiatives with the core organization is consistent with our findings that tight coupling between the core organization and the IT enabled initiatives are likely to enhance agility. Firms seeking to respond effectively to changes in their business environments would have to assemble the needed resources and capabilities to create and bring new products and services to the market. To the extent that they can leverage existing firm resource endowments, they would be able to respond faster to market opportunities and with lower costs. Such resource leverage is more likely when the linkage between the new initiatives and the core organization is higher. Moreover, tight coupling enables firms to scale new initiatives effectively by leveraging assets used in core activities. Empirical findings that tight integration between online and physical channels in retail firms to be value enhancing (Gulati and Garino, 1999; Oh et al., 2006) and tight linkages between the online and print businesses of newspapers has been synergistic and enhance the value of both offerings (Govindarajan and Trimble, 2005) are consistent with the findings reported here.

Our findings about the causal relationship between IS capabilities, IT investment orientation and digital platform capability highlight the path and time dependencies involved in creating digital platforms. Organizations that have successfully created effective digital platforms have been able to do so because of a history of choices about the acquisition and development of IS assets. IS capabilities are developed over time through the development, evaluation, and refinement of routines within the IS department. Substantial learning and embedding of learned theories of action in organizational processes occur in the development of these routines (Powell, 1998). For example, it takes an average of four to six years to develop mature systems delivery processes, when organizations systematically implement process improvement frameworks such as the capability maturity model. Similarly, firms that have aggressively invested in technologies in the past might have accumulated the necessary technological assets that enable them to deploy and leverage emerging technologies to create organizational competencies. This is consistent with arguments that both learning and asset accumulation barriers might enable firms that have invested in and developed IT assets to be more agile compared to firms that have not (Piccoli and Ives, 2005).

Contributions to research

Galliers et al. (2012) reviewed the past twenty years of strategic IS research and called for more studies aimed at understanding the role of IT in firm behaviors in "*ever increasing dynamic high velocity environments*". In line with these calls, this study examines the role of digital platforms in enabling agile behaviors of firms. Building on the conceptual work of Sambamurthy et al. (2003) empirical studies that link IT capabilities to agility are just emerging (Sambamurthy et al., 2007; Tallon and Pinsonneault, 2011; Lu and Ramamurthy, 2011; Roberts and Grover, 2012; DeGroote and Marx, 2013; Huang et al., 2012; Tan et al., 2017) while calls for exploring the value of IS capabilities have been made by scholars for some time (Peppard and Ward, 2004; Gable, 2010; Besson and Rowe, 2012). Our study adds to the body of strategic IS research by conceptualizing and measuring agility in terms of three dimensions, developing and testing scales for these constructs and linking IT competencies to organizational agility and providing empirical evidence to support this relationship. We restricted our focus to defining agility in terms of the capacity of the firm to respond when they need to. However, agility could include the capacity to respond as well as the ability to envision strategic opportunities and proactively conduct strategic experiments. It is possible that strategic foresight is as important as the resilience to act for firms to be successful in dynamic business environments. Future studies could expand the theorizing done here to include strategic foresight and resilience in the conceptualization of organizational agility and examine the effects of these different facets of agility on firm performance.

Our focus on the innovation capacity of the firm extends the theorizing about the antecedents of agility from IT competencies to other complementary capabilities and underscores the need to examine both IT and other non-IT factors in order to develop a more complete understanding of the determinants of firm competencies. While many IS studies have argued that the broader organizational context in which an IS unit operates influences if and how firms effectively leverage IT capabilities, very few studies have examined this when exploring the agile behaviors of firms. In this study, we examine how the innovation capacity of the firm influences its ability to leverage its digital platforms to achieve agility. We hope that the nomological network of relationships proposed here and the empirical findings will stimulate future research aimed at

understanding how IT and other firm capabilities jointly impact organizational competencies. We drew from the innovation and technology commercialization literature to conceptualize innovation capacity in terms of firm innovativeness and its ability to leverage firm assets and found that both aspects are important in enabling firms to be agile. While our use of coupling as an indicator of the ability to leverage firm assets is consistent with recent literature (Govindarajan and Trimble, 2005), studies have also pointed out that innovation capacity should span the entire commercialization process and include discovery, incubation and acceleration capabilities (Leifer et al., 2000). Future studies could expand the conceptualization of innovation capacity to include these facets and examine if these competencies enable firms to leverage their IT platforms more effectively.

