The Influence of IT and Knowledge on Firm Agility and Performance

Full Paper

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Abstract

In this conceptual paper, we describe how IT and knowledge strategies, resources and capabilities co-evolve and collectively influence firm agility. We briefly examine links between business strategy and IT and knowledge strategies, and also between agility and firm performance. To do so, we conduct a comprehensive literature review. Using the resource-based view of the firm and a dynamic capabilities perspective, we build a research model and put forward eight propositions to be tested in future studies. We argue that a holistic view that takes into account interacting, co-evolving aspects of business, IT and knowledge is necessary if we are to understand the drivers and impacts of firm agility in complex, dynamic business ecosystems.

Keywords

Co-evolution, business, information technology, knowledge, strategies, resources, dynamic capabilities, agility, turbulent environments, performance.

Introduction

The importance of information technology (IT) and knowledge has been highlighted by the information systems (IS), management and strategic literature. Using a resource-based view (Barney, 1991), IT and knowledge resources can be seen as essential assets in modern enterprises that, when combined with other firm resources, provide competitive advantages. IT provides critical support for contemporary organizations. In addition, the ability to manage knowledge resources is important in today’s knowledge economy (Theriou et al., 2011). It is widely believed that IT can have a significant impact on a firm’s growth and survival, and can add value to a firm via reducing costs and/or increasing revenues (Mata et al., 1995). Anecdotal evidence and case studies also indicate that effective and efficient use of IT is a key differentiator between successful firms and their less successful counterparts (Bharadwaj, 2000). Similarly, it is widely claimed that knowledge is an important driving force for business success (Theriou et al., 2011). Through successful knowledge management (KM) initiatives, organizations improve their effectiveness and gain competitive benefits.

Given today’s unstable and uncertain business environments, a number of recent studies have examined IT and KM in firms experiencing turbulence. Several have focused on the capabilities a firm needs to survive in a turbulent marketplace (Pavlou and Sawy, 2006; Wu, 2006). Environmental turbulence refers to external conditions of uncertainty or unpredictability resulting, for instance, from changes in consumer preferences and technology developments (Pavlou and El Sawy, 2006). To keep pace with internal and external changes, a firm must utilize dynamic capabilities which can be defined as “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (Teece et al., 1997). One important dynamic capability, agility, emphasizes the organization’s flexibility and speed when coping with environmental changes. Agility can be reflected in a
series of actions, e.g., sensing, action, and decision making (Eisenhardt and Martin, 2000; Houghton, Savy, Gray, and Donegan, 2004; Mendonça, 2007).

More studies are needed to explore the links among IT, knowledge and firm performance, particularly in dynamic contexts. In this conceptual paper, we use theory and literature to examine how a firm’s IT and knowledge resources and capabilities influence its agility and ultimate performance. In particular, we explore three research questions:

- How are a firm’s business, IT and knowledge strategies inter-related?
- How do IT and knowledge capabilities together influence the agility of the firm?
- In dynamic, IT-intensive, knowledge-based industries, how does agility influence firm performance?

To address these complex issues, we conducted a comprehensive literature review. This facilitated theory development and created a solid foundation for advancing knowledge (Webster and Watson, 2002). We searched the ABI/Inform database using key terms such as “agility”, “IT capability” and “knowledge management”. Relevant articles were chosen from high-ranking journals in the IS field such as the MIS Quarterly, Information Systems Research, Journal of Management Information Systems, and the Journal of the Association for Information Systems. We used the articles to identify dimensions of, and relationships among, business strategy, IT, knowledge and firm agility. Related research propositions were then developed.

Theoretical Foundation

We present theory and literature on IT and knowledge resources and capabilities below. Later, we discuss how strategies, resources and capabilities interconnect and collectively influence firm agility and performance.

