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SHAPING AGILITY THROUGH DIGITAL OPTIONS: RECONCEPTUALIZING THE ROLE OF INFORMATION TECHNOLOGY IN CONTEMPORARY FIRMS¹

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Abstract

Agility is vital to the innovation and competitive performance of firms in contemporary business environments. Firms are increasingly relying on information technologies, including process, knowledge, and communication technologies, to enhance their agility. The purpose of this paper is to broaden understanding about the strategic role of IT by examining the nomological network of influences through which IT impacts firm performance. By drawing upon recent thinking in the strategy, entrepreneurship, and IT management literatures, this paper uses a multitheoretic lens to argue that information technology investments and capabilities influence firm performance through three significant organizational capabilities (agility, digital options, and entrepreneurial alertness) and strategic processes (capability-building, entrepreneurial action, and coevolutionary adaptation). We also propose that these dynamic capabilities and strategic processes impact the ability of firms to launch many and varied competitive actions and that, in turn, these competitive actions are a significant antecedent of firm performance. Through our theorizing, we draw attention to a significant and reframed role of IT as a digital options generator in contemporary firms.

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Introduction

As contemporary firms face intense rivalry, globalization, and time-to-market pressures, *agility*, or the ability to detect and seize market opportunities with speed and surprise, is considered to be an imperative for business success (Brown and Eisenhardt 1997; Christensen 1997; D'Aveni 1994; Goldman et al. 1995). Agile firms continually sense opportunities for competitive action in their product-market spaces and marshal the necessary knowledge and assets for seizing those opportunities. Agility underlies firms' success in continually enhancing and redefining their value creation, capture, and competitive performance through innovations in products, services, channels, and market segmentation.

The convergence of computing, communications, and content technologies offers firms significant opportunities for enhancing agility (Goldman et al. 1995; Moore 2000; Venkatraman and Henderson 1998). Contemporary firms are making significant investments in information technologies (such as Web services, data warehousing, customer relationship management, or supply chain management technologies) to leverage the functionalities of these technologies in shaping their business strategies, customer relationships, and extended enterprise networks. In particular, the disruptive forces of digitization, unbundling of information and physical value chains, and disaggregation of organizational infrastructures for customer relationship, manufacturing, procurement, and supply chain fulfillment have heightened the significance of IT in enabling agile competitive moves (Hagel and Singer 1999; Rayport and Sviokla 1995).

As IT emerges as a strategic differentiator, there is greater interest in understanding how IT assets and resources influence superior firm perfor-

mance. Although prior research has demonstrated that IT investments do have beneficial performance and productivity impacts (for example, Bharadwaj et al. 1999; Hitt and Brynjolfsson 1996), theoretical frameworks are yet to explain *how* and *why* these investments enhance firm performance. Similarly, although researchers have examined the performance benefits of IT-related capabilities (Bharadwaj 2000; Bharadwaj et al. 2001; Mata et al. 1995), further attention is needed to understand how and why these capabilities shape firm performance.

The purpose of this paper is to broaden understanding about the strategic role of IT by examining the nomological network of influences through which IT impacts firm performance. In particular, as illustrated in Figure 1, we argue that information technology investments and capabilities influence firm performance through a nomological network of three significant organizational capabilities (agility, digital options, and entrepreneurial alertness) and strategic processes (capability-building, entrepreneurial action, and coevolutionary adaptation). We also propose that these dynamic capabilities and strategic processes impact the quality of competitive actions by firms and that, in turn, these competitive actions are a significant antecedent of firm performance (i.e., competitive actions mediate the links to firm performance). Through our theorizing, we draw attention to a significant and reframed role of IT as a digital options generator in contemporary firms.

The rest of the paper is structured as follows. First, we explore the theoretical underpinnings of our model. Second, we develop our model and propositions. Finally, we close with a discussion of the theoretical and practical contributions of the paper.

Theoretical Underpinnings

Three distinct, but increasingly converging, streams of literature frame our proposed conceptualization. First, the strategic management literature offers insights about the resources,

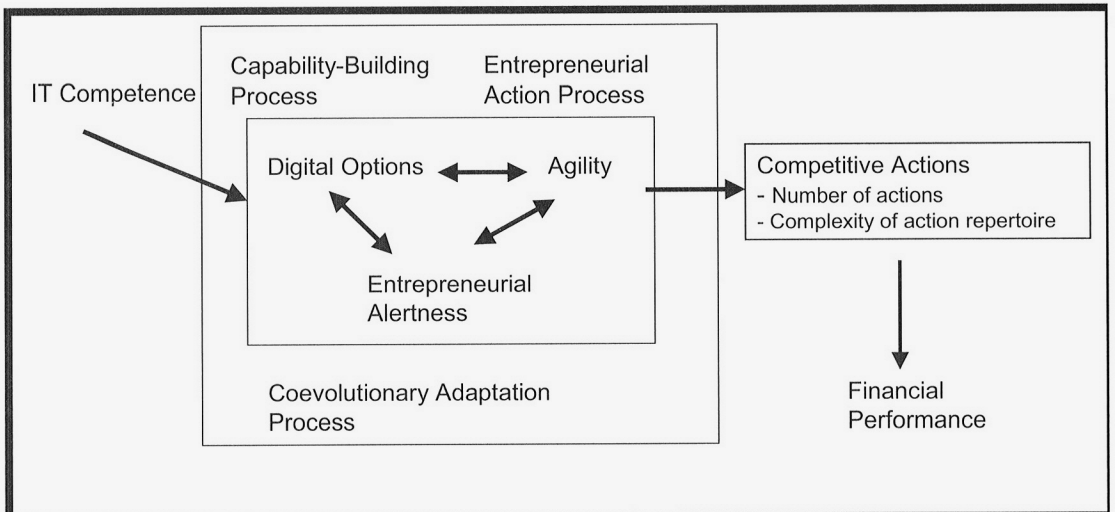


Figure 1. The Nomological Network of Relationships between IT Competence and Firm Performance

capabilities, and processes shaping firms' competitive conduct. Next, the entrepreneurship literature offers insights about the processes associated with agility and competitive actions in firms. Finally, the IT management literature contributes ideas about the role of IT in influencing agility. Relevant ideas from these three streams are briefly highlighted in the following sections.

The Logic of Strategy: Factors Affecting Firm Performance

As shown in Table 1, three distinct logics describe the role of strategy in shaping superior firm performance. First, the *logic of positioning* emphasizes that superior firm performance is the consequence of a firm's strategic position and the degree to which it executes those positions through an integrated system of activities. Positions establish the uniqueness and value of the firms' products or services and the activity systems reinforce how well it executes its positions to reap economic rents (Porter 1980, 1996, 2001). Integrated activity systems represent commitments to a specific position. On one hand, they lock-out rivals from mimicking that position;

but at the same time, they lock-in the firm to the chosen position and constrain its strategic mobility (Ghemawat 1991). Much of the early IT strategy literature embraced the positioning logic by emphasizing the role of IT in activities such as pricing (Beath and Ives 1986) and customer relationship management (Benjamin et al. 1984; Ives and Learmonth 1984; Porter and Millar 1985). However, this logic does not explain *how* firms construct inimitable activity systems (Sambamurthy 2000) and how strategic conduct occurs in dynamic, disequilibrating, or discontinuous business environments where the sustainability of fixed positions might be untenable (Jacobson 1992).

The *logic of leverage* argues that firm performance is shaped by the deployment and use of idiosyncratic, valuable, and inimitable resources and capabilities that might be heterogeneously distributed across firms (Barney 1991). Firms leverage two distinct mechanisms in the form of resource-picking and capability-building (Makadok 2001). Resource-picking mechanisms create economic rents when firms apply superior information and knowledge in procuring resources cheaper than their marginal productivity when used in combination with other resources (Barney 1986).