Despite a decade of research examining the contribution of IT towards firm performance improvements significant gaps exist in our understanding of the mechanism through which IT enables firm performance. Recent theorizing has started to focus on mediating links such as IT-enabled new product development capabilities (Pavlou and El Sawy, 2006) that explain differences in how firms utilize IT and consequently the impacts of IT on firm performance. This study adds to this body of work by theorizing that firms that create and renew appropriate IT platforms and utilize these platforms to develop higher order competencies such as agility are likely to enhance their performance. In doing so, this study responds to the calls for deep theorizing that links IS function level factors to firm outcomes through appropriate mediating constructs. Since the causal distance between IS functional capabilities and firm level outcomes is high, nomological networks such as the one proposed here are needed to assess if indeed IS capabilities are rent yielding and if so how. Moreover, the inclusion of IT investment behavior as part of our nomological network fills gaps in the IS literature. While past research has looked at IT investment intensity and their value, other aspects of IT investing such as swiftness of investing in new technologies has received limited attention. In fact, recent conceptual work has used options theories to propose that aggressive investing could be value yielding in some contexts (Dai et al., 2007), although empirical evidence of this is just emerging (Otim et al., 2012). Our findings that aggressive IT investment orientation enables firms to create digital platforms sets the stage for further research examining the effects of different types of IT investment behavior on firm level outcomes. More broadly, we hope the theorizing done here and the empirical findings encourages future research to construct and test models that link managerial actions pertaining to IT and firm level outcomes.

The role of IS personnel in enabling agile behaviors has not received much attention. Recent work has started exploring the importance of the technical and managerial skills of IS personnel (Ravichandran and Lertwongsatien, 2005) and their service orientation (Lowry and Wilson, 2016) on firm behaviors. Future research should explore if and how the entrepreneurial mind set and the ambidexterity of IS personnel influences organizational agility.

Practical implications

This study makes several practical contributions. By providing empirical evidence that IT competence could enable agility, this study stresses the importance of investing in the development of IT competencies. When some have questioned whether digital platforms are strategic differentiators (Carr, 2003), our findings counter these viewpoints by highlighting that firms that have been investing to create appropriate digital platforms can be agile and such agility has significant effects of performance. While senior executives acknowledge the strategic value of information technology, they tend to view IS activities as commodity services and target them for cost cutting. Our findings that strong IS functional capabilities and an aggressive investment orientation are value yielding suggest that such a cost focused approach to managing IS might be dysfunctional. Senior executives who understand the strategic value of IT platforms must proactively educate other executives in the organization and seek the necessary funding to renew and improve IT competencies. Given the time and path dependencies involved in the development of IT competencies, a sustained effort towards competence development is more likely to be beneficial than the boom and bust cycles that seem to characterize IT investing.

The findings reported here lend support to the idea that IT competence combined with complementary assets are likely to be value yielding. Executives seeking to exploit IT to gain strategic advantage have to look beyond the IT function and ask what other organizational levers could be pulled. Our findings that a firm's innovation capacity is an important organizational factor that could impact how firms utilize IT, adds one more reason to the growing call for firms to nurture an innovative culture. Similar to developing IT competencies, enhancing the innovation capacity requires time. Hence, executives are advised to adopt a long-term orientation in the development of these critical competencies and our findings provide evidence to justify such a managerial agenda.

Concluding remarks

In this study, we developed and tested a nomological network that linked IT competence, innovation capacity, organizational agility and firm performance. The empirical results strongly support the model and the findings provide specific actionable guidance for practitioners on how to enhance organizational agility. The study departs from prior studies on agility in several ways, thereby adding to the cumulative body of knowledge in this important domain of research. The conceptualization and validation of IT competence, examination of the independent and joint effects of IT competence and innovation capacity on organizational agility underscoring the importance of the complementarities between IT and non-IT capabilities set the study apart from prior studies on agility. It is hoped that the theorizing and the substantive results

of this study set stage for future work on organizational agility targeted at exploring complementarities between IT and other firm competencies.