Resource-Based View of the Firm

The resource-based view (RBV) of the firm can be traced back to Penrose’s work (1959), where she described a firm as a bundle of resources. To date, it is one of the most influential explanations of how a firm’s internal assets can provide competitive advantages. Rooted in the strategic management literature, the central proposition of RBV is that firms can obtain competitive advantages and perform well in the long term if they possess “unique” resources which are valuable, rare, and not easily imitated or substituted by competitors (Barney, 1991). There are two basic assertions underlying the resource-based theory, that is, resource heterogeneity (resources and capabilities possessed by competing firms may differ) and resource immobility (these differences may be long lasting) (Mata et al., 1995). In other words, a firm can keep its advantages over longer periods if the firm is able to protect against resource imitation, transfer or substitution (Wade and Hulland, 2004). Moreover, the way organizations use these resources varies and leads to very different outcomes. To some extent, the ability to find or create truly distinctive competences is the key to a firm’s success and long-term development (Teece et al., 1997). IT and knowledge resources and capabilities are discussed more fully below.

IT Resources and Capabilities

When we refer to IT resources, we adopt Bharadwaj’s (2000) resource classification which consists of IT infrastructure, human IT resources, and IT-enabled intangibles. We describe each of these resources below.

IT infrastructure, which provides a fundamental platform for information sharing, primarily includes physical IT assets, such as hardware, software and networks (Bharadwaj, 2000). IT infrastructure is viewed as the shared information delivery base; a strong technology architecture supports the operation of a firm’s daily business. Human IT resources refer to a firm’s IT-related employees including IT staff, managers, executives, and how they work together as a team or department. Different members have different roles, but together are responsible for a firm’s IT. Other important IT resources are IT-enabled intangibles. These refer to IT’s enabling role in leveraging key organizational intangibles, such as tracking and predicting customer preferences, supporting knowledge management and sharing resources across organizational divisions (Bharadwaj, 2000).

However, owning IT resources is not sufficient. The firm also must develop superior IT capabilities to manage the resources. IT capabilities are combinations of IT-based assets and routines that support
business in value-adding ways (Sambamurthy and Zmud, 2000). They are enterprise-wide capabilities that can differentiate the firm from its competitors as it uses its IT assets to provide desired results (Bharadwaj, 2000; Stoel and Muhanna, 2009). We examine three IT-related capabilities. They are IT personnel expertise, IT infrastructure flexibility and IT management capabilities which cover human, physical, and organizational aspects (Kim et al., 2011). These are described next.

IT personnel expertise represents professional skills, technology management know how, and relational skills that are capabilities developed and used by the human IT resources (see above) as they complete their tasks (Lee et al., 1995; Kim et al., 2011). Many of these skills are accumulated over a long time period and related to employees’ personal backgrounds. IT infrastructure flexibility concerns the modularity, composition and integration of various IT assets in an organization such as systems, applications, networks and telecommunication facilities (Duncan, 1995; Byrd and Turner, 2000; Kim et al., 2011). The term flexibility emphasizes the degree to which IT resources are shareable and reusable which allows IT staff to quickly develop, diffuse, and support various system elements to meet business requirements (Keen, 1991). IT management capability refers to the ability a firm has to manage its IT resources to deliver business value (Kim et al., 2011). It focuses more on organizational level issues and many of these activities are related to planning, investment decision making, coordination, and control on the technology side. It is important for a firm’s executive team to have a shared understanding of the value of IT, and then using this comprehensive view, to create both short-range and long-range IT strategies (Preston and Karahanna, 2005).

A summary of IT resources and capabilities is provided in Table 1.