Table 1. Factors Affecting Firm Performance: Three Logics of Strategy

Logic of Strategy	Factors Affecting Firm Performance	Limitations	Contributing Literature
Positioning	<ul style="list-style-type: none">• Nature of the industry's competitive forces• Profitability of the firms' strategic position• Extent of integration among the activity systems	<ul style="list-style-type: none">• Predominant focus on external industry forces• Inadequate attention to how firms construct inimitable activity systems• Weaker ability to explain strategic conduct in dynamic, disequilibrating, or discontinuous business environments	<ul style="list-style-type: none">• Ghemawat 1991• Porter 1986, 1996, 2001
Leverage	<ul style="list-style-type: none">• Procurement and possession of rare, valuable, and inimitable resources• Ability to create capabilities through integration and reconfiguration of internal and external resources and embedding in firms' social, structural, and cultural contexts	<ul style="list-style-type: none">• Weaker ability to explain competitive strategic conduct in fast-paced business environments	<ul style="list-style-type: none">• Barney 1986, 1991• Eisenhardt and Martin 2001• Makadok 2001
Opportunity	<ul style="list-style-type: none">• Ability to continuously innovate• Ability to develop superior market intelligence• Ability to coevolve assets, capabilities, and knowledge	<ul style="list-style-type: none">• Underemphasizes the significance of strategic positions	<ul style="list-style-type: none">• Brown and Eisenhardt 1997• D'Aveni 1994• Eisenhardt and Galunic 2000• Eisenhardt and Sull 2001• Lengnick-Hall and Wolff 1999• Schumpeter 1934, 1950• Young et al. 1996

However, it is not clear whether the mere procurement and possession of resource bundles is adequate for supernormal performance, especially when most firms may have access to similar factor markets. In contrast, *capability-building* leverage refers to firms' ability to integrate, build, and reconfigure internal and external resources in creating the higher-order capabilities that are embedded in their social, structural, and cultural

context (Grant 1995; Teece et al. 1997). The embeddedness of these capabilities makes them comparatively more valuable and inimitable. Capability-building mechanisms have also been termed as dynamic capabilities: "the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die" (Eisenhardt and Martin 2000, p. 1107). Although the logic of

leverage explains strategic conduct in stable to moderately dynamic markets, its relevance has been questioned in explaining strategic conduct in fast-paced business environments. In these latter environments, long-term competitive advantage is rarely achieved. Firms must compete by seizing a series of short-term advantages through many competitive actions (D'Aveni 1994; Smith et al. 1992). Therefore, there is a need for understanding how firms engage in rapid and relentless innovation for seizing market opportunities (Brown and Eisenhardt 1997; D'Aveni 1994; Eisenhardt 1989).

The *logic of opportunity* argues that superior firm is shaped through relentless innovation and competitive actions (D'Aveni 1994; Lengnick-Hall and Wolff 1999; Young et al. 1996). Rooted in the Schumpeterian dynamics of disequilibrium and market disruption (Schumpeter 1934, 1950), this logic suggests that competitive advantages built through positioning or leverage could be eroded because: (1) rivals or new entrants can generate superior knowledge about the market, or insights about creative resource configurations, and launch moves to disrupt the incumbents' current advantage, and (2) technological, socioeconomic, or cultural shifts may uncover new market opportunities that threaten current advantages. Therefore, continuous innovations in products, services, or channels and vigilance to emerging opportunities or countervailing threats are vital for superior performance.

Eisenhardt and Brown (1999; also Eisenhardt and Galunic 2000; Eisenhardt and Sull 2001) suggest that the logic of opportunity draws attention to coevolution as a strategic process, whereby firms routinely change "the web of collaborative links—everything from information exchanges to shared assets to multibusiness strategies—among businesses" (Eisenhardt and Galunic 2000, p. 91-92). Coevolution implies flexibility in the line-up of assets, capabilities, and knowledge that a firm can assemble in order to detect the windows of opportunity in the marketplace and capture positions of advantage. The dynamics of coevolution also imply an iterative loop among assets, capabilities, and knowledge: experience with seizing or

losing positions begets new assets, capabilities, and knowledge, which in turn, positions the firm toward better detection and exploitation of future opportunities (Helfat and Raubitschek 2000). The logic of opportunity also suggests that strategy relies upon

surveillance, interpretation, initiative, opportunism, and shaping situations as they develop. Success requires improvisation, reconnaissance, and the ability to act quickly and decisively (Lengnick-Hall and Wolff 1999, p. 1113).

Two insights emerge from our review of the strategic management literature. First, our interest is in dynamic capabilities that permit firms to flexibly combine different IT and business resources and stimulate competitive actions through innovations in products, services, and channels. Second, strategic processes provide an insight into how firms improvise combinations of knowledge, assets, and resources in crafting competitive actions.

Further, our theory's boundary condition is firms operating in moderate to rapidly changing business environments, such as the high-tech, retailing, and financial services sectors. D'Aveni (1994) describes this competition as having three important characteristics. First, competitive advantage is short lived because firms continually launch competitive actions to disrupt their rivals' positions and wrest economic rents. Second, firms must undertake a series of actions to continuously recreate competitive advantage. Third, firms with a greater number and variety of new competitive actions will seize greater advantages. These characteristics are prevalent in contemporary industries that have been subjected to the disruptive force of digitization. This also implies that strategy must embrace the logic of opportunity and be targeted at seizing series of competitive advantages. Of course, this view does not imply that firms can easily alter their positions or resources (Porter 1996, 2001). Path dependencies limit the range of strategic alternatives for firms even as they embrace the logic of opportunity (Teece et al. 1997). Furthermore, firms may become complacent and strategically simple over

time, as their managers narrow the range of actions to only those that have worked well in the past (Ferrier et al. 1999; Miller and Chen 1996).

Entrepreneurial Action: The Discovery of Strategic Opportunities

Entrepreneurial action refers to behaviors through which firms recognize and exploit market opportunities through novelty in resources, customers, markets, or combinations of resources, customers, and markets (Smith and DeGregorio 2001). Traditional models of competition assume that all firms possess perfect and complete knowledge about their markets. However, literature rooted in the Austrian school of economic theory acknowledges that firms might possess imperfect knowledge and information about their markets and customers (Grimm and Smith 1997). Hayek (1949) conceptualized the environment as consisting of varying levels of information on what might be the best product features and the prices that sellers can offer and that buyers are willing to pay. Firms differ in their knowledge about appropriate products, customer preferences, locations where customers will be found, and the type of channels that they will prefer. Incumbent firms have their own cognitive maps, whereas new entrants or rivals can develop competing cognitive maps that capitalize upon the incumbents' blind spots. Kirzner (1973) suggests that firms are often ignorant of the real market opportunities available to them. When some firms pass up opportunities due to market ignorance, others that spot and exploit those opportunities can avail of the scope for entrepreneurial action. Thus, entrepreneurial action is about the discovery and exploitation of market opportunities to create new products, services, customers, or distribution channels.

Further, competition enhances firms' market knowledge:

Competition is essentially a process of the formation of opinion: by spreading

information, it creates that unity and coherence of the economic system which we presuppose when we think of it as one market (Hayek 1949, p. 106).

