A study of how ICT capabilities can influence dynamic capabilities

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Abstract

Purpose – Prior studies have argued that small firms with dynamic capabilities can revise and reconfigure their internal resources to meet the uncertainties of their business environment. However, there is a lack of understanding of how they can develop such critical capabilities. The purpose of this paper is to propose that small firms can employ information and communication technology (ICT) capabilities as a facilitator for developing dynamic capabilities. Thus, the study builds on resource-based view (RBV) literature and information systems (IS) literature by examining the influence of ICT capabilities on the dynamic capabilities of small firms.

Design/methodology/approach – Several hypotheses were tested by analysing the survey data from 291 small high-technology firms in Sweden.

Findings – The results reveal that ICT capabilities influence dynamic capabilities of small firms. More specifically, the ICT use for internal efficiency positively influences adoptive capabilities, collaborative use of ICT positively influences networking capabilities, and ICT use for communications positively influences both adaptive and innovation capabilities. Consequently, the results suggest that the different components of ICT capabilities facilitate the development of the different organizational capabilities that together represent dynamic capabilities and thus, can contribute to a small firm's competitive advantage.

Practical implications – This study has few implications for the managers and CEO's of small high-technology firms. First, by prioritizing ICT capabilities, small firms can benefit from the development of dynamic capabilities that will support them to meet the challenges of turbulent business environment. Second, because small firms usually lack internal resources (i.e. financial resources and competence), the study provides more specific direction on how they can strategically invest and build different components of ICT that will positively influence their adaptive, absorptive, innovative, and network capabilities.

Originality/value – The study provides an alternative view of how ICT capabilities influence the performance of small firms, and outlines how such capabilities influence the development of dynamic capabilities. Therefore, the study in hand contributes to the RBV and IS literature by specifically linking the components of ICT capabilities to dynamic capabilities and its related sub-capabilities.

Keywords Innovation capability, Dynamic capabilities, Adaptive capability, Adsorptive capability, ICT capabilities, Network capability

Paper type Research paper

Introduction

Small firms (i.e. less than 50 employees) are regarded as the backbone of the European economy. They offer employment, promote growth, and instil innovation (European Commission, 2006). However, small firms are increasingly operating in a turbulent and

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dynamic environment, which is characterized by changing customer needs, increased competition, greater need for flexibility, and the rapid development of innovative products/services (Van de Vrande *et al.*, 2009). In such an environment, firms with dynamic capabilities can revise and reconfigure their resources and routines to meet the rapidly changing environmental conditions (Teece *et al.*, 2007). Although, several studies have conceptually argued for the critical role of dynamic capabilities for achieving competitive advantage (Bessant *et al.*, 2011; Strehle *et al.*, 2010; Wang and Ahmed, 2007; Eisenhardt and Martin, 2000; Teece *et al.*, 2007), there is a lack of understanding of how small firms can develop such critical capabilities and secure their future competiveness (Azadegan *et al.*, 2012).

In this regard, prior studies have argued that information and communication technology (ICT) capabilities can be an important facilitator for enhancing other capabilities of a firm (Mithas *et al.*, 2011; Morabito *et al.*, 2010; Kohli and Grover, 2008; Sambamurthy *et al.*, 2003; Marchand *et al.*, 2000). Therefore, European governments are fascinated and intrigued by ICT, and see it as the key to the success of small firms in the dynamic, knowledge-based economy (Taylor and Murphy, 2004). In contrast to the prior research on ICT capability, this study focuses on an ICT-orientation view, rather than on the ICT infrastructure investment view, because it emphasizes the usage of ICT (Marchand *et al.*, 2000; Parida and Örtqvist, 2015). Thus, we define ICT capabilities as a firm's ability to strategically use a wide array of technologies for business purposes, ranging from basic to very sophisticated (Mithas *et al.*, 2011; Tippins and Sohi, 2003; Johannessen *et al.*, 1999). In this study, ICT capabilities include the use of intranet, extranet, ERP, SCM, e-commerce, and other related technological applications that are applicable to small firms (Kannabiran and Dharmalingam, 2012; Tan *et al.*, 2010).

ICT capabilities can be particularly beneficial for small firms in several ways. We focus on three components that constitute ICT capabilities. They are primarily linked with ICT use to increase internal efficiency, initiate and maintain collaboration with external partners, and improve internal and external communication (Mithas *et al.*, 2011; Scupola, 2009; Nieto and Fernández, 2005; Matlay and Addis, 2003). Among other benefits, these ICT components can provide small firms with the ability to identify opportunities, act flexibly (Overby *et al.*, 2006), absorb and use external knowledge (Roberts *et al.*, 2012; Sambamurthy *et al.*, 2003), drive innovations (Barczak *et al.*, 2007, 2008) and gain from network relationships (Ozer, 2004; Sambamurthy *et al.*, 2003). These benefits represent critical premises for managing a dynamic environment. Thus, we argue that if small firms possess high levels of ICT capabilities, they can utilize their limited internal resources to influence the development of high-order organizational capabilities, such as dynamic capabilities.

This study draws from resources-based view (RBV) literature (Barney, 1991; Wernerfelt, 1984; Wang and Ahmed, 2007; Eisenhardt and Martin, 2000), and information systems (IS) literature (Tan *et al.*, 2010; Wade and Hulland, 2004; Santhanam and Hartono, 2003; Sambamurthy *et al.*, 2003), to explore the link between ICT capabilities and dynamic capabilities. More specifically, the purpose of this study is to empirically examine the influence of ICT capabilities on the dynamic capabilities of small firms. By doings so, we are able to make two theoretical contributions. First, we build on the knowledge related to understanding the complex relationship between ICT capabilities and performance (Mithas *et al.*, 2011; Stoel and Muhanna, 2009; Bhatt and Grover, 2005; Santhanam and Hartono, 2003). We hold the view that the main benefit of ICT capability is not directly related to achieving performance, but rather to enhancing other organizational high-order capabilities, like dynamic capabilities.

Second, we improve our understanding the mechanisms of how ICT capabilities can influence dynamic capabilities by investigating this relationship at the level of ICT components. This enables us to understand the role of ICT capabilities at an operational level, which is particularly valuable for small firms with limited resources. Thus, we believe that the results of our study are valuable for both academic purposes and for practitioners (e.g. managers of small firms).

Theoretical background

Rooted in RBV, dynamic capabilities are defined as a firm's ability to integrate, build, and reconfigure the internal and external competence needed to address a rapidly changing environment (Teece *et al.*, 1997). This conceptual framework was introduced in the RBV literature as a way to explain how a firm's capabilities can lead to competitive advantage in a dynamic and turbulent environment (Bessant *et al.*, 2011; Strehle *et al.*, 2010; Liao *et al.*, 2009). Although, the past two decades have witnessed extensive research on the topic, research on dynamic capability has been criticized for two main reasons (Teece *et al.*, 2007; Wang and Ahmed, 2007). First, the research work on dynamic capability has been performed on a "piecemeal basis", resulting in inconsistent and unrelated results and there has been a lack of empirical, quantitative study of the topic. Second and more importantly, there is lack of understanding of the operationalization of dynamic capability and how it can be developed (Eisenhardt and Martin, 2000; Wang and Ahmed, 2007).