<table>
<thead>
<tr>
<th>IT Resources</th>
<th>IT Infrastructure: hardware, software and networks</th>
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<tbody>
<tr>
<td>Human IT resources</td>
<td>IT staff, managers, executives, teams, etc.</td>
</tr>
<tr>
<td>IT-enabled intangibles</td>
<td>customer orientation, knowledge assets and synergy</td>
</tr>
<tr>
<td>IT Capabilities</td>
<td>IT personnel expertise: personal experience, earlier work experience, etc.</td>
</tr>
<tr>
<td>IT Infrastructure flexibility</td>
<td>connected, modular, shareable, reusable assets</td>
</tr>
<tr>
<td>IT management capabilities</td>
<td>planning, investment decision making, coordination, and control</td>
</tr>
</tbody>
</table>

Table 1. IT Resources and Capabilities

Knowledge Resources and Capabilities

Knowledge, which is an abstract and multifaceted concept, is at the heart of both knowledge resources and capabilities (Casselman and Samson, 2007). The definition of knowledge has been debated by philosophers since the classical Greek era. From a personal “belief” perspective, knowledge can be defined as justified true beliefs, that is, a dynamic human process of justifying personal beliefs toward ‘truth’ (Nonaka, 1994; Nonaka and Takeuchi, 1995). The knowledge resources of a firm can be considered to have three primary attributes: knowledge nature, knowledge source and knowledge focus. These are outlined below.

The essence or nature of knowledge can be described in many different ways. A common distinction concerns explicit versus tacit knowledge (Nonaka, 1994). Explicit knowledge is typically formal and systematic, and arguably can be coded or stored in databases, for instance, in the form of models, documents and pictures. On the other hand, tacit knowledge is far more private and deeply rooted in one’s experience (Nonaka and Takeuchi, 1995). It typically refers to a person’s own experiences and views; it is built on know-how, values and beliefs accumulated over a long time. Therefore, this kind of knowledge cannot be easily shared among people via standard databases or procedures. Nevertheless, other mechanisms can help to transfer this kind of knowledge, such as social networks.

The source of knowledge can be used to distinguish whether knowledge is obtained within or outside firm boundaries (Zack, 1999). Internal knowledge is unique, specific and tacitly held inside the firm including knowledge that is resident within employee’s heads; embedded in daily behaviors, procedures, software and equipment; and recorded in firm’s documents and databases (Zack, 1999). External knowledge is related to knowledge obtained from the environment, such as publications, professional associations, personal relations, consultants, vendors, etc. (Bierly and Chakrabarti, 1996; Zack, 1999). It is important
for organizations to access external knowledge, integrating it with internal knowledge (Wang and Ahmed, 2007) and then transferring it throughout the organization (Bierly and Chakrabarti, 1996).

The knowledge focus can be used to distinguish between whether a firm puts more emphasis on obtaining new, original and creative knowledge or on enhancing its existing knowledge domains where it already has a good understanding (Bierly, 1999). For instance, a firm can be classified as an explorer if it focuses on creating new knowledge, finding new ways of doing things and keeping abreast of cutting-edge technologies; or it can be classified as an exploiter if it focuses on deeply digging into, and using, existing knowledge (Zack, 1999; Bierly and Chakrabarti, 1996). Usually, exploitation and exploration are not exclusive which means a firm may explore a new area of knowledge while it exploits another (Zack, 1999).

In addition to the nature, source and focus of knowledge, distinctions are commonly made regarding specific knowledge capabilities. It is crucial to develop knowledge operating capabilities that use current knowledge resources effectively and profitably. We focus on three kinds of knowledge capabilities: knowledge infrastructure capability, knowledge process capability and human resource capability, as outlined below.

The firm’s knowledge infrastructure capability is shaped by its technology, structure and culture. The technology of interest refers to the tools employed to manage knowledge. Particularly, firms now rely more on cloud-based technologies to enhance knowledge collaboration among employees (Rafiq et al., 2014). Databases and applications that manipulate data are often linked to knowledge flows. In the context of knowledge infrastructure, structure refers to the technological architecture within the organization (Gold et al., 2001). A well-organized and flexible KM structure should support the firm’s organizational structure and facilitate knowledge sharing among employees. The third aspect, culture, can be a significant hurdle to effective KM (Gold et al., 2001). A firm’s policies and its encouragement of knowledge sharing are important drivers for new idea creation and innovation.