In an environment where firms have varying degrees of knowledge (or ignorance), Kirzner suggests that entrepreneurial action requires alertness to opportunities. Alert firms are constantly on the lookout for previously unnoticed aspects of the market through imagination, trial-and-error experimentation, probing, and learning from successes and failures:

the aspect of knowledge which is crucially relevant to entrepreneurship is not so much substantive knowledge of market data as alertness, the "knowledge" of where to find market data (Kirzner 1973, p. 74).

Zaheer and Zaheer (1997) propose that entrepreneurial action is about exploiting market arbitrage² opportunities through alertness and responsiveness. They define alertness as proactive attentiveness to information about the environment—figuratively, "having one's antenna out" (p. 1496).² Further, they describe responsiveness as the nimbleness with which firms respond to environmental signals. In their study of 4,088 banks engaged in foreign trading, they found that alertness and responsiveness had enabled firms to exercise greater market influence.

Finally, Smith and DeGregorio (2001) view entrepreneurial action as a creative and subjective process. Entrepreneurial action occurs whenever a firm: (1) integrates its preexisting knowledge with subjective interpretations about the marketplace and competitive actions and insights from proactive experiments in the marketplace, (2) detects an opportunity, and (3) acts upon the opportunity. Therefore, effective entrepreneurial action requires organizational capabilities for

²Adapting the concept of financial arbitrage, market arbitrage refers to the ability of a firm to seize profits by capitalizing upon superior insights about the market relative to its rivals.

exploration and exploitation of market opportunities. Firms exhibiting high entrepreneurial alertness can sense product-market discontinuities and visualize how organizational resources and capabilities can be orchestrated and exploited.

The Strategic Value of IT: Platform for Agility

The sustainable business value of IT emerges primarily through its complementarity and integration with business strategies, organizational designs, structures, and competencies (Barua and Mukhopadhyay 2000; Kettinger et al. 1994; Wheeler 2002). IT can be an enabler of agility by virtue of the differences between digital economics and the (traditional) economics of physical components (Arthur 1996; Grover and Ramanlal 1999; Shapiro and Varian 1999). Some of these differences are:

- The fixed costs of production of information goods are dramatically higher due to the human costs of developing intellectual capital (rather than plant and equipment).
- The marginal costs rapidly approach zero, going down successively as new generations of technologies become available.
- The coordination costs are becoming extremely low, which not only allows ease of searching and product comparison, but also enhances the ability to combine digital products to create new value.
- Network effects create increasing returns for firms that can expand the size of their base of customers.

With the pervasiveness of digitization within organizational boundaries as well in the inter-organizational networks, these economics will influence the viability of firms' competitive actions. Evans and Wurster (2000) argue that firms have traditionally constructed their value chains and interorganizational relationships by bundling infor-

mation and physical products and services into integrated structures. Digital economics (e.g., lower coordination costs), however, enables firms to deconstruct their value chains and interorganizational relationships by unbundling information from physical products and services. Not only does this create new options for information-based products and services, but it also facilitates the streamlining of work processes and building of interorganizational relationships. Additionally, firms are able to move their information value chains to the forefront of competitive moves (Bradley and Nolan 1998; Hagel and Singer 1999).

Overall, these conceptual frameworks stimulate thinking about the role of IT as a platform for agility. Firms are integrating IT with key processes, knowledge, and relationships to nurture innovation in customer relationships, manufacturing, procurement, supply chains, and other key activities (Agarwal and Sambamurthy 2002; Barua and Mukhopadhyay 2000). Digitized platform of processes and knowledge permit firms to adapt to changing requirements more quickly by changing information-based value propositions, forging value-chain collaborations with partners that competitors cannot easily duplicate, and rapidly exploiting emerging and untapped market niches.

Theoretical Model

Our theoretical perspective highlights three important dynamic capabilities (digital options, agility, and entrepreneurial alertness) and three strategic processes (capability-building, entrepreneurial action, and coevolutionary adaptation) within the nomological network of influences that mediate between IT investments and capabilities and firm performance (see Figure 1).

Although financial performance would be the ultimate outcome variable of interest, strategy researchers have argued that competitive actions mediate the relationship between firms' capabilities and financial performance (D'Aveni 1994). Competitive actions are market-based moves that

challenge the status quo of the market or industry through innovations in products, services, and channels (Ferrier et al. 1999; Jacobson 1992). Examples of such competitive actions include the launch of a new product or service, introduction of a new channel or a multichannel arrangement, or the cultivation of a new segment that fractures the existing bases of market segmentation. These actions disrupt existing conceptualizations about how the industry players can sustain or generate superior financial performance. These disruptions provide opportunities for the firm initiating the competitive action to enjoy periods of superior financial performance while rivals react and attempt to mount their own competitive response (Ferrier et al. 1999). The focus on competitive actions as an important antecedent of financial performance is consistent with recent research on competitive dynamics (Grimm and Smith 1997). Further, such competitive actions are reflective of the logic of opportunism and of leverage. They measure how well positioned a firm is to explore opportunities in its business environment and exploit them through its resources and capabilities.

We focus on two characteristics of competitive actions in our model: the number of competitive actions and the complexity of the action repertoire (Ferrier et al. 1999). The number of competitive actions is the total number of competitive innovations in new products, services, distribution channels, or market segmentation by a firm. Action repertoire complexity refers to the variety and richness of competitive actions. Firms can choose to execute competitive actions mostly of the same kind (i.e., continual new product introductions), or they can carry out a broad range of actions intertwined around new product introductions, channel reconfigurations, and market segmentation. Repertoire simplicity refers to actions limited to the same type of competitive innovations, whereas actions spanning a broad variety represent repertoire complexity. Ferrier et al. (1999) argue that repertoire complexity creates more aggressive competitive actions, prolongs the disruptive character of the action, and lengthens the window of opportunity for the initiating firm before rivals can mount a suitable response.

They found empirical evidence that industry leaders with a greater number of competitive actions and higher action repertoire complexity were successful in gaining market share. Similarly, Young et al. (1996) found that firms with greater number of competitive actions sustained superior financial profitability.

We propose that the number of competitive actions and action repertoire complexity are important consequences of firms' ability to financially prosper in moderate to fast-paced business environments. Further, our model argues that firms' success in generating more competitive actions and in maintaining action repertoire complexity is related to their IT competence, three dynamic capabilities (digital options, agility, and entrepreneurial alertness), and three strategic processes (capability building, entrepreneurial action, and coevolutionary adaptation) (Figure 1). Each one of these elements is described below.

IT Competence

IT competence is the organizational base of IT resources and capabilities and describes a firm's capacity for IT-based innovation by virtue of the available IT resources and the ability to convert IT assets and services into strategic applications. Important elements of IT competence include the level of IT investments, the quality of the IT infrastructure (global connectivity and reliability), IT human capital (appropriate technical and business skills), and the nature of IS/business partnerships (Feeny and Wilcocks 1998; Henderson 1990; Ross et al. 1996; Weill and Broadbent 1998). The level of IT investments has been found to have a significant and positive effect on firm performance (for a comprehensive review, see Barua and Mukhopadhyay 2000). Further, the quality of IT capabilities has been found to have a significant positive impact on firm performance (Bharadwaj 2000). Extending these research findings, we consider IT competence as a critical antecedent for firms to generate more competitive actions and greater action repertoire complexity. Particularly, based on the logic of digital econo-

mics, whereby firms are discovering greater avenues for competitive innovation through their information value chain and through the functionalities of advanced information technologies, we expect IT competence to be an antecedent of the level of competitive actions by firms. However, we propose that this relationship is mediated by three significant dynamic capabilities: agility, digital options, and entrepreneurial alertness.