Appendix A. Scales for the constructs

Constructs	Constructs, indicators and scale anchors	Supporting literature
Firm performance	Operating Performance (5 item scale, Scale Anchors: Strongly agree. . ..Strongly Disagree, 7 point scale) Performance in the last 3 years on (1) improvement in market share in major product markets, (2) cost, (3) productivity, (4) profitability and (5) overall financial performance compared to competitors	Powell and Dent-Micallef (1997) and Ravichandran and Lertwongsatien (2005)
Organizational agility	Customer Responsiveness (5 item scale, Scale Anchors: Less Successful . . ..Similar. . .More Successful, 7 point scale) How successful the firm is compared to the top 3 firms in its industry in (1) identifying customer needs, (2) tailoring products/services to customer needs, (3) identifying customer groups not served by the firm, (4) responding to customer service requests, (5) providing information to customers	Nicholas and Grover (2002)
	Operational Flexibility (6 item scale, Scale Anchors: Less successful . . ..Similar. . .More Successful, 7 point scale) How successful the firm is compared to the top 3 firms in its industry in: (1) integrating internal processes, (2) integrating across its supply chain, (3) enhancing business process flexibility, (4) increasing the speed of product development, (5) increasing the speed of product delivery, (6) increasing the speed of logistics activities	Sambamurthy et al. (2003)
	Strategic Flexibility (5 item scale, Scale Anchors: Less successful . . ..Similar. . .More Successful, 7 point scale) How successful the firm is compared to the top 3 firms in its industry in: (1) increasing the speed of responding to business opportunities and threats, (2) identifying new markets, (3) entering new markets, (4) redefining the scope of its business, (5) responding to competitors' product and service strategies	Rindova and Kotha (2001) and Mahmood and Soon (1991)
Digital platform capability	IT Infrastructure Flexibility (5 item scale, Scale Anchors: Strongly Agree . . .. Strongly Disagree, 7 point scale) (1) IT infrastructure components are standardized, (2) connectivity of IT platforms within the firm are adequate, (3) connectivity of IT platforms across the supply chain are adequate, (4) data is easily sharable within and across the firm, (5) application systems are highly modular	Armstrong and Sambamurthy (1999), Rai et al. (1997), and Duncan (1995)
	Application Platform Scope Which of the following technologies have been adopted by your organization (Pick all that apply) (1) Enterprise Resource Planning, (2) Supply Chain Management, (3) Customer Relationship Management, (4) Electronic Commerce, (5) Business Intelligence, (6) Knowledge Management, (7) Mobile Computing	Sambamurthy et al. (2003) and Overby et al. (2006)

Appendix A (*continued*)

Constructs	Constructs, indicators and scale anchors	Supporting literature
Innovation capacity	Firm Innovativeness (5 item scale, Scale Anchors: Strongly Agree . . .... Strongly Disagree, 7 point scale). (1) risk taking is encouraged in our firm, (2) creativity is encouraged in our firm, (3) management actively seeks innovative ideas, (4) management is tolerant to mistakes when taking risks (5) the firm is often first to market with new products and services	Hurley and Hult (1998)
	Coupling (Scale Anchor: Totally Separate, Somewhat Separate, Somewhat Integrated, Fully Integrated) How integrated are your IT-enabled new initiatives (such as E-Business) with your current business operations	Govindarajan and Trimble, 2005; Gulati and Garino, 1999; Steinfield and Harry Bouwman, 2002
IT investment orientation	Please check the box that best describes your organization's orientation towards investing in information technology. (tick one) • Our organization is quick to adopt leading edge information technology. We have a philosophy of being first in acquiring and applying new information technology. We are very creative and innovative in using "leading edge" information technology. We spend significantly more on information technology than our competitors • We avoid investments in leading edge information technology. We have a philosophy of investing in proven technologies. We quickly follow the lead of innovators in adopting new and emerging information technologies. We are not the biggest IT spenders in our industry, but our IT investments are comparable to our competitors • We adopt information technology only after it becomes a necessity. We adopt only proven technology. We rarely experiment with new and emerging information technologies. We critically evaluate information technology investments to assess their potential business value	Fichman (2004)
IS capabilities	IS Planning Sophistication (4 item scale, Scale Anchors: Strongly Agree . . .... Strongly Disagree, 7 point scale) (1) participation of senior management in IS planning, (2) participation of business units in IS planning, (3) use of formal IS planning methodologies, (4) comprehensiveness of the planning methodology	Segars and Grover (1998), Sabherwal (1999), and Premkumar and King (1994)
	Systems Delivery Capability (6 item scale, Scale Anchors: Strongly Agree . . .... Strongly Disagree, 7 point scale) The systems delivery process is (1) adaptable to different projects, (2) is continuously improved using formal measurement and feedback systems, (3) has adequate controls to achieve development outcomes in a predictable manner, (4) is flexible to allow quick infusion of new development methods, tools and techniques, (5) facilitates reuse of software assets	Nidumolu and Knotts (1998) and Ravichandran and Lertwongsatien (2005)