Based on these limitations, we conceptualize dynamic capabilities as a high order of capability, consisting of different sub-capabilities. A similar view has been proposed by Wang and Ahmed (2007), who include four related, but distinctive sub-capabilities: adsorptive capability, adaptive capability, innovation capability, and network capability. Firms with an absorptive capability are able to identify and utilize external knowledge for commercial purposes (Cohen and Levinthal, 1990). Adaptive capability is a firm's ability to quickly identify and capitalize on emerging market opportunities (Oktemgil and Greenley, 1997). Firms with an innovation capability are able to develop new products or processes (Wang and Ahmed, 2004). Finally, network capability is the "ability of firms to develop and utilize inter-organizational relationships to gain access to various resources held by other actors" (Walter *et al.*, 2006, p. 542). Thus, firms with the aspects related to the sub-capabilities are able to effectively mitigate the challenges associated with environmental dynamism and achieve competitive advantage. However, an empirical examination of how these sub-capabilities are developed is needed, in order to better understand the antecedents of dynamic capabilities.

We propose that the neglected role of ICT capabilities is an important enabler, which can influence the development of a firm's dynamic capabilities. Prior studies, emerging from the IS literature, have focused on answering the question of how ICT capabilities contribute to competitive advantage (Wade and Hulland, 2004; Bhatt and Grover, 2005; Stoel and Muhanna, 2009; Santhanam and Hartono, 2003). However, "the underlining mechanisms" through which ICT capabilities influence competitive advantage or firm performance have remained unclear (Bharadwaj, 2000, p. 188). An emerging view in the research field argues that ICT capabilities "enable high-order capabilities", rather than relate directly to the performance of a firm (Mithas *et al.*, 2011, p. 238). We build on this idea and examine the influence of ICT capabilities on high-order dynamic capabilities.

Although IS studies have provided several conceptualizations of the dimensions of ICT capability, only a few studies have empirically measured it (Bhatt and Grover, 2005;

Wade and Hulland, 2004; Mithas *et al.*, 2011). Furthermore, small firms tend to have a less-structured IS department, resources, and routines (Kannabiran and Dharmalingam, 2012; Tan *et al.*, 2010), which means that several of the suggested operationalization of ICT capabilities need to be revised in the context of small firms. Therefore, based on a literature reviews and empirical insights, we decided to focus on the usage of ICT as the underlining premise for ICT capabilities rather than on ICT infrastructure. Further, we have defined ICT capabilities as a firm's ability to strategically use a wide array of technologies for business purposes, ranging from basic to very sophisticated (Matlay and Addis, 2003; Johannessen *et al.*, 1999).

We have identified three strategic uses or components (i.e. sub-dimensions) of ICT capabilities: use for internal efficiency, use for collaboration, and use for communication.

The internal component of ICT capabilities is mainly related to the use of technology for improving internal operational efficiency (Fillis *et al.*, 2003; Levy *et al.*, 2001). Small firms, with their limited internal resources, usually employ ICT as way of achieving cost savings through minimizing the overhead costs related to back-office production, and operational support (Stoel and Muhanna, 2009). ICT systems can also be used as tools for information scanning, to provide information for strategic planning (Johannessen *et al.*, 1999). Moreover, they can provide the opportunity for small firms to develop the competence and skill of their employees though access to new information. Their use of knowledge management systems leads to a better flow of information, which can improve the individual and organizational knowledge base (Mata *et al.*, 1995; Sambamurthy *et al.*, 2003).

The next component relates to ICT use for collaboration (Sarshar and Isikdag, 2004; Levy *et al.*, 2001). This is associated with the use of ICT for establishing and maintaining collaboration external partners, such as customers, suppliers, and other external actors (Tan *et al.*, 2010). For example, the use of an electronic data interchange system can provide a stable connection with the trading partners, which improves knowledge-sharing and information-exchange with customers/suppliers (Zaheer and Venkatraman, 1994). In the presence of superior ICT capabilities, firms are also able to offer high-value services, such as just-in-time delivery, and a higher quality of communication. According to Levy *et al.* (2001), such practices can lead to the development of trust, satisfaction, and commitment that facilitate the development of long-term collaborations. This further enables a small firm to be viewed as an attractive partner for collaboration and helps it to establish new strategic relationships (Nieto and Fernández, 2005).

The final component deals with ICT use for communication (Kannabiran and Dharmalingam, 2012; Venkatraman, 1994). This represents the use of ICT for communicating within and outside the boundaries of the firm (Stoel and Muhanna, 2009). ICT-oriented firms can use an intranet and extranet for achieving a constant inflow and outflow of information, which results in better learning opportunities (Shiau *et al.*, 2009). An intranet provides a valuable communication platform for sharing information, ideas, and knowledge within the firm, and helps to build a common language and tacit knowledge. An extranet enhances a firm's ability to improve communication with new and existing partners (Nieto and Fernández, 2005). Together, these technological communication systems can eliminate geographical barriers and can help firms to effectively perform interactive work processes. Small firms may also find it easier to handle large numbers of business relations through improved internal and external communication (Ozer, 2004). Thus, taken together, these components capture the essence of the specific ICT capabilities of the small firm.

We have proposed that the components of ICT capabilities share a unique relationship with the four sub-capabilities related to dynamic capabilities. Such a proposition builds on prior studies by suggesting an alternative view of the relationship between ICT capabilities and performance and introduces the mediating effect on high-order capabilities (Mithas *et al.*, 2011; Tippins and Sohi, 2003; Marchand *et al.*, 2000). This relationship can have different results due to the moderating influence of the size of a firm. Essentially, smaller firms (i.e. micro firms as compared to small firms) may lack the financial and human resources for achieving strong positive effect between ICT capability and dynamic capability (Morabito *et al.*, 2010; Tan *et al.*, 2010; Nieto and Fernández, 2005). Thus, while testing the influence of ICT capabilities on dynamic capabilities, we also investigate the moderating effect of firm size as a conditional variable.

Development of the hypotheses

Figure 1 illustrates the conceptual model of this study. The model hypothesizes interrelationship between ICT capabilities and dynamic capabilities, and investigates the moderating effect of firm size. In the following section, we build specific hypotheses based on the conceptual model. In doing so, we first briefly review the relevant literature and make logical arguments for each hypothesis.