Agility

Agility is the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise (D'Aveni 1994; Goldman et al. 1995). Agility encompasses the exploration and exploitation of opportunities for market arbitrage. Exploration is organizational experimentation with new alternatives and pursuit of knowledge about currently unknown opportunities for competitive action (March 1991). Exploitation is the use and development of things already known through refinement and extension of existing competencies, technologies, and knowledge (March 1991). Further, agility encompasses a firm's capabilities related to interactions with customers, orchestration of internal operations, and utilization of its ecosystem of external business partners. Specifically, we argue that agility comprises of three interrelated capabilities: customer agility, partnering agility, and operational agility (Cronin 2000; Tapscott et al. 2000; Treacy and Wiersema 1993)³ (Table 2).

Customer agility is the co-opting of customers in the exploration and exploitation of opportunities for innovation and competitive action moves. Nambisan (2002) argues that customers serve three valuable roles in stimulating firms' competitive actions: as a source of innovation ideas, as

a cocreator in the development and design of innovative products and services, and as a user in testing the product or in helping other users learn about the new product or service. Customer agility describes firms' ability to leverage the voice of the customer for gaining market intelligence and detecting competitive action opportunities (Kohli and Jaworski 1990). Information technologies provide opportunities for building and enhancing virtual customer communities and, thereby, customer agility (Holström 2001; Kambil et al. 1999; Nambisan 2002).

Partnering agility is ability to leverage the assets, knowledge, and competencies of suppliers, distributors, contract manufacturers, and logistics providers through alliances, partnerships, and joint ventures (Venkatraman and Henderson 1998). Partnering agility enables firms to build a network of strategic, extended, or virtual partnerships to explore opportunities for innovation and competitive action (Choudhury and Xia 1999). Partnering agility also refers to the ability of firms to exploit opportunities through efficient sourcing and staging of manufacturing, logistics, or customer support assets and resources. It enables a firm to modify or adapt its extended enterprise network when it needs access to assets, competencies, or knowledge not currently resident in its networks (Dyer and Singh 1998). Zaheer and Zaheer (1997) found that firms with wide-ranging information networks were able to exhibit superior responsiveness and performance in turbulent business environments. Information technologies enable greater interfirm collaboration through platforms such as portals, supply chain management, and visibility technologies.

Operational agility reflects the ability of firms' business processes to accomplish speed, accuracy, and cost economy in the exploitation of opportunities for innovation and competitive action. Operational agility ensures that firms can rapidly redesign existing processes and create new processes for exploiting dynamic marketplace conditions. Information technologies are driving the modularization and atomization of business processes and enabling their combination and recombination to create new business processes

³Note that this view is consistent with Grant's (1995) perspective on a hierarchy of organizational capabilities. Therefore, we view agility as a higher order capability built around these three specific capabilities.

Table 2. Types of Agility

Type of Agility	Description	Role of IT	Example
Customer	Ability to co-opt customers in exploration and exploitation of innovation opportunities <ul style="list-style-type: none">• as sources of innovation ideas• as cocreators of innovation• as users in testing ideas or helping other users learn about the idea	Technologies for building and enhancing virtual customer communities for product design, feedback, and testing	Ebay customers are its defacto product development team because they post an average of 10,000 messages each week to share tips, point out glitches, and lobby for changes (Hof 2001)
Partnering	Ability to leverage assets, knowledge, and competencies of suppliers, distributors, contract manufacturers and logistics providers in the exploration and exploitation of innovation opportunities	Technologies facilitating inter-firm collaboration, such as collaborative platforms and portals, supply-chain systems, etc.	Yahoo! has accomplished a significant transformation of its service from a search engine into a portal by initiating numerous partnerships to provide content and other media related services from its web site (Rindova and Kotha 2001)
Operational	Ability to accomplish speed, accuracy, and cost economy in the exploitation of innovation opportunities	Technologies for modularization, and and integration of business processes	Ingram Micro, a global wholesaler has deployed an integrated trading system allowing its customer and suppliers to connect directly to its procurement and ERP systems, driving operational costs down and increasing order fulfillment accuracy

(Malone et al. 1999). Operational agility allows firms to reduce information asymmetries between buyers and sellers through rapid and up-to-date supply of comprehensive information, often through the use of electronic distribution channels. Firms can enhance their operational agility by leveraging the cheap interconnectivity of virtual markets and gaining faster and more informed decision making (Amit and Zott 2001).

These three dimensions collectively reflect agility. Ferrier et al. (1999) argue that firms that possess a more complex base of resources and capabilities will be in an advantageous position to launch competitive actions. We propose that firms that have developed all of these dimensions of agility should be in a better position to engage in more competitive action as well as complex action repertoires by bundling their customer, partnering, and operational agility.

Digital Options

We draw on real options theory to postulate a redefined role for IT as a *digital options generator*. Real options theory describes how organizations position themselves to seize emergent opportunities. Options are rights to future investment choices without a current obligation for full investment. The holder of an option typically makes a small initial investment, holds it open until an opportunity arrives, and then exercises a choice to strike the option and capture the value inherent in that opportunity. The value of holding an option becomes magnified especially when the options holder has preferential advantages in exploiting the opportunity as opposed to those who do not hold those options. Thus, when path dependencies in the form of prior learning, investment, or experience guide prospects for exploiting emergent opportunities, the holding of options is economically advantageous (Amram and Kulatilaka 1999). Bowman and Hurry (1993) argue that options "form the inimitable resources that give an organization its sustained performance and competitive advantage" (p. 775). Expanding on the notion of options as organizational capabilities, Kogut and Zander (1992; see also Kogut and Kulatilaka 1994) describe a firm's knowledge and combinative capabilities as its strategic options.

We describe digital options as a set of IT-enabled capabilities in the form of digitized enterprise work processes and knowledge systems. Information technologies can strengthen organizational processes and knowledge systems (Alavi and Leidner 2001; Davenport 1993; Davenport and Prusak 1998). Therefore, digitized process capital is the IT-enabled inter- and intra-organizational work processes for automating, informing, and integrating activities such as customer capture, order fulfillment, supply chain, product innovation, and manufacturing flow and creating a seamless flow of information (Davenport 1993; Garvin 1998). Digitized knowledge capital is the IT-enabled repository of knowledge and the systems of interaction among organizational members to generate knowledge sharing of expertise and perspectives. Further, we conceptualize digitized process and knowledge capital along the dimen-

sions of reach and richness (Evans and Wurster 2000; Keen 1991).

Table 3 illustrates the digitized process capital in terms of reach and richness. Digitized process refers to the extent to which a firm deploys common, integrated, and connected IT-enabled processes. High reach is associated with the design and implementation of digitized processes that tie activity and information flows across departmental units, functional units, geographical regions, and value network partners (including suppliers, customers, and vendors). With greater reach, firms can co-opt more customers or business partners within their value stream activities (Venkatraman and Henderson 1998). Digitization technologies have also enabled the creation of atomized and modular business processes that lend themselves to storage, manipulation, combination, and recombination (Malone et al. 1999). Such processes can be accessed from anywhere through electronic interfaces, greatly enhancing their reach.

Digitized process richness describes the quality of information collected about transactions in the process, transparency of that information to other processes and systems that are linked to it, and the ability to use the information to adapt or reengineer the process. Digitized process richness is built by embedding interactivity, customization, currency, and relevance in processes through appropriate information technologies such as decision modeling and analytic processing (Evans and Wurster 2000).