(*continued on next page*)

Appendix A (*continued*)

Constructs	Constructs, indicators and scale anchors	Supporting literature
	such as design, code and requirements specifications, (6) is mature, well defined and documented	
	IS Operations Capability (7 item scale, Scale Anchors: Strongly Agree . . .... Strongly Disagree, 7 point scale) (1) systems operations are automated and not dependent on manual intervention for running computer systems, (2) automated tools are used to monitor and fine tune the performance of computer systems, databases, networks and telecom infrastructure, (3) detailed procedures are there to respond to unplanned systems outages, (4) strict back procedures are enforced in the data centers, (5) periodically mock trials of diaster recovery plans are conducted, (6) security systems and procedures to assess vulnerabilities are continuously reviewed	Mirani and King (1994), Benbasat et al. (1980), and Ravichandran and Lertwongsatien (2005)
	IS Support Maturity (5 item scale, Scale Anchors: Strongly Agree . . .... Strongly Disagree, 7 point scale) (1) clear guidelines exists for prioritizing service requests from users, (2) service level agreements have been established with all users groups in the organization, (3) well defined service quality criteria exists for IS support tasks, (4) appropriate performance standards to monitor service quality exists, (5) sophisticated systems to record, track and respond to service requests exists	Boynton et al. (1994) and Ravichandran and Lertwongsatien (2005)

References

Amit, R., Zott, C., 2001. Value creation in e-business. Strateg. Manage. J. 22 (6–7), 493–520.
Armstrong, C.P., Sambamurthy, V., 1999. Information technology assimilation in firms: the influence of senior leadership and IT infrastructures. Inform. Syst. Res. 10 (4), 304–327.
Bagozzi, R.P., Heatherton, T.F., 1994. A general approach to representing multifaceted personality constructs: application to state self-esteem. Struct. Eq. Model.: Multidiscip. J. 1 (1), 35–67.
Barki, H., Pinsonneault, A., 2005. A model of organizational integration, implementation effort, and performance. Organ. Sci. 16 (2), 165–179.
Barua, A., Kriebel, C.H., Mukhopadhyay, T., 1991. An economic analysis of strategic information technology investments. MIS Quart., 313–331
Benbasat, I., Dexter, A.S., Mantha, R.W., 1980. Impact of organizational maturity on information system skill needs. MIS Quart., 21–34
Besson, P., Rowe, F., 2012. Strategizing information systems-enabled organizational transformation: a transdisciplinary review and new directions. J. Strateg. Inform. Syst. 21 (2), 103–124.
Boynton, A.C., Zmud, R.W., Jacobs, G.C., 1994. The influence of IT management practice on IT use in large organizations. Mis Quart., 299–318
Carr, N.G., 2003. IT doesn't matter. Harvard Bus. Rev. 81 (5), 41–49.
Chen, M.J., 1996. Competitor analysis and interfirm rivalry: toward a theoretical integration. Acad. Manage. Rev. 21 (1), 100–134.
Chi, L., Ravichandran, T., Andrevski, G., 2010. Information technology, network structure, and competitive action. Inform. Syst. Res. 21 (3), 543–570.
Chin, W.W., Marcolin, B.L., Newsted, P.R., 2003. A partial least squares latent variable modeling approach for measuring interaction effects: results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. Inform. Syst. Res. 14 (2), 189–217.
Christensen, C.M., 2013. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business Review Press.
Cohen, J., 1988. Statistical Power Analysis for the Behavioral Sciences. Lawrence Earlbaum, Hillsdale, NJ.
Dai, Q., Kauffman, R.J., March, S.T., 2007. Valuing information technology infrastructures: a growth options approach. Inform. Technol. Manage. 8 (1), 1–17.
Dalton, G., 1999. Schwab stays focused. InformationWeek (March 8), 32–36.
Danneels, E., 2002. The dynamics of product innovation and firm competences. Strateg. Manage. J. 23 (12), 1095–1121.
D'Aveni, R.A., Gunther, R.E., 1994. Hypercompetition: Managing the Dynamics of Strategic Maneuvering. The Free Press, New York.
DeGroote, S.E., Marx, T.G., 2013. The impact of IT on supply chain agility and firm performance: an empirical investigation. Int. J. Inform. Manage. 33 (6), 909–916.
Demirhan, D., Jacob, V.S., Raghunathan, S., 2005. Information technology investment strategies under declining technology cost. J. Manage. Inform. Syst. 22 (3), 321–350.
Dewan, S., Mendelson, H., 1998. Information technology and time-based competition in financial markets. Manage. Sci. 44 (5), 595–609.
Dierickx, I., Cool, K., 1989. Asset stock accumulation and sustainability of competitive advantage. Manage. Sci. 35 (12), 1504–1511.
Dougherty, D., 1992. A practice-centered model of organizational renewal through product innovation. Strateg. Manage. J. 13 (S1), 77–92.
Duncan, N.B., 1995. Capturing flexibility of information technology infrastructure: a study of resource characteristics and their measure. J. Manage. Inform. Syst. 12 (2), 37–57.
Ferrier, W.J., 2001. Navigating the competitive landscape: the drivers and consequences of competitive aggressiveness. Acad. Manage. J. 44 (4), 858–877.
Ferrier, W.J., Lyon, D.W., 2004. Competitive repertoire simplicity and firm performance: the moderating role of top management team heterogeneity. Manage. Decis. Econ. 25 (6–7), 317–327.
Ferrier, W.J., Smith, K.G., Grimm, C.M., 1999. The role of competitive action in market share erosion and industry dethronement: a study of industry leaders and challengers. Acad. Manage. J. 42 (4), 372–388.