Knowledge process capability can be viewed as encapsulating four basic KM procedures: acquisition, conversion, application and protection. Acquisition aims to obtain knowledge (Gold et al., 2001). This process can be described by a number of activities, such as acquiring, seeking, generating, and capturing knowledge. Conversion concerns the ability to make knowledge useful, i.e., converting knowledge into a useful form (Gold et al., 2001). This process also involves effective knowledge integration, distribution and the reduction of knowledge redundancy. Application focuses on the actual use of knowledge (Gold et al., 2001). For a firm, the ultimate purpose of knowledge is to apply it towards organizational goals (Penrose, 1959). A final component of knowledge process capabilities is knowledge protection which is related to the security of knowledge. This process protects a firm’s knowledge from inappropriate or illegal use (Gold et al., 2001), by adopting various governance mechanisms.

Human resource (HR) capability is another crucial aspect of knowledge capability because much knowledge resides in the head of individuals (Grant, 1996). In the past, the traditional HR department focused internally on the human capital of its employees. In today’s knowledge economy, much needed intellectual capital is external to the organization, and firms face more challenges than before, as they seek to develop competitive organizational capabilities in turbulent environments (Ezzedeen, 2003). It is important for firms to empower employees with important knowledge and skills (entrepreneurial, collaborative, documentation-related, technological, etc.) A firm’s HR architecture for managing its knowledge supports, and positively relates to, its KM (Intan-Soraya and Chew, 2010).

The knowledge resources and capabilities discussed above are summarized in Table 2.

<table>
<thead>
<tr>
<th>Knowledge Resources</th>
<th>Nature: tacit vs. explicit</th>
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<tbody>
<tr>
<td>Source: internal vs. external</td>
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<tr>
<td>Extent: existing vs. new</td>
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<table>
<thead>
<tr>
<th>Knowledge Capabilities</th>
<th>Infrastructure capability: technology, structure and culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process capability: acquisition, conversion, application and protection</td>
<td></td>
</tr>
<tr>
<td>Human resource capability: entrepreneurial, collaborative, documentation-related, technological, etc.</td>
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</table>

**Table 2. Knowledge Resources and Capabilities**
**Business, IT and Knowledge Strategies**

A business strategy can be viewed as a plan, pattern of actions, positioning, or perspective with the objective of organizational performance (Mintzberg, 1987). It is influenced by a firm’s vision, mission and values, as well as an analysis of the competitive environment and organizational context (Toni et al., 2011). Generally, the business strategy reflects the firm’s aim and orientation. It can be used to allocate company resources and guide decisions (Gartlan and Shanks, 2007).

An IT strategy can be defined as an organizational perspective on the investment in, deployment, use and management of information systems and information technologies (Chen, et al., 2010). It is a shared view of the IT role within the organization. IT strategies guide the acquisition and development of resources and the building and maintenance of IT capabilities (Sambamurthy et al., 2003).

According to Zack (1999), knowledge strategy is the overall approach an organization intends to take to align its knowledge resources and capabilities to the intellectual requirements of its business strategy. A knowledge strategy can shape and direct an organization’s learning process which ultimately determines the firm’s knowledge base (Bierly and Chakrabarti, 1996). As a critical asset in knowledge-intensive firms, knowledge strategy guides firms as they manage key knowledge resources and develop relevant capabilities in order to survive.

Today, business, IT and knowledge strategies closely interrelate.

**Firm Agility – A Dynamic Capability**

In the face of rapidly changing markets, intense competition, policy changes, emergence of new technologies, etc., businesses acquire critical dynamic capabilities in order to survive. A dynamic capability, as defined by Teece et al. (1997), is “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments”. In the global marketplace, a winner is often the firm that can make timely, responsive actions, be innovative with flexible products/services, and effectively coordinate and redeploy internal and external resources.