Similarly, Table 4 shows the digitized knowledge capital in terms of reach and richness. Digitized knowledge reach refers to the comprehensiveness and accessibility of codified knowledge in a firm's knowledge base and the interconnected networks and systems that enhance interactions among individuals for knowledge sharing and transfer. High reach occurs with the capture of integrated knowledge about customers, business partners, employees, organizational processes and other significant sources of organizational intelligence (Grover and Davenport 2001). Alavi and Leidner (2001) describe three common applications of IT

Table 3. Types of Digital Options: Process Capital			
Type of Digital Option	Definition	Salient Information Technologies	Example
Digitized process reach	Extent to which a firm deploys common, integrated, and connected IT-enabled processes. High reach is associated with processes that tie activity and information flows across departmental units, functional units, geographical regions, and value network partners (e.g., suppliers).	Enterprise resource planning, supply chain management, customer relationship management, product data management	When customers make a purchase from anywhere in the world using Ebay's online auctions, the firm's sales process integrates with a variety of partner processes that include payment processes (e.g., Paypal), shipping processes (e.g., FedEx), and other partners' internal processes (e.g., online retailers who sell through Ebay).
Digitized process richness	Quality of information collected about transactions in the process, transparency of that information to other processes and systems that are linked to it, and the ability to use that information to reengineer the process	Decision support, analytic, and tracking technologies	Four firms had partnered as a virtual corporation through the effective use of information systems to coordinate the work processes in the design of a complex aircraft (Argyres 1999). The use of a virtual product definition system enabled all partner firms to submit, track, access and modify manufacturing engineering drawings and machine codes virtually, without having to render them physically. The process richness enabled the team to achieve a 90% first-time fit ratio (fit to specifications), compared to an average of 50% fit with traditional design and work processes.

Table 4. Types of Digital Options: Process Capital

Type of Digital Option	Definition	Salient Information Technologies	Example
Digitized knowledge reach	Comprehensiveness and accessibility of codified knowledge in firm's knowledge base and the interconnected networks and systems for enhancing interactions among individuals for knowledge transfer and sharing.	Intranets, databases, and knowledge repositories	Accenture uses its KnowledgeXchange (a Lotus Notes system) to capture intelligence from around the globe—business cases from previous engagements, technical information, training modules, and information organized around communities of practice.
Digitized knowledge richness	Systems of interactions among organizational members to support sense-making, perspective sharing and development of tacit knowledge.	Advanced knowledge technologies, virtual video-conferencing systems, collaborative tools for knowledge sharing, etc.	BP uses 3-D imaging rooms equipped with state-of-the-art videoconferencing systems for helping its engineers gather in any of the company's 15 imaging rooms and tap into and share data over the network. This system allows them to view images of the far-off Caspian seabed or the Canadian Rockies and avoid expensive mistakes such as dryholes (Echikson 2001).

for organizational knowledge management initiatives: (1) coding and sharing of best practices, (2) creation of corporate knowledge directories, and (3) creation of knowledge networks. The "productization" of knowledge enables firms to systematize firm-specific knowledge into a menu of product formats across the enterprise, thereby promoting greater reach (Slywotzky and Mundt 1999). Knowledge reach is also enabled when firms use electronic communication systems to interconnect people for enabling knowledge production and knowledge sharing. The design of electronic systems affects how organizational members engage in perspective making and perspective taking and thus helps build communities of knowing (Boland and Tenkasi 1995).

Digitized knowledge richness refers to IT-based systems of interactions among organizational members to support their sense-making, perspective-sharing, and development of tacit knowledge. IT facilitates knowledge development by enabling a variety of strong and loose ties among managers (Constant et al. 1996). Advanced communication technologies enable rich communication among managers and facilitate the long-term emergence of shared structures of interactions, cognition, and trust (Huber 1990). A recent study of interorganization learning and knowledge sharing among firms in the disk drive industry finds that IT not only improved lower level inter-organizational learning, but also provided mechanisms for higher-level interorganizational learning through trust and collaboration. IT sys-

tems contribute to reliable performance measurement and thereby help increase cognitive trust and promote collaboration through electronic networks. IT systems also expand the range of weak ties and increase the probability of expertise and knowledge sharing among communities of practice (Granovetter 1973). Advances in information technologies, such as the simultaneous use of audio and video in electronic conferencing and other virtual settings, has also made the capture and sharing of richer knowledge (e.g., soft or tacit knowledge) and the "meaning" of information possible, thereby alleviating concerns that the use of IT for knowledge processes is strictly limited to codifiable or explicit knowledge (Dewett and Jones 2001; Mintzberg 1975; Weick 1985).

Entrepreneurial Alertness

Although agility and digital options are important dynamic capabilities, entrepreneurial alertness is essential for their activation in continually shaping innovation and competitive actions. Entrepreneurial alertness is the capability of a firm to explore its marketplace, detect areas of marketplace ignorance, and determine opportunities for action. Two specific capabilities describe entrepreneurial alertness: strategic foresight and systemic insight.

Strategic foresight is the ability to anticipate discontinuities in the business environment, marketplace, or the information technology space, the threats and opportunities in the extended enterprise chain, and the impending disruptive moves by competitors. Foresight includes an integrated exploration of IT and business opportunities in the conceptualization of competitive actions. Foresight is critical to entrepreneurial action because it reflects the ability to anticipate and visualize the market imperfections and opportunities for IT-based competitive actions (Christensen 1997). Firms develop foresight through their executives' personal intuition and experiences, organizational intelligence about emerging information technologies and their business potential, and alertness to competitive innovation actions by rivals. The success stories

of a variety of firms, such as FedEx (hub-and-spoke business innovation), Amazon (personalization on the Web), or Dell (direct selling of personal computers) testify to the role of foresight in shaping competitive actions, particularly through the creative use of IT.

Systemic insight is the ability to visualize connections between digital options, agility capabilities, and emerging market opportunities in architecting competitive actions. Competitive actions require multiple digital options and agility capabilities; therefore, systemic insight is vital for considering the complex interconnections among these different capabilities and marketplace opportunities. Systemic insight enables an appreciation of the opportunities, the feasibility of seizing those opportunities, the nature of the different business, technology, and competitive risks, and the repertoire of possible countermoves if competitors respond to the disruptive moves initiated by the firm. Vitale (1986) points to the hazards of inadequate systemic insight in the case of many firms that did not consider the variety of risks before initiating competitive applications of IT.

The Strategic Processes of Capability-Building and Entrepreneurial Action

Literature in strategy and information technology has primarily focused on the significance of dynamic capabilities as predictors of firm performance. However, we identify two strategic processes that are significant to how firms could leverage information technologies for superior performance through continual competitive actions. These processes are the capability-building and entrepreneurial action processes (Figure 2). Capability-building processes are consistent with the logic of leverage and represent the relationships among IT competence, digital options, agility, and entrepreneurial alertness in the development of dynamic capabilities. Entrepreneurial action processes are consistent with the logic of opportunity and describe the creative ways in which firms exercise their capabilities for competitive action.