Fichman, R.G., 2004. Real options and IT platform adoption: implications for theory and practice. Inform. Syst. Res. 15 (2), 132–154.
Gable, G., 2010. Strategic information systems research: an archival analysis. J. Strateg. Inform. Syst. 19 (1), 3–16.
Galliers, R.D., Jarvenpaa, S.L., Chan, Y.E., Lyytinen, K., 2012. Strategic information systems: reflections and prospectives. J. Strateg. Inform. Syst. 2 (21), 85–90.
Goodhue, D.L., Chen, D.Q., Boudreau, M.C., Davis, A., Cochran, J.D., 2009. Addressing business agility challenges with enterprise systems. MIS Quart. Execut. 8 (2), 73–87.
Gosain, S., Malhotra, A., El Sawy, O.A., 2004. Coordinating for flexibility in e-business supply chains. J. Manage. Inform. Syst. 21 (3), 7–45.
Govindarajan, V., Trimble, C., 2005. Ten Rules for Strategic Innovators: From Idea to Execution. Mass, Harvard Business School Press, Boston.
Grant, R.M., 1996. Toward a knowledge-based theory of the firm. Strateg. Manage. J. 17 (S2), 109–122.
Gulati, R., Garino, J., 1999. Get the right mix of bricks & clicks. Harvard Bus. Rev. 78 (3), 107–114.
Huang, P.Y., Ouyang, T.H., Pan, S.L., Chou, T.C., 2012. The role of IT in achieving operational agility: a case study of Haier, China. Int. J. Inform. Manag. 32 (3), 294–298.
Hurley, R.F., Hult, G.T.M., 1998. Innovation, market orientation, and organizational learning: an integration and empirical examination. J. Market., 42–54
Ives, B., Piccoli, G., 2003. Custom made apparel and individualized service at Lands' End. Commun. Assoc. Inform. Syst. 11 (1), 3.
Kay, R., 2007. What is dell doing in Wal mart? Business Week, June 01, 2007.
Kayworth, T.R., Chatterjee, D., Sambamurthy, V., 2002. Theoretical justification for IT infrastructure investments. Adv. Top. Inform. Resour. Manage. 1, 73–90.
Leifer, R., McDermott, C., Peters, L., O'Connor, G., Veryzer, R., 2000. Radical Innovation, How Mature Companies Can Outsmart Upstarts. Harvard Business School Press.
Liang, H., Saraf, N., Hu, Q., Xue, Y., 2007. Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management. MIS Quart., 59–87
Linder, J.C., Jarvenpaa, S., Davenport, T., 2003. Toward an innovation sourcing strategy. MIT Sloan Manage. Rev. 44 (4), 43–49 (Summer 2003).
Loveman, G., 2003. Dimonds in the data mine. Harvard Bus. Rev. (May 1)
Lowry, P.B., Wilson, D., 2016. Creating agile organizations through IT: the influence of internal IT service perceptions on IT service quality and IT agility. J. Strateg. Inform. Syst. 25 (3), 211–226.
Lu, Y., Ramamurthy, K.(Ram), 2011. Understanding the link between information technology capability and organizational agility: an empirical examination. Mis Quart., 931–954
Lyytinen, K., Rose, G.M., 2006. Information system development agility as organizational learning. Eur. J. Inform. Syst. 15 (2), 183–199.
Magretta, J., 1998. The power of virtual integration: an interview with Dell Computer's Michael Dell. Harvard Bus. Rev. 72 (March-April), 72–83.
Mahmood, M.A., Soon, S.K., 1991. A comprehensive model for measuring the potential impact of information technology on organizational strategic variables. Decis. Sci. 22 (4), 869–897.
Mirani, R., King, W.R., 1994. Impacts of end-user and information center characteristics on end-user computing support. J. Manage. Inform. Syst. 11 (1), 141–166.
Mooney, J.G., Ganley, D., 2007. Enabling Strategic Agility Through Agile Information Systems. Agile Information Systems: Conceptualization, Construction, and Management. Elsevier, Burlington, USA. ISBN, 10, 0-7506.
Narasimhan, R., Das, A., 1999. An empirical investigation of the contribution of strategic sourcing to manufacturing flexibilities and performance. Decis. Sci. 30 (3), 683–718.
Narasimhan, R., Swink, M., Kim, S.W., 2006. Disentangling leanness and agility: an empirical investigation. J. Oper. Manage. 24 (5), 440–457.
Nidumolu, S.R., Knotts, G.W., 1998. The effects of customizability and reusability on perceived process and competitive performance of software firms. MIS Quart., 105–137