The relationship between ICT capabilities and absorptive capability

Firms with an absorptive capability are able to identify and utilize external knowledge for commercial purposes (Cohen and Levinthal, 1990). Prior studies argue that developing and maintaining absorptive capability is important for ensuring long-term survival and success, due to an improved knowledge base (Wales *et al.*, 2013; Volberda *et al.*, 2010). According to Lane *et al.* (2006), most scholars identify three key aspects of absorptive capability: a firm's ability to interact with its external environment (exploratory learning), interaction between the sub-units within the firm (transformative learning), and distribution of new knowledge within the firm (exploitative learning). This learning enables firms to manage the uncertainty

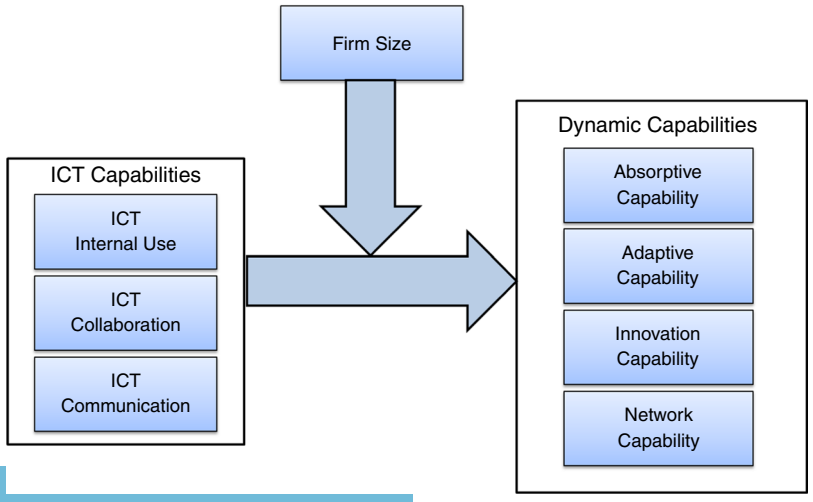

Figure 1. The conceptual model and the hypotheses used for studying the relationship between ICT capabilities, dynamic capabilities, and firm size

associated with a dynamic, turbulent environment while, at the same time, securing competitiveness. Thus, absorptive capability can be regarded as a sub-capability of dynamic capabilities (Roberts *et al.*, 2012; Wang and Ahmed, 2007).

A recent study by Ndiege *et al.* (2012) argues that role of absorptive capability is equally as important for small firms as for larger firms, although the level of such capability can be low for small firms due to a lack of internal resources. In this regard, we argue that ICT capabilities can have positive influence on building absorptive capability for small firms (Roberts *et al.*, 2012). First, the ICT use for internal efficiency includes scanning mechanisms, which can enable small firms to identify and absorb potential information and knowledge (Levy *et al.*, 2001). Further, through development of employees' competence and knowledge through internal use of ICT, small firms can become efficient and effective in locating and accessing appropriate external technologies. Second, as firms absorb knowledge from external partners, use of ICT for maintaining collaboration with different actors becomes a critical precondition for building absorptive capability. Finally, the use of ICT for internal communication through an information management system can provide convenient conditions for small firms to disseminate and comprehend acquired knowledge for commercial ends. For example, an improved level of communication through ICT can lead to the development of a common language within the organization, which can foster the exchange of inter-departmental knowledge (Ruiz-Mercader *et al.*, 2006). Thus, taken together, we propose that the three components of ICT capabilities positively influence the absorptive capability (Sambamurthy *et al.*, 2003; Roberts *et al.*, 2012) of small firms, formally stated as the following hypotheses:

H1a. ICT use for internal efficiency positively influences the absorptive capability of small firms.

H1b. ICT use for collaboration positively influences the absorptive capability of small firms.

H1c. ICT use for communication positively influences the absorptive capability of small firms.

The relationship between ICT capabilities and adaptive capability

Adaptive capability is a firm's ability to quickly identify and capitalize on emerging market opportunities (Gibson and Birkinshaw, 2004). Doing this requires a high degree of strategic flexibility and agility. However, promoting such adaptability to external development and changes tends to be resource-intensive and costly (Oktemgil and Greenley, 1997). Adaptive capability also represents a unique attitude, which is represented by proactive and opportunistic behaviour. Accordingly, firms with an adaptive capability are able to meet changing challenges in their environment by aligning their internal resources, and thus exhibiting dynamic capabilities (Ma *et al.*, 2009; Wang and Ahmed, 2007).

We argue that firms with ICT capabilities can enhance adaptive capability in several ways. First, ICT use for internal efficiency contributes to both the ability of small firms to conduct external scanning for information and facilitates a quick strategic response based on acquired knowledge (Overby *et al.*, 2006). Further, ICT use can create just-in-time routines and processes that boost a firm's overall adaptability, such as, an inventory control system. Second, ICT use for collaboration also represents an important function for enabling adaptive capability. Sambamurthy *et al.* (2003) propose that firms can significantly improve their organizational agility through collaboration

with virtual markets to gain faster and more informed market insights. Similarly, collaborations with customers and other partners also provided the basis for acquiring vital information about future market trends. Thus, firms with a wide-range of information networks have the positive effect of adaptive capability for responding to environmental changes (Zaheer and Zaheer, 1997). Finally, ICT use for communication can provide two advantages for small firms, which lead to the development of adaptive capability. First, improved communication means that firms can de-code the external information through improved sense making functions. Second, ICT-driven communication improves the ability of small firms to coordinate their internal efforts and actions based on the information gained, because of a better flow of information, externally and internally. Thus, we propose that the three components of ICT capabilities positively influence the adaptive capability of small firms, formally stated as the following hypotheses:

H2a. ICT use for internal efficiency positively influences the adaptive capability of small firms.

H2b. ICT use for collaboration positively influences the adaptive capability of small firms.

H2c. ICT use for communication positively influences the adaptive capability of small firms.

The relationship between ICT capabilities and innovation capability

According to Schumpeter (1934), there are many possible ways to achieve innovation, such as the development of new products or services, the development of new methods of production, the identification of new markets, the discovery of new sources of supply, and the development of new organizational forms. Building on this view, Wang and Ahmed (2004) proposed that innovation capability represents a firm's ability to introduce new products to the market, or open up new markets, through the combination of strategic orientation with innovative behaviour and processes. Innovation capability has become an important competitive weapon for small firms operating in a dynamic environment (Parida *et al.*, 2012; Van de Vrande *et al.*, 2009). Therefore, Teece *et al.* (1997) proposed that firms with innovation capability are likely to effectively sustain their competitive advantage in a turbulent environment.

We argue that firms with ICT capabilities can enhance their innovation capability in several ways. First, the ICT use for internal efficiency ensures that resource-intensive development processes will lead to minimized costs. For example, technological functions, such as computer-aided design (CAD), and virtual prototyping enhance a firm's capability for product innovation with minimum overheads (Corso *et al.*, 2001). This can lead to the accumulation of financial slack, which can provide fertile ground for improving a firm's ability to explore incremental and radical innovations (Parida *et al.*, 2012). Second, ICT use for maintaining collaboration with existing partners provides access to external knowledge, leading to improved innovation. For example, the use of a common and linked IS (e.g. e-mail, CAD/CAM, or a database) with suppliers can lower costs and improve the speed of innovation (Barczak *et al.*, 2008). ICT can also drive collaboration with new and diverse partners, allowing small firms to go beyond their geographical boundaries. This can infuse small firms with possibilities for the development and introduction of innovative products/services in international markets and in collaboration with new partners. Finally, the use of ICT for communication can provide small firms with an

improved ability to respond to customers' needs and provide them with customized products (Dierckx and Stroeken, 1999). Being able to meet customers' demands in an effective manner ensures that cutting-edge, innovative products are technically and commercially viable. Thus, based on the above arguments, we propose a strong link between the components of ICT capabilities and innovation capability (Gago and Rubalcaba, 2007; Barczak *et al.*, 2008), which we test with the following hypotheses:

H3a. ICT use for internal efficiency positively influences the innovation capability of small firms.

H3b. ICT use for collaboration positively influences the innovation capability of small firms.

H3c. ICT use for communication positively influences the innovation capability of small firms.