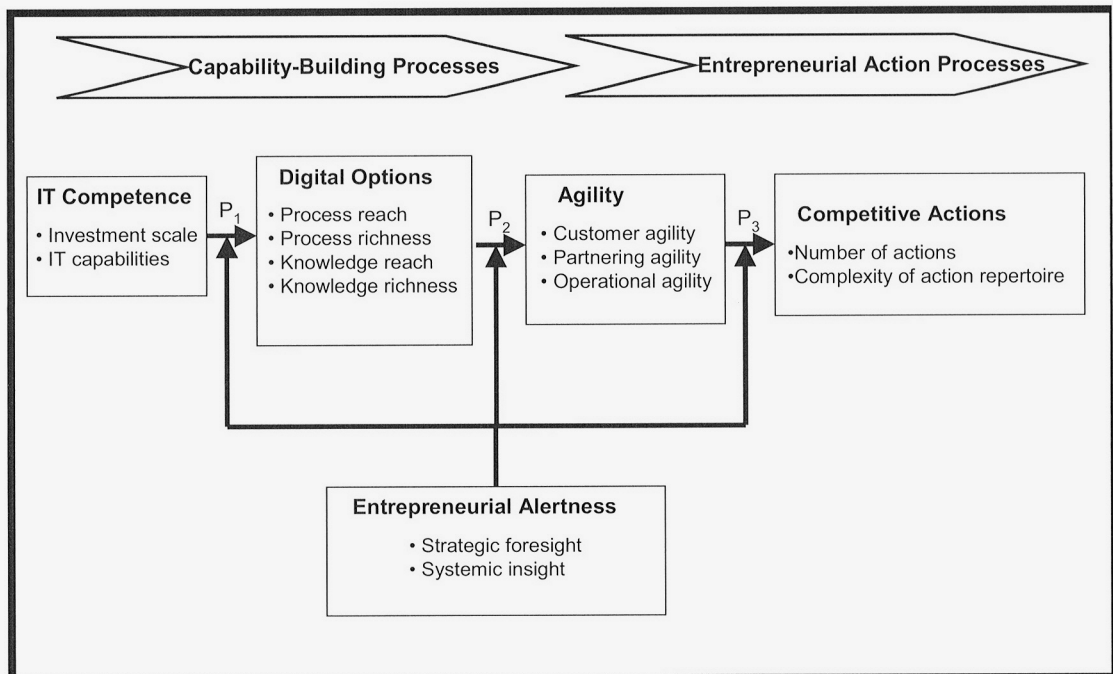


Figure 2. Capability-Building and Entrepreneurial Action

Capability-Building Processes

Capability-building processes integrate IT and business resources into organizational capabilities. Firms develop capabilities over time through a series of linked strategic decisions about investments in information technologies and the blending of information technologies with organizational processes and knowledge (Barua and Mukhopadhyay 2000). Entrepreneurial alertness facilitates the conversion of IT investments and capabilities into digital options. Although IT competence is an important prerequisite for building digital options, strategic foresight is vital so that executives can anticipate the opportunities and business value available in information technologies. Particularly with a proliferation of information technologies, foresight is key so that firms can anticipate the emergence of new information technologies, their promise for the business, and their likelihood of making current technologies obsolete. At the same time, systemic insight is required to recognize the complementarities

between IT competence and organizational processes and knowledge. It enables the firm to time its investments in information technologies, manage relationships with IT vendors and consultants to leverage their expertise, and recognize the justification rationale for investments in information technologies, even if their benefits might not be easily quantifiable.

Therefore, we propose that entrepreneurial alertness will facilitate the leveraging of IT competence into digital options. Evidence of this proposition is observed in the case description of Cisco's experiences with the deployment of IT for global process reach (Nolan 2001). In 1994, the firm invested about \$15 million in enterprise requirements planning (ERP) technologies to replace its legacy systems with an integrated environment for manufacturing, finance, and order entry applications. The firm augmented its investments with IT capabilities in the form of project management, solution integration, and partnerships between the IS group and key functional executives. However,

management foresight was important. At a time when the prevailing philosophy toward applications development was one application at a time, management recognized the need for speedy overhaul of the legacy infrastructure through integrated applications environments. Championship from the senior vice president of Manufacturing provided the impetus for undertaking the risky challenge of a big-bang, \$15 million ERP solution to be implemented in a nine-month period. Similarly, a combination of foresight and systemic insight was exhibited in the fact that senior management did not get bogged down in an elaborate economic justification for the project. In the words of the senior vice president of Manufacturing,

You don't approach this kind of thing from a justification perspective. Cost avoidance is not an appropriate way to look at it. You really need to look at it like, "Hey, we are going to do business this way." You are institutionalizing a business model for your organization (Nolan 2001, p. 7).

As a consequence of these investments, Cisco succeeded in attaining high levels of IT-enabled process integration around customers, suppliers, partners, and employees. Further, these integrated processes enabled them to capture additional and more fine-grained information about their processes, thereby developing process richness. Therefore,

P₁ The impact of IT competence on digital options will be positively moderated by the entrepreneurial alertness of the firm.

Capability-building processes also shape relationships between digital options, entrepreneurial alertness, and agility. As explained earlier, digital options enable all three forms of agility. Higher levels of digital process reach and richness promote operational agility through rapid sequencing and coordination of business services along the entire value chain. Digital process options and digital knowledge options facilitate

customer agility in the form of virtual communities and customization and delivery of product configuration knowledge (Nambisan 2002). Finally, greater reach and richness of process and knowledge options also enhances a firm's partnering agility by enabling it to rapidly seek and integrate new competencies within its value network. While the knowledge dimension enables tapping into a partner's knowledge and skill competences, the process options ensure that such capabilities are seamlessly integrated and synthesized for rapid access and leverage.

However, entrepreneurial alertness is also necessary for converting digital options into agility. Although customer, partnering, and operational agility are technology mediated, they are socially embedded organizational capabilities, meaning that their development requires more than a simple activation of digital options. Agility develops through the complementary intertwining of digital options with organizational structures, cultures, and skills. For instance, customer agility requires the coupling of a culture that values the voice of the customer with digitized processes and knowledge for motivating customer involvement and generating, capturing, and reusing customer insight. Similarly, interorganizational trust is vital for development of extended enterprise networks and partnering agility (Gulati 1999). Finally, operational agility requires attention to metrics about cycle time, continuous quality enhancement, and trustful willingness to share proprietary and strategic information across the partnership network. Strategic foresight is important in anticipating the cultures, organizational structures, skills, and interorganizational relationships that will be needed to leverage digital options in development of agility. Insight is needed to recognize the critical connections among the digital options and other organizational mechanisms needed to promote customer, partnering, or operational agility. As an example, the case study of Marshall Industries (now Avnet) demonstrates the importance of strategic foresight and systemic insight in leveraging digital options for customer agility (El Sawy et al. 1999). Overall, we argue that entrepreneurial alertness is critical for exploring and exploiting the complementarities between digital

options and other organizational mechanisms in the development of agility. Therefore,

- P₂ The impact of digital options (i.e., process reach and richness and knowledge reach and richness) on agility will be positively moderated by entrepreneurial alertness.

Entrepreneurial Action Processes

Entrepreneurial action is consistent with the logic of opportunism and underlies the creative combinations of agility and entrepreneurial alertness for the launch of competitive actions. With imperfect market knowledge, firms possessing higher levels of entrepreneurial alertness and agility are better positioned to detect and exploit windows of market opportunity. Strategic foresight and systemic insight enable such firms to explore opportunities for market arbitrage through their connections with customers (customer agility) and other partners (partnering agility). Further, these firms are in a better position to exploit the opportunities for competitive action through their operational, customer, and partnering agility. Therefore, we anticipate that such firms will exhibit a larger number of competitive actions. Further, firms that have developed all forms of agility and entrepreneurial alertness will be able to draw upon more capabilities and bundle them in complex ways that enable action repertoire complexity. As one illustration, not only will such firms be able to detect a promising opportunity for product innovation through customer agility, but also they will be able to execute the action with speed because of their operational agility, and architect an innovative multichannel distribution through their partnering agility.