Nolan, R.L., Porter, K., Akers, C., 2001. Cisco Systems Architecture: Erp and Web-Enabled IT. European Case Clearing House.
Oh, L.B., Teo, H.H., Sambamurthy, V., 2006. Building Ambidextrous Competencies in Net-enabled Retail Organization. Working Paper. School of Computing, National University of Singapore.
van Oosterhout, M., Waarts, E., van Hillegersberg, J., 2006. Change factors requiring agility and implications for IT. Eur. J. Inform. Syst. 15 (2), 132–145.
Otim, S., Dow, K.E., Grover, V., Wong, J.A., 2012. The impact of information technology investments on downside risk of the firm: alternative measurement of the business value of IT. J. Manage. Inform. Syst. 29 (1), 159–194.
Overby, E., Bharadwaj, A., Sambamurthy, V., 2006. Enterprise agility and the enabling role of information technology. Eur. J. Inform. Syst. 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. Inform. Syst. Res. 17 (3), 198–227.
Peppard, J., Ward, J., 2004. Beyond strategic information systems: towards an IS capability. J. Strateg. Inform. Syst. 13 (2), 167–194.
Petter, S., Straub, D., Rai, A., 2007. Specifying formative constructs in information systems research. MIS Quart., 623–656
Piccoli, G., Ives, B., 2005. IT-dependent strategic initiatives and sustained competitive advantage: a review and synthesis of the literature. MIS Quart. 29 (4), 747–776.
Podsakoff, P.M., Organ, D.W., 1986. Self-reports in organizational research: problems and prospects. J. Manage. 12 (4), 531–544.
Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., Podsakoff, N.P., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psychol. 88 (5), 879.
Powell, W.W., 1998. Learning from collaboration: knowledge and networks in the biotechnology and pharmaceutical industries. Calif. Manage. Rev. 40 (3), 228–240.
Powell, T.C., Dent-Micallef, A., 1997. Information technology as competitive advantage: the role of human, business, and technology resources. Strateg. Manage. J., 375–405
Premkumar, G., King, W.R., 1994. The evaluation of strategic information system planning. Inform. Manage. 26 (6), 327–340.
Radding, A., 1999. Disaster! Computerworld (May 31, 1999), 70–73.
Rai, A., Patnayakuni, R., Patnayakuni, N., 1997. Technology investment and business performance. Commun. ACM 40 (7), 89–97.
Ravichandran, T., Lertwongsatien, C., 2005. Effect of information systems resources and capabilities on firm performance: a resource-based perspective. J. Manage. Inform. Syst. 21 (4), 237–276.
Ravichandran, T., Liu, Y., 2007. Leadership Processes, Environmental Factors and IT Investment Strategies. Working Paper. Lally School of Mgmt & Technology, RPI, Troy, NY.
Reich, B.H., Benbasat, I., 1990. An empirical investigation of factors influencing the success of customer-oriented strategic systems. Inform. Syst. Res. 1 (3), 325–347.
Rindova, V.P., Kotha, S., 2001. Continuous "morphing": competing through dynamic capabilities, form, and function. Acad. Manage. J. 44 (6), 1263–1280.
Roberts, N., Grover, V., 2012. Leveraging information technology infrastructure to facilitate a firm's customer agility and competitive activity: an empirical investigation. J. Manage. Inform. Syst. 28 (4), 231–270.
Rockart, J.F., Hofman, J.D., 1992. Systems delivery: evolving new strategies. Sloan Manage. Rev. 33 (4), 21.
Ross, J.W., Beath, C.M., 2002. Beyond the business case: new approaches to IT investment. MIT Sloan Manage. Rev. 43 (2), 51.
Sabherwal, R., 1999. The relationship between information system planning sophistication and information system success: an empirical assessment. Decis. Sci. 30 (1), 137–167.
Sambamurthy, V., Bharadwaj, A., Grover, V., 2003. Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms. MIS Quart., 237–263
Sambamurthy, V., Wei, K.K., Lim, K., Lee, D., 2007. IT-enabled organizational agility and firms' sustainable competitive advantage. In: ICIS 2007 Proceedings, p. 91.