The relationship between ICT capabilities and network capability

Firms with network capability are able to develop and utilize inter-organizational relationships to gain access to various resources held by other actors. According to Walter *et al.* (2006), network capability consists of four functions related to coordination, relational skills, partner knowledge, and internal communication. Typically, small firms are unable to effectively exploit and influence their network relationships due to limited resources and legitimacy (Stuart, 2000). However, if they are able to develop their network capability, they can compensate for their limitations, project themselves as attractive partners, and achieve a competitive advantage (Human and Naude, 2009). Thus, firms with network capability possess an enhanced ability to create new knowledge routines with external actors, which represents a crucial dynamic capability in some industries (Eisenhardt and Martin, 2000).

In particular, we argue that ICT capabilities can be instrumental in enhancing network capability for several reasons. First, through ICT use for internal efficiency, firms are able to coordinate their relationship with diverse external actors. For example, data management systems ensure that all of the critical contacts of a firm are stored in a catalogued manner and can be retrieved when required (Venkatraman, 1994). Second, ICT use for communication can ensure improvement in the flow of information and knowledge, externally and internally through the use of intranet and extranet. Such conditions are important for internal communication within the organization and can also provide knowledge about their partners' needs and expectations (Mostaghel *et al.*, 2012; Southern and Tilley, 2000). Third, ICT use of collaboration can drive the development of trust, commitment, and satisfaction with external partners by providing improved services. These elements are important ingredients for improving relational skills, and making a small firm an attractive partner for strategic collaboration (Sambamurthy *et al.*, 2003; Ozer, 2004; Stoel and Muhanna, 2009). Taken together, we argue that the three components of ICT capabilities positively influence the network capability of small firms, formally stated as the following hypotheses:

H4a. ICT use for efficiency positively influences the network capability of small firms.

H4b. ICT use for collaboration positively influences the network capability of small firms.

H4c. ICT use for communication positively influences the network capability of small firms.

The moderating effect of firm size

Demographic characteristics, such as firm size can have an impact on the level of ICT capabilities (Tan *et al.*, 2010; Fink and Disterer, 2006; Parida *et al.*, 2009; Quayle, 2003). More specifically, we propose two reasons why firm size may represent an important moderator and influences the relationship between ICT capabilities and dynamic capabilities. First, because small firms lack internal resources, they struggle with investment in advanced ICT systems, diminishing their effect on dynamic capabilities (Kannabiran and Dharmalingam, 2012). However, because the costs of implementing ICT have gone down drastically, this now represents a window of opportunity for small firms to level the playing field with their larger counterparts (Levy *et al.*, 2001). This leads to our second argument, that even when smaller firms acquire advanced ICT tools and functions, the level of usage within these firms is low, leading to minimal results in terms of dynamic capabilities. For instance, micro firms (i.e. firms with less than ten employees) may prefer to use informal channels for communication rather than advanced technological solutions. However, as firms grow beyond a certain number, the need to formalize working practices becomes more evident, leading to a higher usage and better results from ICT capabilities. Therefore, we hypothesis a moderating effect of firm size on the connection between ICT capabilities and sub-capabilities related to dynamic capabilities, formally stated as:

H5. Firm size moderates the relationship between ICT capabilities and dynamic capabilities of small firms.

Research method

Data collection and sample

To test the stated hypotheses, we focused on small firms, working within the high-technology sector in Sweden. Once the population is defined the next step is to identify a suitable sampling frame. A sampling frame is a list of elements based on which the sample is drawn (Mostaghel *et al.*, 2012; Churchill and Iacobucci, 2006). A number of potential sampling frames were thoroughly investigated in order to identify the one most suited to the requirements of the current study. All of the available sampling frames had their share of advantages and shortcomings, and these were weighed against one another. After studying many of the official and commercial list providers and directories it was decided that the best source would be Statistics Sweden (www.scb.se). This is the country's official government authority in charge of coordinating and supporting the Swedish system for official statistics, and it has a business register service that uses information from the national customs department to identify and select enterprises involved in many different activities. Additionally, the service permits a customer to classify companies according to number of employees, legal form, industry code (in SNI format)[1], activity date (when they first set up the business), annual turnover, and production area. The company information that is derived from this business register can be acquired, based on random selection if required, according to any one (or a combination) of the aforementioned classifications, and the output provides the requested company information in electronic form, including contact details (telephone and mailing address). The combination of comprehensiveness, convenience, and contemporaneity in Statistic Sweden's business register argued for its adoption as this study's sampling frame. More specifically, these firms belong to the Swedish industry index code (SNI) 72220, which represents "consultancy-related computer systems or computer software" firms. We collected data

from this sector for three main reasons. First, because we intended to examine the relationship between ICT capabilities and dynamic capabilities, we expected the sample firms that were selected to be frontrunners in terms of advanced use of ICT for gaining competitive advantage (Parida *et al.*, 2009). Thus, by sampling these firms instead of focusing on generic small firms, we ensured that we could find a relevant outcome from the proposed relationship. Second, as the basic premise of this study requires a sample of firms operating in dynamic environments, the high-tech industry was deemed an appropriate sample. Finally, focusing on a single industry limits the data to a common environment and the effect of extraneous variance is considered to be low (Westerberg *et al.*, 1997). Therefore, as this study aims to examine new relationships, it is appropriate to dig deeper, rather than more broadly and this was achieved by focusing on small, high-technology firms.

We collected data through a survey study, which was conducted in mid-2007. By using the SNI code 72220 of the Swedish business database (i.e. Affärsdata), we identified approximately 9,000 active firms. However, after employing two criteria to focus on small firms (i.e. less than 50 employees) and ensuring active business operations (i.e. approximately 100,000 euro in sales per year), we were left with 3,737 firms. The sample consists of 885 firms (with one employee), 983 firms (with two employees), 473 firms (with three to five employees), 698 firms (with six to nine employees), and 698 firms (with 10-49 employees). To balance survey cost with sample representativeness, we started by identifying an acceptable sample size. Assuming a statistical power of 0.8, a sampling error of 1 per cent, and a response rate of 10 per cent, sample power analysis indicated that an initial sampling frame of 1,471 small firms would suffice. We selected 294 small firms at random from the first four stratification cells, and 295 from the last (10-49 employees) segment.

The survey instrument was pilot-tested with 15 CEOs in similar industries and they were excluded from the survey study. Appropriate changes and modifications were made based on the feedback from these CEOs. From the sample of 1,471 small firms, 93 questionnaires were returned, due to misfit of the criteria of less than 50 employees and more than 100,000 euro in sales. Furthermore, six surveys did not reach targeted respondents since they had changed their addresses without leaving a forwarding address. This reduced the sample size to 1,372 firms. Finally, a total of 306 replies were received. Among the responses, four surveys were incorrectly answered and one was a duplicate. Moreover, in ten surveys, the CEOs based their responses in the context of another firm or group of firms. This resulted in 291 usable responses (21 per cent response rate). A non-response analysis was made, by comparing different variables, such the ages of the firm (year of establishment), size (number of employees), profit, and solidarity (i.e. the amount of internally funded capital). The analysis showed no significant differences between respondents and non-respondents.