One particularly important dynamic capability is agility. Agility refers to a firm’s ability to detect and respond to market opportunities and threats through assembling requisite assets, knowledge, and relationships with ease, speed, and dexterity (Sambamurthy et al., 2003; Tallon and Pinsoneault, 2011). This capability highlights the organization’s flexibility when coping with environment changes and supports a series of actions related to the redeployment of assets. Maintaining sustainable organizational agility requires a continuous process of identifying and leveraging resources (Trinh-Phuong et al., 2012). Compared with other firms, nimble firms are more likely to survive and thrive in turbulent marketplaces (Jafarnejad and Shahaie, 2008).

Three primary dimensions of firm agility are focused on in this paper: 1) Acting, which refers to the firm’s ability to quickly modify business processes and systems in response to market dynamism (Eisenhardt and Martin, 2000; Teece et al., 1997; Thomas, Clark, and Gloia, 1993); 2) Sensing, which involves recognizing the changes in the environment, both internal and external, such as customer preference shifts (Houghton et al., 2004; Daft et al., 1988; Sawy, 1985); and 3) Decision making (Mendonça, 2007), which requires interpreting captured events and further defining possible opportunities, threats and action to be taken.

**Research Model and Propositions**

We use the literature and theory outlined above to create Figure 1, a conceptual model for future research in the complex and dynamic area of business, IT and knowledge management. In the model, business strategy is regarded as an antecedent which shapes, and is shaped by, the firm’s IT and knowledge strategies. IT and knowledge strategies, resources and capabilities interact with each other. IT and knowledge capabilities together influence a firm’s agility which in turn influences its performance.

In addition, each firm is embedded in a unique context that influences its strategies, operations and outcomes. We pay particular attention to the firm’s industry and business ecosystem. By industry, we refer to a specific area of an economy, such as the publishing industry or the automotive industry. Each
industry has its own unique set of characteristics (geographic scope, boundary, dominant economic characteristics, target customers, etc.) that reflect a series of market attributes exhibited by companies in the given market. These characteristics will shape the firm's behaviors and strategies to some extent. The business ecosystem, as defined by Moore (1996), is an economic community supported by a foundation of interacting organizations and individuals—the “organisms” of the business world. It highlights relationships and partnerships among organizations. For instance, a value chain (part of an ecosystem) can include suppliers, clients, and distributors. Each business in the ecosystem can affect, as well as be affected by, others and there are many interactions and interdependencies. These stakeholders cannot survive in isolation outside the ecosystem, and they evolve together. Research propositions are developed below.

![Research Model Diagram]

**Figure 1. Research Model**

**The Alignment of Business Strategy, IT Strategy and Knowledge Strategy**

Previous research indicates that achieving alignment between the business strategy and other strategies (e.g., for IT and KM) has been a critical issue for many organizations (Chan and Reich, 2007; Chen et al., 2010; De Toni et al., 2011; Zack, 1999). The firm’s IT strategy is shaped by its business strategy but also can provide new business strategy opportunities (Chen et al., 2010). On one hand, IT needs to be managed in a way that mirrors the management of the business (Sauer and Yetton, 1997). The adoption of an IT strategy needs to support a firm’s business orientation and match its development plans. For example, business concerns will drive decisions about IT investments and directional aspects (principles, policies, standards and architectures) of IT strategy. On the other hand, increasingly, new opportunities in the market are created by using IT innovatively. IT changes the structure of industries in the economy, altering the rules and allowing organizations to create competitive advantages throughout all aspects of the value chain (Porter & Millar, 1985) and other aspects of the ecosystem. IT is not just an implementation tool, but it influences other strategies (Wheeler, 2002). It is a critical strategic resource that can address business needs and create business value (Gartlan and Shanks, 2007). IT considerations can be used to proactively and innovatively shape business plans. For executives, it is important to consider how IT and business strategies are dynamically synchronized. Therefore, we propose:

**P1: The business strategy of a firm is significantly influenced by, and significantly influences, the firm's IT strategy.**
Since knowledge is of strategic significance to modern companies, it is also important to examine the relationship between a firm’s knowledge strategy and business strategy. According to Zack (1999), knowledge strategy needs to be appropriate given the firm’s business strategy, and can provide new business opportunities. On one hand, the strategic choices (e.g., service, process) a firm makes or the goals (e.g., revenue, market share) it sets has a profound influence on the knowledge resources or competencies required to achieve these objectives (Zack, 1999). Business strategy provides guidance for knowledge initiatives and the overall knowledge strategy. In turn, if a firm views knowledge as its most strategic asset, then its business strategy should reflect the special role of knowledge in competition (Porter-Liebeskind, 1996). For instance, knowledge is the core asset for most management consulting firms. Their business strategies are usually closely related to managing their intellectual property and intangible capital. Thus, we propose:

**P2:** *The business strategy of a firm is significantly influenced by, and significantly influences, the firm’s knowledge strategy.*

**The Relationships between IT and Knowledge**

The interconnections between IT and knowledge are well known, but complicated. A firm’s knowledge strategy and IT strategy are closely interrelated.

First, data, information and knowledge are interdependent. Organizations usually generate and access a great deal of data. Data is considered to be unprocessed or unorganized raw representations of reality (Anand, 2011). Information is related to the data that is processed in a meaningful way and put in a certain context (Gallup et al., 2002). It is a flow of messages (Nonaka, 1994). Information can be used to support decision making. New knowledge results when personnel combine information with personal and company experience (Grover and Davenport, 2001). Some argue that an essential aspect which differentiates knowledge from information is that knowledge relates to human action (Nonaka, 1994).

Significant recent advancements in IT have provided new possibilities for data analysis, information generation and knowledge management. For instance, IT is used to classify, summarize, transfer and manipulate data into useful and valuable information for specific purposes and contexts (e.g., data mining). In addition, knowledge management systems have been widely applied in organizations to support managing knowledge assets (Alavi and Leidner, 2001). Firms use IT-based communication and coordination applications (e.g., cloud-based tools) to increase their knowledge reach and quality (Overby et al., 2006).

Several studies have empirically tested relationships between IT and knowledge. For instance, Park et al. (2011) demonstrated that IT human capability has a direct effect on learning and knowledge transfer in IT outsourcing situations. It is important to examine the complex interactions between knowledge and IT. At a high level, we propose:

**P3:** *A firm’s knowledge and IT significantly influence each other.*

**The Interactions among Strategy, Resources and Capabilities**

Grant (1991) argues that the resources and capabilities of a firm are central considerations in formulating its strategy. We adopt and extend Grant’s (1991) view, and argue that a firm’s strategies influence, and are influenced by, its resources and capabilities. In particular, we propose that a firm’s knowledge and IT strategies influence, and are influenced by, its IT resources, IT capabilities, knowledge resources and knowledge capabilities. Resources are assets that can be used to detect and respond to market opportunities and threats, while capabilities are repeatable patterns of actions in the use of assets (e.g., to create, produce, and/or offer products and services to the market) (Sanchez et al., 1996). In other words, capabilities involve organizations’ abilities to integrate and deploy valuable assets (Bharadwaj, 2000; Ambrosini, 2009 Teece et al., 1997). Thus, we propose that:

**P4:** *The IT strategy, IT resources and IT capabilities of a firm significantly influence each other.*

**P5:** *The knowledge strategy, knowledge resources and knowledge capabilities of a firm significantly influence each other.*
Linking IT and Knowledge Capabilities to Agility

From an overall perspective, agility is influenced by many aspects of an organization, such as technology, business processes, workforce, information, capabilities and strategy (Trinh-Phuong et al., 2012). The influence of IT and knowledge is of specific interest. They are two essential assets in contemporary firms; a firm cannot thrive without effectively using its IT and knowledge resources.