Sanchez, R., 1995. Strategic flexibility in product competition. Strateg. Manage. J. 16 (S1), 135–159.
Segars, A.H., Grover, V., 1998. Strategic information systems planning success: an investigation of the construct and its measurement. MIS Quart., 139–163
Smith, K.W., Sasaki, M.S., 1979. Decreasing multicollinearity: a method for models with multiplicative functions. Sociol. Methods Res. 8 (1), 35–56.
Steinfield, C., Harry Bouwman, T.A., 2002. The dynamics of click-and-mortar electronic commerce: opportunities and management strategies. Int. J. Electron. Commer. 7 (1), 93–119.
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 Quart., 463–486
Tan, F.T.C., Tan, B., Wang, W., Sedera, D., 2017. IT-enabled operational agility: an interdependencies perspective. Inform. Manage. 54 (3), 292–303.
Tapscott, D., Lowy, A., Ticoll, D., 2000. Digital Capital: Harnessing the Power of Business Webs. Harvard Business Press.
Teece, D.J., 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strateg. Manage. J. 28 (13), 1319–1350.
Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strateg. Manage. J., 509–533
Wang, N., Liang, H., Zhong, W., Xue, Y., Xiao, J., 2012. Resource structuring or capability building? An empirical study of the business value of information technology. J. Manage. Inform. Syst. 29 (2), 325–367.
Wheeler, B.C., 2002. NEBIC: a dynamic capabilities theory for assessing net-enablement. Inform. Syst. Res. 13 (2), 125–146.
Williams, L.J., Hazer, J.T., 1986. Antecedents and consequences of satisfaction and commitment in turnover models: a reanalysis using latent variable structural equation methods. J. Appl. Psychol. 71 (2), 219.
Zhu, K., Kraemer, K.L., Dedrick, J., 2004. Information technology payoff in e-business environments: an international perspective on value creation of e-business in the financial services industry. J. Manage. Inform. Syst. 21 (1), 17–54.