Most of Ebay's competitive actions in Web-based auction markets, which have enabled it to stave off competition and gain market share, have come from the company's ability to listen to its customers (customer agility) and detect opportunities for entrepreneurial action much before its competitors. The firm's fastest growing categories, such as autos, have grown out of its noticing seller

activity and giving it the momentum at the right time by launching a separate web site equipped with specialized features such as vehicle inspection and shipping (Hof 2001). Thus,

- P₃ The impact of agility on the number of competitive actions and action repertoire complexity will be positively moderated by entrepreneurial alertness.

The Strategic Process of Coevolutionary Adaptation

Coevolutionary adaptation refers to the fact that firms learn over time and through experience as they develop digital options and agility and launch a variety of competitive actions (Figure 3). Adaptation is a virtuous process of feedback and experience through which success with competitive actions revitalizes the three dynamic capabilities of agility, entrepreneurial alertness, and digital options. In addition, the recursive and iterative learning embodied in these coevolutionary adaptive processes also influence the future development of IT competence. Put simply, while capability-building and entrepreneurial action processes describe the unfolding sequence of effects from IT competence to competitive actions (propositions 1 through 3), coevolutionary adaptation describes the learning-by-doing sequence of effects in the reverse direction.

Digital options develop through an iterative and learning process of integrating information technologies with business processes and knowledge. Initial experiences with building digital options influence the subsequent IT competence and entrepreneurial alertness. First, initial experiences with digital options often result in additional IT investments in similar, related, or unrelated technologies. Although we argue that the scale of IT investments is likely to rise as firms develop better digital options (i.e., greater process and knowledge reach and richness), the nature of the continued IT investments is likely to be varied. Bowman and Hurry (1993) argue that initial experiences may stimulate firms to either continue

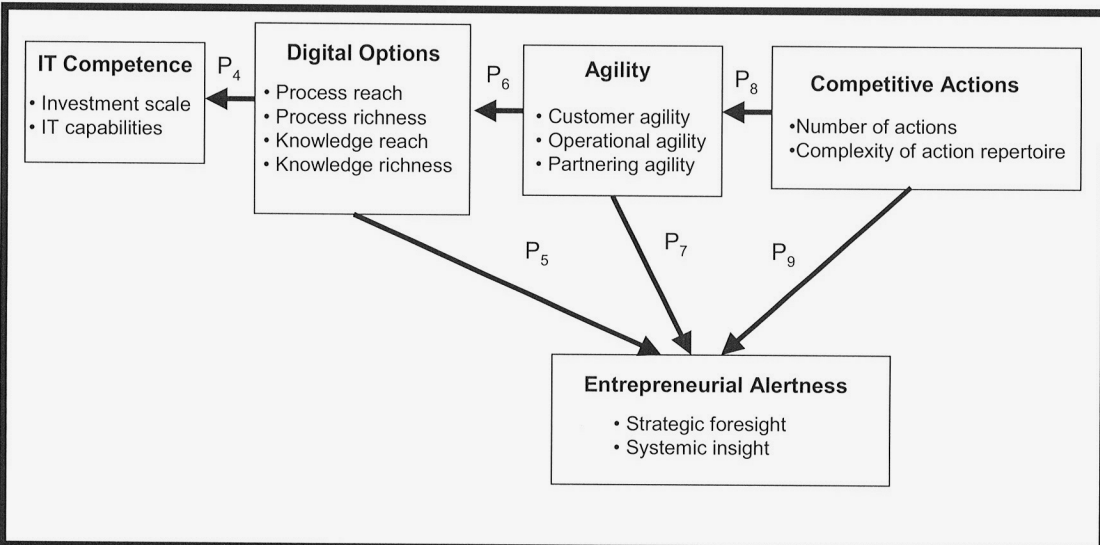


Figure 3. Coevolutionary Adaptation

or switch their investment streams. Periodically, as learning occurs, firms may also discontinue investments in certain technologies or switch to new ones. For example, anecdotal evidence at some firms suggests that initial experiences with ERP investments and the development of process options led to decisions to switch to investments in other platform technologies or scaled-down versions of enterprise platforms (Davenport 2000). Overall, while proposing that well-developed digital options will stimulate more IT investments, we acknowledge that there might be different trajectories of these consequent investments. Propositions about these individual trajectories are beyond the scope of our current theorizing and could be an interesting direction for future research. Experiences with the development of digital options are also likely to shape the firm's IT capability, such as expanded project management knowledge or enhanced relationships between the business and IT managers. For example, successful deployment of complex IT systems (e.g., ERP and other platform technologies) often reinforces the cultures, structures, and processes for business championship of IT initiatives and strengthens both internal and external IT/business partnerships. Thus, we anticipate that experi-

ences with well-developed digital options will influence the IT competence of those firms.

Similarly, initial experiences with development of digital options will shape managerial foresight and insight about future opportunities and actions. The assimilation of complex technologies is a process of mutual adaptation of the technology and prevailing business processes, institutional structures, and knowledge. Therefore, initial experiences with building digital options enable learning-by-doing and shape management insight about the complementarities between information technologies and the business. Such initial experiences increase the absorptive capacity of the organization by increasing the ability to understand and react to new information technologies (Cohen and Levinthal 1990). For instance, greater awareness about the IT market (i.e., emerging segments, new technology offerings) might result in learning that shapes management's ability to recognize and value new opportunities and, thereby, greater foresight and insight. In other words, experiences with the development of better digital options will enhance the entrepreneurial alertness of those firms. Therefore, we propose that

- P₄ Well-developed digital options (i.e., greater process reach and richness and greater knowledge reach and richness) will contribute to higher levels of IT competence.
- P₅ Well-developed digital options (i.e., greater process reach and richness and greater knowledge reach and richness) will contribute to higher levels of entrepreneurial alertness.

Similarly, experiences with the development of greater agility will influence the subsequent development of entrepreneurial alertness and digital options. Agile firms are likely to develop greater foresight and insight because of their sensitivity to the voice of the customer, greater appreciation for operational agility, and access to the knowledge and insights of their business partners. Greater levels of agility and an understanding of its benefits could also trigger recognition of the need to expand process reach and richness or knowledge reach and richness. Therefore,

- P₆ Higher levels of agility will further enhance digital options.
- P₇ Higher levels of agility will further enhance entrepreneurial alertness.

Experiences with competitive actions will shape subsequent entrepreneurial alertness and agility. Planning and executing periodic and complex competitive actions provides opportunities for trial-and-error learning and development of better foresight and insight about the marketplace. Further, such firms become more alert because they observe the payoffs of detecting market imperfections and seizing opportunities. Competitive actions are also likely to strengthen customer agility because customers are more likely to reward continual innovation through their loyalty and affiliation with the firm. Similarly, partnering agility is also likely to be strengthened because of the observed gains to all members of the extended enterprise. Operational agility is likely to be reinforced as better ways of doing business are

learned and incorporated into the business model. Therefore, we propose that

- P₈ Greater number of competitive actions and action repertoire complexity will enhance agility.
- P₉ Greater number of competitive actions and action repertoire complexity will enhance entrepreneurial alertness.

Discussion and Conclusion

During the past seven years, the rise of the Internet era prompted most corporations to reexamine their strategic logic and the role of information technologies in shaping their business strategies. At the same time, the collapse of many Internet-era startups has fueled skepticism about some of the prevalent business models and the role of information technologies in shaping those business strategies. However, our work is motivated by the realization that agility, continual innovation, and competitive action have become core elements of strategic thinking in most contemporary corporations. Incumbent and surviving start-up firms both share a common understanding that information technologies play a fundamental role in their ability to enhance their business performance through continual innovations in products, services, channels, and customer segments. Therefore, the goal of this paper has been to develop a theoretical perspective for understanding the connections between firms' IT investments and capabilities and their ability to launch a variety of competitive actions to solidify their business performance. Our theorizing highlights the rich interplay between three dynamic capabilities in the form of digital options, agility, and entrepreneurial alertness. More significantly, our theoretical model points to the important role of three strategic processes that activate these dynamic capabilities and link them over time to shape the development of capabilities and the execution of competitive actions: capability-building, entrepreneurial action, and coevolutionary adaptation processes.