Measurements

Dependent variables. Dynamic capabilities. In this study, dynamic capabilities were conceptualized as a high-order construct. Although, no specific questions on dynamic capabilities were used, it was measured through a combination of absorptive capability, adaptive capability, innovation capability, and network capability. During factor analysis, all the four components loaded as a single component with reasonably high loadings (i.e. absorptive capability 0.81, adaptive capability 0.81, innovation capability 0.73, and network capability 0.68): the four components are related but at the same time different from each other, which essentially represents construct validity.

On the reliability test, the Cronbach's α value of dynamic capabilities was (α: 0.73), which is well acceptable for this nature of context and study.

Absorptive capability. The measurement of absorptive capability was self-developed, based on a review article by Lane *et al.* (2006). The authors reviewed 289 articles on absorptive capability and identified three main elements, which were converted into three items. They addressed exploratory learning, transformational learning, and exploitative learning. The questions for this variable were framed as "the firm being able to recognize and understand new external knowledge, being able to combine newly-acquired knowledge, and being able to use the newly-acquired knowledge for developing new commercial and knowledge outputs". The Cronbach's α value for the scale was high (α: 0.78), representing strong reliability.

Adaptive capability. The measurement for adaptive capability (three items) was adopted based on study of Gibson and Birkinshaw (2004). They measure this capability by evaluating whether the firm's leaders encourage people to challenge traditional practices, if they are flexible enough for the changing market and if they evolve rapidly to shifting business priorities. The Cronbach's α value of the proposed scale was at 0.68, representing moderately strong reliability.

Innovation capability. Innovation capability was measured through three perspectives: product innovation, market innovation, and strategy innovation, based on an empirical study by Wang and Ahmed (2004). They suggested three questions as to how often the firm launches new products and services in market, introduce new ways of working, and introduce new products and services, which are the cutting-edge technology. The Cronbach's α value (α: 0.85) for the three items scale for innovation capability was at a reasonably high level.

Network capability. Network capability was measured as a high-order construct, based on a study by Walter *et al.* (2006). In this study, network capability was conceptualized as consisting of four sub-components, namely, coordination activity (three items), relational skills (three items), partner knowledge (three items), and internal communication (three items). The 12 items scale of network capability had a high Cronbach's α value (α: 0.73), which is adequate for this study.

Independent variables. ICT capabilities. Based on Johannessen *et al.* (1999), we identified 13 strategic activities or uses of ICT in technology-based small firms. These activities were further refined, based on their relevance using a case-study approach. The case study involved three small, high-technology firms and the interviews were conducted with the senior managers or the equivalent with responsibility for ICT in the firm (Parida *et al.*, 2009). The interviewees were asked to explain, in detail, what they viewed as the strategic employment of ICT for their firms and for other small firms in their industry. As small firms have different opportunities and challenges related to ICT usage, as composed to larger firms (Kannabiran and Dharmalingam, 2012), we wanted to develop a scale that is more appropriate in a small-firm context. We were able to recognize ten strategic activities or employments of ICT for small high-technology firms, which together represent ICT capability. The next step involved reducing these items into three underlying dimensions: ICT internal efficiency (four items), ICT collaboration (three items), and ICT communication (three items). The Cronbach's α value of ICT capabilities was considerably above the threshold level (collaboration = α: 0.78; communication = α: 0.75; internal = α: 0.75).

Moderator variables. Firm size. Firm size was measured based on controlling the log-number of employees. This variable was used as the moderator, as we expected

that small firms of a larger size would possess more internal resources for development of capabilities (Morabito *et al.*, 2010; Tan *et al.*, 2010), thus showing a stronger relationship between ICT capability and dynamic capabilities and vice versa.

Control variables. In this study, we used firm age as a control variable. Older small firms can be characterized as having advanced capabilities, as they naturally would, over time, developed refined internal routines and processes. Moreover, we also controlled for external environmental turbulence by sub-dividing it into two dimensions: dynamism (three items) and hostility (four items). This measurement scale for the environment was adopted from Miller and Friesen's (1983) study.

Data analysis

Statistical Package for the Social Sciences was used for data analysis. Factor analysis was used to check for any irregularity or cross-loading for all variables. Next, we conducted bi-variant analysis to check for correlation between the variables under investigation. Finally, for testing the hypotheses related to effect of ICT capabilities on the dynamic capabilities and the moderating role on firm size, regression analysis was performed. During the regression analysis, a total of eight models were run with four dependent variables. Each dependent variable had two models: the first model examined the effect of control variables and independent variables. The second model accordingly, examined the effect of the control variables, independent variables, and moderating variables.

Results

The correlations and descriptive statistics are listed in Table I. Furthermore, Table II displays the results of the regression analysis. In brief, we found a strong positive relationship between ICT capabilities and the four components of dynamic capabilities.

Turning to entities of each hypotheses, *H1a* received strong support, suggesting that ICT use for internal efficiency is significantly related to absorptive capability ($\beta = 0.19$, $p \leqslant 0.01$). *H1b* was weakly supported, suggesting that ICT usage for collaboration is marginally linked to absorptive capability ($\beta = 0.12$, $p \leqslant 0.10$), whereas no support for *H1c* was found. For adaptive capability, we found no significant effect with regard to *H2a* and *H2b*, suggesting that both ICT use for internal efficiency and ICT use for collaboration, do not influence adaptive capability. However, moderate support for *H2c* was found, suggesting that there is a relationship between ICT usage for communication and adaptive capability ($\beta = 0.11$, $p \leqslant 0.05$). Regarding *H3*, we found a positive influence due to two components of ICT capabilities on innovation capability. More specifically, *H3a*, i.e. the influence of ICT use for internal efficiency on innovation capability is weakly supported ($\beta = 0.14$, $p \leqslant 0.10$), while *H3c* showed a stronger influence of ICT use for communication on innovation capability ($\beta = 0.17$, $p \leqslant 0.05$). Furthermore, no support for *H3b* and *H4a* were established. However, both *H4b* ($\beta = 0.26$, $p \leqslant 0.01$) and *H4c* ($\beta = 0.15$, $p \leqslant 0.05$) were supported, suggesting a strong, positive influence of ICT capability-related components' communication and collaboration on network capability. Finally, we did not find adequate support for *H5*, arguing for the moderating role of firm size on the relationship between ICT capabilities and dynamic capabilities of the firms. Still, we found minor indication suggesting that smaller firms with ICT capabilities negatively influence dynamic capabilities, for the reason that ICT usage in communication was negatively linked to adaptive capability ($\beta = -0.44$, $p \leqslant 0.10$) and network capability ($\beta = -0.50$, $p \leqslant 0.05$).