IT capabilities are vital for firms to sense and appropriately respond to business opportunities and challenges (Chakravarty et al., 2013). With respect to sensing, advanced IT capabilities allow firms to anticipate changes more effectively. Firms with strong IT infrastructure and IT expertise are more likely to capture opportunities created by emerging technologies (Kalakota and Robinson, 2001). With regard to acting, IT-related resources and capabilities provide firms with timely information and enable them to quickly adjust current business processes. IT competencies can directly enhance organizational agility which can affect firm performance (Chakravarty et al., 2013). Therefore, it is important for firms to develop related IT competencies to cope with fast changing marketplaces. We propose:

P6: The IT capabilities of a firm positively influence firm agility.

Furthermore, knowledge is deeply embedded in business processes and decision making (Zanjirchi and Nasab, 2011). For many knowledge-driven enterprises, knowledge management capabilities, such as developing and applying knowledge, play a critical role in enabling a firm to be agile when dealing with market changes (Dove, 1999). With respect to sensing, an adequate level of knowledge capabilities is necessary for a firm to identify potential opportunities in the industry. With respect to action, knowledge capabilities can influence whether ideas can be quickly transformed into reality. Efficient actions often require market knowledge (Naylor et al., 1999). Organizations seeking to become nimble often emphasize the development of employees with appropriate skills, expertise and knowledge, and the ability to convert the collective knowledge into solution products (Zanjirchi and Nasab, 2011). With regards to decision making, knowledge capabilities make decisions more robust. For example, knowledge sharing supports idea exchanges among employees. Thus, we propose:

P7: The knowledge capabilities of a firm positively influence firm agility.

Agility and Firm Performance

Dynamic capabilities have been linked with the performance of firms in unstable environments. For example, Wu (2006) demonstrated that dynamic capabilities are significant mediators between a firm’s resources and performance areas such as innovation speed and speed responding to market changes. Wu’s (2006) research shows that firms with well-defined dynamic capabilities can achieve better performance than their rivals. Kim et al. (2011) found that process-oriented dynamic capabilities positively contribute to a firm’s perceived financial performance. As a dynamic capability, agility provides firms with the ability to detect changes in market risks and uncertainties and to take appropriate actions. Therefore, agile firms can have a wide array of market-response options (e.g., by using various IT tools). Firms exercise these options to obtain future benefits (Tallon and Pinsonneault, 2011). Agility can improve a firm’s performance in many ways, such as increasing product and service innovation (Pavlou and El Sawy, 2010; Zahra and George, 2002), expanding a firm’s repertoire of competitive actions and obtaining a higher or leading market position (Samhamurthy et al., 2003; Tallon and Pinsonneault, 2011). Increased flexibility of business processes is associated with increased competitiveness, so we propose:

P8: The agility of a firm positively influences the firm’s performance.

Important outcomes of agility include improved firm innovation, market growth and financial performance (Carayannis and Provance, 2008). These are expanded on next.

Innovation, defined by the Organisation for Economic Co-operation and Development (OECD) and Eurostat (2005, p. 46), refers to “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organizations or external relations”. An important dimension of innovation is commercialization which involves the act of bringing innovations to market (Datta, 2011; Kelm et al., 1995).
Market growth refers to changes in the firm’s market share (Carayannis and Provance, 2008). It can be viewed as the growth rate of total sales in a business unit’s principal market segment (Gebauer, 2008) or the changes in market volume (Hambrick et al., 2014). This firm outcome is an important indicator of the performance of a firm’s products and services in specific markets, and its market position.

Financial performance measures a firm’s efficiency and effectiveness. It includes several important dimensions, such as firm profitability, liquidity ratios, and activity ratios (Groppelli and Ehsan, 2000; Homburg and Bucerius, 2005). Adequate financial performance is required for the firm’s long-term survival. Other financial performance indicators that are commonly examined include the growth in return on sales, and growth in return on assets (Huo et al., 2008).

**Conclusion**

Below we outline key implications of our paper for research and practice.