There are three significant implications of our theorizing for researchers and practitioners interested in understanding the strategic management of information technologies. First, we direct attention toward the role of information technologies as a digital options generator that enables a potent business infrastructure for competing in the digital economy. This conceptualization has significant implications for how researchers and executives should think about the valuation of IT investments and capabilities. Prior perspectives have suggested that the value of IT lies in strategic information systems applications through which firms manipulate the competitive forces shaping their industry (cf., Beath and Ives 1986; Ives and Learmonth 1984). However, in contemporary business environments where firms succeed through frequent and varied competitive actions, we highlight the role of information technologies as a platform for organizational capabilities in the form of digital options and agility. Consistent with the thinking of authors such as Boynton (1993), Quinn and Baily (1994), and Kogut and Kulatilaka (1994), we propose that the value-added role of IT lies in enabling a business infrastructure that shapes a firms' capacity to launch frequent and varied competitive actions. Therefore, questions about the strategic role and value of IT should be reframed in terms of digital options, agility capabilities, and competitive actions. The assessment and benchmarking of IT value should be oriented toward the following questions:

1. What is the quality of the digital options bundle in this firm (i.e., process reach and richness and knowledge reach and richness)? How does this firm compare with the best-in-practice with respect to development of digital options?
2. What is the degree of (IT-enabled) agility in this firm (i.e., customer, partnering, and operational agility)? How does this firm compare with the best-in-practice for each form of agility?
3. What is the frequency and variety of (IT-enabled) competitive actions by this firm?

How does this compare with the actions of the industry leaders in the same industry or other industries?

Further, our theorizing presents a perspective about the valuation of IT that is valid for the enterprise, business unit, and process levels in a firm. Digital options and agility represent enterprise capabilities for competing in a digital economy. Therefore, firms should assess their IT investments and capabilities in terms of the overall quality of their digital options and agility. At the same time, the relationships between these dynamic capabilities and competitive actions help evaluate how well individual business units in large multidivisional firms leverage information technology in their competitive actions. Therefore, business unit executives can benchmark their entrepreneurial alertness in leveraging digital options and agility through the frequency and variety of their competitive actions. Finally, as firms make significant investments in process technologies such as supply chain management, product data management, or customer relationship management, and knowledge technologies such as intranets or data mining, their value can be judged in terms of how they might enhance digital options or the degree of agility.

A second implication is that our theorizing highlights a dynamic perspective on the evolution of IT investments, organizational capabilities (digital options, agility, and entrepreneurial alertness), competitive actions, and firm performance. In particular, we highlight three strategic processes in the form of capability-building, entrepreneurial action, and coevolutionary adaptation. IS researchers have mostly focused their attention toward IT and business capabilities for understanding the strategic management of IT (Bharadwaj 2000; Marchand et al. 2000). We propose that these strategic processes are important because they visualize the dynamics of how firms continually develop their capabilities and shape their strategic conduct over time. Further, these processes capture the interactions among IT investments and capabilities, digital options, agility, and entrepreneurial alertness in shaping the competitive conduct of the firm.

Finally, these processes describe the impacts of learning-through-action as firms observe the consequences of their competitive actions and regenerate or redirect their existing capabilities. Attention to the three processes in our model will be important for both researchers and executives. Although substantial attention has been devoted to organizational work flow processes (Davenport 1993), more attention will need to be focused on the strategic processes that generate, regenerate, and redirect organizational capabilities over time (Garvin 1998; Ghoshal and Bartlett 1995). Research is needed to understand the temporal flows of these strategic processes and how firms could effectively direct such processes in virtuous ways.

A final implication of our theorizing is that it highlights an integrated perspective on IT and business capabilities, actions, and strategies. Our conceptualizations about digital options and agility are illustrations of the complementarity between IT and business activities in firms (Barua and Mukhopadhyay 2000). More importantly, we argue that entrepreneurial alertness is the key to the activation of these capabilities in launching competitive actions. The theoretical model suggests that success in competitive actions and firm performance will require attention toward the integration of IT and business resources, capabilities, strategies, and actions in firms. Researchers and practitioners should examine the nature of organization designs, governance structures, and managerial skills that will foster such integration and facilitate the development of the required dynamic capabilities and strategic processes (Sambamurthy and Zmud 2000). For instance, how should top management teams and other integration mechanisms in firms be organized and structured to facilitate attention toward the leverage of IT in digital options, agility, and competitive actions? What are novel organization designs for firms in the digital economy? Agarwal and Sambamurthy (2002) and El Sawy et al. (1999) provide some of the initial insights about organization designs that might be more appropriate for firms in the digital economy. However, researchers and executives must focus their attention toward discovering and experimenting

with organization designs, governance structures, and managerial skills that will enable firms to develop the dynamic capabilities and strategic processes described in our model. Only with these new organizational arrangements will firms be able to reframe their IT assets and resources as digital options generators and succeed in launching multiple competitive actions.

Clearly, the model can benefit from additional theoretical work that can extend our initial conceptualization in several ways. First, there is a need to examine the model more closely and determine if there exist other unexplored, but salient, forms of digital options and their associations to agility. Also, with rapid changes in technology and the nature of competition especially in information intensive industries, the question must be asked as to how the digital options bundle will change with time in response to changes in technology and competition. Will particular aspects of the digital options bundle become more or less salient? Will new forms of digital options emerge? Next, the question of how IT facilitates the building of digital options can be further developed. How do IT investments enable firms to deconstruct their value chains and create options for reconstructing them? Are there certain types of options that will benefit from different hardware and software investments? How can richness and reach of digital options be tied to specific IT investments?

Finally, additional research would be needed to empirically test the model. As a process model, it would be useful to examine how firms execute competitive actions through the capability-building and entrepreneurial actions. As a variance model, tying the concepts proposed to specific measurable constructs would enable testing of the propositions. For instance, there have been recent attempts to operationalize managerial insight as a predictor of executive potential (Sprietzer and McCall 1997), competitive actions as the number of actions and action repertoire complexity (Ferrier et al. 1999; Young et al. 1996), and knowledge endowment as intellectual capital (Edvinson and Malone 1997). These and other concepts drawn from strategy, innovation, and

organizational behavior can prove valuable in further development and testing of our proposed model.

Concluding Remarks

Today, researchers and executives must recognize that information technologies play a fundamentally different role in firms, viz, as a digital options generator. Investments in information technology and IT capabilities enable firms to develop digital options and agility. Further, through entrepreneurial alertness, firms not only succeed in building these capabilities, but also in activating them through entrepreneurial actions for launching frequent and varied competitive actions. Our theoretical model and the associated propositions add granularity to the prevailing understanding about critical linkages between IT investment and firm performance. Digital options, entrepreneurial alertness, and agility serve as mediating concepts in the IT–performance relationship and the strategic processes of capability-building, entrepreneurial action, and coevolutionary adaptation activate interactions among these capabilities in capturing the IT-performance benefits.

We would encourage future researchers and practitioners to critique, illustrate, expand, and investigate the model in order to unlock the mysteries of an increasingly important, but complex, set of relationships between IT investments and firm performance. We hope that we have set the stage for an ambitious research agenda for reframing the role of IT in firms in the contemporary digital economy.

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