Table I. Correlations table

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Firm age	2.24	0.67	1										
2. Firm size	11.26	8.64	0.24	1									
3. Environmental dynamism	4.26	0.96	−0.03	−0.08	1								
4. Environmental hostility	4.49	1.00	−0.06	−0.01	0.44***	1							
5. ICT internal efficiency	4.86	1.28	−0.03	0.20***	0.13**	−0.01	1						
6. ICT collaboration	5.38	1.32	−0.04	0.05	0.10*	0.01	0.52***	1					
7. ICT communication	4.86	1.42	0.05	0.33***	−0.01	−0.03	0.55***	0.43***	1				
8. Adaptive capability	5.86	0.83	−0.09	0.11*	0.13**	−0.02	0.25***	0.15***	0.21***	1			
9. Absorptive capability	6.00	0.78	−0.09	0.09	0.12**	−0.02	0.32***	0.27***	0.25***	0.52***	1		
10. Innovation capability	4.91	1.30	0.03	0.21***	0.03	−0.04	0.25***	0.13**	0.28***	0.48***	0.45***	1	
11. Network capability	5.64	0.73	−0.11*	0.19***	0.11*	−0.04	0.31***	0.37***	0.33***	0.39***	0.39***	0.24***	1

Notes: $n = 291$. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table II. Hierarchical moderated regression results

	Absorptive capability		Adaptive capability		Innovation capability		Network capability	
	Direct effects	Moderation effects	Direct effects	Moderation effects	Direct effects	Moderation effects	Direct effects	Moderation effects
Controls								
Firm age	−0.084	−0.078	−0.095*	−0.084	0.028	0.032	−0.112**	−0.106**
Firm size	0.032	0.036**	0.059	0.372**	0.136**	0.327*	0.138**	0.269*
Environmental dynamism	0.127**	0.123*	0.160**	0.143**	0.056	0.049	0.138**	0.114*
Environmental hostility	−0.087	−0.076	−0.093	−0.079	−0.061	−0.053	−0.106*	−0.093
Direct effects								
ICT internal efficiency	0.192***	0.382***	0.152	0.052	0.141*	0.234*	0.038	0.031
ICT collaboration	0.122*	0.163	0.001	0.118	−0.027	−0.033	0.264***	0.146
ICT communication	0.083	0.103	0.113**	0.348**	0.171**	0.240	0.156**	0.434***
Moderation effects								
ICT internal efficiency × firm size		−0.380		0.202		−0.186		0.020
ICT collaboration × firm size		−0.065		−0.222		0.017		0.218
ICT communication × firm size		−0.032		−0.449*		−0.122		−0.503**
Model summary								
F-ratio	6.69	5.58	4.60	3.83	5.33	3.93	11.65	8.74
R^2	0.147	0.166	0.102	0.121	0.117	0.123	0.224	0.238
R^2 (adj)	0.126	0.137	0.080	0.089	0.095	0.092	0.205	0.211
Sig.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Notes: $n = 291$. Regression coefficients shown are β coefficients. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

Discussion and conclusion

In this study, we attempted to relate RBV literature and IS literature by examining the complex relationship between ICT capabilities and dynamic capabilities in the context of small firms. Based on our empirical analysis of 291 small, high-technology firms in Sweden, we found several interesting results, which are discussed under three discussion themes: first, ICT capabilities influence on performance; second, ICT capabilities components influence on dynamic capabilities; and third, the moderating influence of firm size.

Studies in the domain of IS research have been attempting to establish a positive relationship between ICT capabilities and firm performance (e.g. Bharadwaj, 2000). While some progress has been made in this direction, a significant gap in knowledge still exists regarding this relationship (Stoel and Muhanna, 2009; Wade and Hulland, 2004). More importantly, recent studies have argued that the ICT capabilities is a critical enabler for influencing high-order capabilities, rather than having a direct influence on performance (Mithas *et al.*, 2011; Sambamurthy *et al.*, 2003). We find initial indication for this alternative view through the empirical examination of ICT capabilities and dynamic capabilities relationship. Thus, we contribute to the IS literature by supporting the emerging view, which highlights the role of ICT capabilities as an enhancer of organizational capabilities in the context of small firms.

More specifically, we found differences in the influence of the components of ICT capabilities on dynamic capabilities. This means that small firms can effectively utilize their limited internal resources by influencing the development of certain sub-capabilities. They can do this by focusing on the specific usage of the components of ICT capabilities. For example, ICT use for internal efficiency provides small firms with improved scanning processes, cost saving, strategic planning, and competence development. These internal ICT-oriented activities were found to be positively linked to both absorptive capability and innovation capability. Small firms with advance knowledge of their external environment are able to make appropriate decisions regarding "from where and from whom" to absorb the appropriate knowledge (Cohen and Levinthal, 1990). Moreover, once the knowledge is acquired, strategic plans can quickly be revised to gain a "first mover" advantage (Ruiz-Mercader *et al.*, 2006), for example, the development of certain innovative products that were not previously considered due to a lack of internal know-how.

Similarly, ICT usage for collaboration positively influenced network capability and absorptive capability. Because technically enabled small firms can be superior at establishing a connection with new partners and maintaining improved relations with existing partners, they are likely to possess internal processes and routines that strengthen both their network capability and their absorptive capability. For example, ICT usage for collaboration can provide firms with improved partner knowledge and the ability to coordinate relations with several partners through data management systems and real-time systems (Ozer, 2004). These activities have a positive influence on a firm's network capability. Moreover, as small firms continue to successfully expand their partner network with new and diverse partners, the possibility to scan and absorb complimentary knowledge is also enhanced through ICT usage for collaboration.

ICT usage for communication was found to be the most influential component of ICT capabilities, as it showed a significant relationship with adaptive capability, innovation capability, and network capability. Improved internal communication within the organization, coupled with improved communication with external

partners, can enable small firms to adapt to external changes, develop innovative products and processes, and create effective inter-organizational relationships. For example, through the use of ICT for communication, small firms can not only gain information about future trends but can also make internal adaptions quickly, in order to exploit the identified opportunity. Also, constantly communicating with external partners can result in the development of trust, satisfaction, and commitment (Johannessen *et al.*, 1999). All this can improve a firm's ability to better utilize its inter-organizational relations with minimum investment. Further, through the use of ICT-enabled communication systems, there can be an increased flow of information and novel ideas that trigger different types of innovations (Nieto and Fernández, 2005).

We also hypothesized that the larger firms in our sample would have a stronger relationship between ICT capabilities and dynamic capabilities. However, the moderating effect of firm size was non-significant, so it is not possible to provide any strong implication. Nevertheless, we found an indication of a significant negative influence for ICT use for communication on adaptive capability and network capability, which would suggest that smaller firms using ICT for communication could potentially enhance two components of their dynamic capabilities. This further highlight the benefits associated with ICT capabilities for micro-sized firms.

In addition to the academic contribution, this study also has three major practical implications, mainly for managers and CEOs of small, high-tech firms. First, the managers of small firms should prioritize investment in ICT capabilities as it drive the development of dynamic capabilities. This means that small firms can mitigate the challenges associated with operating in a dynamic market by strategic use of ICT. Second, as small firms typically have limited internal resources (i.e. financial resources and competence), we provide more specific direction on how they can strategically invest in different components of ICT capabilities in order to positively influence the components of dynamic capabilities. Third, although we are careful with generalizing our results to larger firms, due to limited influence of firm size, we could argue that medium-sized and larger firms could benefit equally from the development of ICT capabilities. However, the role of ICT capabilities for small-firm managers is highly important due to the limitations of their internal resources and vulnerability in the market.

In conclusion, we provide initial insights into how small firms can effectively use their ICT capabilities for positively influencing dynamic capabilities, and by doing so; we are able to propose an alternative explanation for the influence of ICT capability on performance. Moreover, when it comes to investing limited amounts of internal resources, different components of ICT capabilities provide different outcomes with regard to dynamic capabilities.

Limitations and future studies

Like any other research study, this study has several limitations and the results need to be interpreted, based on their understanding.