**Implications for Research**

This paper makes several contributions to the IS and KM literature. First, we highlight several important antecedents of agility and present crucial links among agility, IT capabilities, and knowledge capabilities. We argue that IT capabilities and knowledge capabilities together affect a firm’s agility, e.g., as reflected in how quickly firms perceive market changes or opportunities, make appropriate decisions and take actions. Prior studies have illustrated the importance of IT and knowledge on a firm’s success (Bharadwaj’s, 2000; Theriou et al., 2011) but researchers have called for the study of intermediate, co-evolving organizational variables through which IT influences firm performance (Barua et al., 1995; Tanriverdi, 2014). In addition, there has been limited examination of the role of IT capabilities and resources in building agile competencies. This also holds true for knowledge resources and capabilities. Moreover, our study brings insights to the dynamic capability literature by exploring how IT and knowledge together help to develop organizational agility, which is a dynamic capability.

Second, most prior research focuses on either the impact of IT resources and capabilities or the impact of knowledge resources and capabilities, or only examines IT and knowledge resources, or only IT and knowledge capabilities. This paper examines all four constructs together. This is appropriate as knowledge and IT tightly connect to each other in the contemporary enterprise, and resources and capabilities interconnect (Alavi and Leidner, 2001). Therefore, it is necessary to consider the effects of IT and knowledge resources and capabilities together rather than separately. We go even further in this paper, examining also the interaction of strategies with resources and capabilities. This model thus offers a more comprehensive perspective to examine how IT and knowledge work together to generate impacts on a firm’s agility. We have considered multiple dimensions of IT and knowledge resources and capabilities.

Third, the research model and propositions presented in this paper are provided to assist scholars in further exploring the relationships, over time, among IT and knowledge strategies, resources and capabilities, agility and performance. In today’s economy, business, IT and knowledge are deeply interconnected and co-evolve. We recommend that longitudinal research be used to document and test our propositions which are summarized in Table 3 below.

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Description</th>
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<tbody>
<tr>
<td>P1:</td>
<td>The business strategy of a firm is significantly influenced by, and significantly influences, the firm’s IT strategy.</td>
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<tr>
<td>P2:</td>
<td>The business strategy of a firm is significantly influenced by, and significantly influences, the firm’s knowledge strategy.</td>
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<tr>
<td>P3:</td>
<td>A firm’s knowledge and IT significantly influence each other.</td>
</tr>
<tr>
<td>P4:</td>
<td>The IT strategy, IT resources and IT capabilities of a firm significantly influence each other.</td>
</tr>
<tr>
<td>P5:</td>
<td>The knowledge strategy, knowledge resources and knowledge capabilities of a firm significantly influence each other.</td>
</tr>
<tr>
<td>P6:</td>
<td>The IT capabilities of a firm positively influence firm agility.</td>
</tr>
<tr>
<td>P7:</td>
<td>The knowledge capabilities of a firm positively influence firm agility.</td>
</tr>
<tr>
<td>P8:</td>
<td>The agility of a firm positively influences the firm’s performance.</td>
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</table>

**Table 3. Summary of Propositions**
While individual propositions have been previously tested, it is important to explore these propositions collectively. Researchers cannot ignore the complexity of the multifaceted interactions among business, IT and knowledge, in terms of strategies, capabilities, resources, and performance impacts. It is this more complex whole that needs further investigation.

Implications for Practice

This paper also provides useful insights for practitioners. Our discussion should encourage practitioners to think carefully about their IT and knowledge strategies, and rethink their use of firm resources and capabilities, in the context of the need for firm agility. Our paper suggests that it is important to place an emphasis on reinforcing strategic knowledge and core IT capabilities that help the firm to be agile and acquire competitive advantages. For firms with limited resources in turbulent environments, ideally the business strategy will continuously co-evolve with the IT and knowledge strategies, as they fluidly interact, increasing firm agility and performance.

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