First, as we have particularly focused on the high-technology sector which ensured that we would find interesting results because these firms can be expected to have advanced ICT capabilities. However, due to this specific focus and the modest data set, we are not able to generalize our findings. Future studies should test the proposed relationship between ICT capabilities and dynamic capabilities components on larger cross-industry sample.

Second, for examining the proposed conceptual model, we have used hierarchical regression analysis, which tests the relationships on each dependent variable in isolation. However, the use of partial least squares (PLS) regression analysis would have provided the possibility for testing the entire model, and added to the robustness of results. Therefore, future studies are recommended to use PLS regression analysis on a simplified model with high response rate for testing the effect of ICT capabilities components on dynamic capabilities.

Third, due to the gap between data collection and the publication of this study, we acknowledge that our findings would have benefited from additional data collection and analysis. One way to address this limitation would be to conduct qualitative analysis to further advance our understanding of the present results. The landmark study by Sutton and Rafaeli (1988) agree with this view as they to use a mixed research approach for developing a fuller picture of the research phenomena. Future studies would benefit from making a qualitative assessment of the present study.

Fourth, we focused on the moderating role of firm size. However, other factors, such as the external environment (Stoel and Muhanna, 2009), and industrial focus (Tan *et al.*, 2010), could potentially influence the outcome of the proposed relationship. Moreover, similar to dynamic capabilities components, the relationship of ICT capabilities with firm performance maybe mediated through other organizational factors. Therefore, future studies are encouraged to include moderating and mediating variables in their research models, when testing for the effect of ICT capabilities.

Finally, viewing dynamic capabilities as a high-order organizational capability is not widely studied, and, to establish such complex conceptualization needs advance empirical and theoretical development, which is currently lacking. Therefore, we would like to encourage researchers to build on the presented study and provide new insights into the role of ICT capabilities for organizational success.

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Note

1. The Swedish Standard Industrial (SNI) classification is based on EU's recommended standard, NACE. SNI 2002 is primarily an activity classification. Production units such as companies and local units are classified according to the activity which they carry out.

References

Azadegan, A., Patel, C.P. and Parida, V. (2012), "Operational slack and venture survival", *Production and Operation Management*, Vol. 22 No. 1, pp. 1-18.

Barczak, G., Hultink, E.J. and Sultan, F. (2008), "Antecedents and consequences of information technology usage in NPD: a comparison of Dutch and US companies", *Journal of Product Innovation Management*, Vol. 25 No. 6, pp. 620-631.

Barczak, G., Sultan, F. and Hultink, E.J. (2007), "Determinants of IT usage and new product performance", *Journal of Product Innovation Management*, Vol. 24 No. 6, pp. 600-613.

Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 2, pp. 99-120.

Bessant, J., Stamm, B.V. and Moeslein, K.M. (2011), "Selection strategies for discontinuous innovation", *International Journal of Technology Management*, Vol. 55 No. 1, pp. 156-170.

Bharadwaj, A.S. (2000), "A resource-based perspective on information technology capability and firm performance: an empirical investigation", *MIS Quarterly*, Vol. 24 No. 1, pp. 169-196.

Bhatt, G.D. and Grover, V. (2005), "Types of information technology capabilities and their role in competitive advantage: an empirical study", *Journal of Management Information Systems*, Vol. 22 No. 2, pp. 253-277.

Churchill, G.A. and Iacobucci, D. (2006), *Marketing Research: Methodological Foundations*, 9th ed., South-Western College Publishing, Mason, OH.

Cohen, W.M. and Levinthal, D.A. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 128-152.

Corso, M., Martini, A., Paolucci, E. and Pellegrini, L. (2001), "Information and communication technologies in product innovation within SMEs – the role of product complexity", *Enterprise and Innovation Management Studies*, Vol. 2 No. 1, pp. 35-48.

Dierckx, M.A.F. and Stroeken, J.H.M. (1999), "Information technology and innovation in small and medium-sized enterprises", *Technological Forecasting and Social Change*, Vol. 60 No. 2, pp. 149-166.

Eisenhardt, K.M. and Martin, J.A. (2000), "Dynamic capabilities: what are they?", *Strategic Management Journal*, Vol. 21 Nos 10-11, pp. 1105-1121.

European Commission (2006), "A guide to SME policy", internet document, available at: http://ec.europe.eu/enterprise/smes/index_em.htm (accessed 24 January 2008).

Fillis, I., Johansson, U. and Wagner, B. (2003), "A conceptualisation of the opportunities and barriers to e-business development in the smaller firm", *Journal of Small Business and Enterprise Development*, Vol. 10 No. 3, pp. 336-344.

Fink, D. and Disterer, G. (2006), "International case studies: to what extent is ICT infused into the operations of SMEs?", *Journal of Enterprise Information Management*, Vol. 19 No. 6, pp. 608-624.

Gago, D. and Rubalcaba, L. (2007), "Innovation and ICT in service firms: towards a multidimensional approach for impact assessment", *Journal of Evolutionary Economics*, Vol. 17 No. 1, pp. 25-44.

Gibson, C.B. and Birkinshaw, J. (2004), "The antecedents, consequences, and mediating role of organizational ambidexterity", *Academy of Management Journal*, Vol. 47 No. 2, pp. 209-226.

Human, G. and Naude, P. (2009), "Exploring the relationship between network competence, network capability, and firm performance: a resource based perspective in an emerging economy", *Management Dynamics*, Vol. 18 No. 1, pp. 2-14.

Johannessen, J.A., Olaisen, J. and Olsen, B. (1999), "Strategic use of information technology for increased innovation and performance", *Information Management & Computer Security*, Vol. 7 No. 1, pp. 5-22.

Kannabiran, G. and Dharmalingam, P. (2012), "Enablers and inhibitors of advanced information technologies adoption by SMEs: an empirical study of auto ancillaries in India", *Journal of Enterprise Information Management*, Vol. 25 No. 2, pp. 186-209.

Kohli, R. and Grover, V. (2008), "Business value of IT: an essay on expanding research directions to keep up with the times", *Journal of the Association for Information Systems*, Vol. 9 No. 1, pp. 23-39.

Lane, P.J., Koka, B.R. and Pathak, S. (2006), "The reification of absorptive capacity: a critical review and rejuvenation of the construct", *The Academy of Management Review*, Vol. 31 No. 4, pp. 833-863.

Levy, M., Powell, P. and Yetton, P. (2001), "SMEs: aligning IS and the strategic context", *Journal of Information Technology*, Vol. 16 No. 3, pp. 133-144.

Liao, J., Kickul, J.R. and Ma, H. (2009), "Organizational dynamic capability and innovation: an empirical examination of internet firms", *Journal of Small Business Management*, Vol. 47 No. 3, pp. 263-286.

Ma, X., Yao, X. and Xi, Y. (2009), "How do interorganizational and interpersonal networks affect a firm's strategic adaptive capability in a transition economy?", *Journal of Business Research*, Vol. 62 No. 11, pp. 1087-1095.

Marchand, D.A., Kettinger, W.J. and Rollins, J.D. (2000), "Information orientation: people, technology and the bottom line", *Sloan Management Review*, Vol. 41 No. 4, pp. 69-80.

Mata, F.J., Fuerst, W.L. and Barney, J.B. (1995), "Information technology and sustained competitive advantage: a resource-based analysis", *MIS Quarterly*, Vol. 19 No. 4, pp. 487-505.

Matlay, H. and Addis, M. (2003), "Adoption of ICT and e-commerce in small businesses: an HEI-based consultancy perspective", *Journal of Small Business and Enterprise Development*, Vol. 10 No. 3, pp. 321-335.

Miller, D.H. and Friesen, P.H. (1983), "Strategy-making and environment: the third link", *Strategic Management Journal*, Vol. 4 No. 3, pp. 221-235.

Mithas, S., Ramasubbu, N. and Sambamurthy, V. (2011), "How information management capability influences firm performance", *MIS Quarterly*, Vol. 35 No. 1, pp. 237-256.

Morabito, V., Themistocleous, M. and Serrano, A. (2010), "A survey on integrated IS and competitive advantage", *Journal of Enterprise Information Management*, Vol. 23 No. 2, pp. 201-214.

Mostaghel, R., Oghazi, P., Hultman, M. and Beheshti, H.M. (2012), "Adoption of enterprise systems and radio frequency identification among service firms", *Service Industries Journal*, Vol. 32 No. 15, pp. 235-243.

Ndiege, J.R., Herselman, M.E. and Flowerday, S.V. (2012), "Absorptive capacity: relevancy for large and small enterprises", *South African Journal of Information Management*, Vol. 14 No. 1, pp. 1-9.

Nieto, M.J. and Fernández, Z. (2005), "The role of information technology in corporate strategy of small and medium enterprises", *Journal of International Entrepreneurship*, Vol. 3 No. 4, pp. 251-262.

Oktemgil, M. and Greenley, G. (1997), "Consequences of high and low adaptive capability in UK companies", *European Journal of Marketing*, Vol. 31 No. 7, pp. 445-466.

Overby, E., Bharadwaj, A. and Sambamurthy, V. (2006), "Enterprise agility and the enabling role of information technology", *European Journal of Information Systems*, Vol. 15 No. 2, pp. 120-131.

Ozer, M. (2004), "The role of the internet in new product performance: a conceptual investigation", *Industrial Marketing Management*, Vol. 33 No. 5, pp. 355-369.

Parida, V. and Örtqvist, D. (2015), "Interactive effects of network capability, ICT capability, and financial slack on technology-based small firm innovation performance", *Journal of Small Business Management*, Vol. 53 No. S1, pp. 278-298.

Parida, V., Westerberg, M. and Frishammar, J. (2012), "Inbound open innovation activities in high-tech SMEs: the impact on innovation performance", *Journal of Small Business Management*, Vol. 50 No. 2, pp. 283-309.

Parida, V., Westerberg, M. and Ylinenpaa, H. (2009), "How do small firms use ICT for business purposes? A study of Swedish technology-based firms", *International Journal of Electronic Business*, Vol. 7 No. 5, pp. 536-551.

Quayle, M. (2003), "A study of supply chain management practice in UK industrial SMEs", *Supply Chain Management*, Vol. 8 No. 1, pp. 79-86.

Roberts, N., Galluch, P.S., Dinger, M. and Grover, V. (2012), "Absorptive capacity and information systems research: review, synthesis, and directions for future research", *MIS Quarterly*, Vol. 36 No. 2, pp. 625-648.

Ruiz-Mercader, J., Meroño-Cerdan, A.L. and Sabater-Sánchez, R. (2006), "Information technology and learning: their relationship and impact on organisational performance in small businesses", *International Journal of Information Management*, Vol. 26 No. 1, pp. 16-29.

Sambamurthy, V., Bharadwaj, A. and Grover, V. (2003), "Shaping agility through digital options: reconceptualizing the role of IT in contemporary firms", *MIS Quarterly*, Vol. 27 No. 2, pp. 237-263.

Santhanam, R. and Hartono, E. (2003), "Issues in linking information technology capability to firm performance", *MIS Quarterly*, Vol. 27 No. 1, pp. 125-153.

Sarshar, M. and Isikdag, U. (2004), "A survey of ICT use in the Turkish construction industry", *Engineering, Construction, and Architectural Management*, Vol. 11 No. 4, pp. 238-247.

Schumpeter, J.C. (1934), "The fundamental phenomenon of economic development", *The Theory of Economic Development*, Harvard University Press, Cambridge.

Scupola, A. (2009), "SMEs' e-commerce adoption: perspectives from Denmark and Australia", *Journal of Enterprise Information Management*, Vol. 22 Nos 1-2, pp. 152-166.

Shiau, W.L., Hsu, P. and Wang, J. (2009), "Development of measures to assess the ERP adoption of small and medium enterprises", *Journal of Enterprise Information Management*, Vol. 22 Nos 1-2, pp. 99-118.

Southern, A. and Tilley, F. (2000), "Small firms and information and communication technologies (ICTs): toward a typology of ICTs usage", *New Technology, Work, and Employment*, Vol. 15 No. 2, pp. 138-154.

Stoel, M.D. and Muhanna, W.A. (2009), "IT capabilities and firm performance: a contingency analysis of the role of industry and IT capability type", *Information & Management*, Vol. 46 No. 3, pp. 181-189.

Strehle, F., Katzy, B.R. and Davila, T. (2010), "Learning capabilities and the growth of technology-based new ventures", *International Journal of Technology Management*, Vol. 52 No. 1, pp. 26-45.

Stuart, T.E. (2000), "Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry", *Strategic Management Journal*, Vol. 21 No. 8, pp. 791-811.

Sutton, R.I. and Rafaeli, A. (1988), "Untangling the relationship between displayed emotions and organizational sales: the case of convenience stores", *The Academy of Management Journal*, Vol. 31 No. 3, pp. 461-487.

Tan, K.S., Chong, S.C., Lin, B. and Eze, U.C. (2010), "Internet-based ICT adoption among SMEs: demographic versus benefits, barriers, and adoption intention", *Journal of Enterprise Information Management*, Vol. 23 No. 1, pp. 27-55.

Taylor, M. and Murphy, A. (2004), "SMEs and e-business", *Journal of Small Business and Enterprise Development*, Vol. 11 No. 3, pp. 280-289.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533.

Teece, D.J., Pisano, G. and Shuen, A. (2007), "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance", *Strategic Management Journal*, Vol. 28 No. 11, pp. 1319-1350.

Tippins, J.M. and Sohi, S.R. (2003), "IT competency and firm performance: is organizational learning a missing link?", *Strategic Management Journal*, Vol. 24 No. 8, pp. 745-761.

Van de Vrande, V., De Jong, J.P.J., Vanhaverbeke, W. and De Rochemont, M. (2009), "Open innovation in SMEs: trends, motives and management challenges", *Technovation*, Vol. 29 Nos 6-7, pp. 423-437.

Venkatraman, N. (1994), "IT-enabled business transformation: from automation to business scope redefinition", *Sloan Management Review*, Vol. 35 No. 2, pp. 73-78.

Volberda, H.W., Foss, N.J. and Lyles, M.A. (2010), "Absorbing the concept of absorptive capacity: how to realize its potential in the organization field", *Organization Science*, Vol. 21 No. 4, pp. 931-951.

Wade, M. and Hulland, J. (2004), "The resource-based view and information systems research: review, extension, and suggestions for future research", *MIS Quarterly*, Vol. 28 No. 1, pp. 107-142.

Wales, W.J., Parida, V. and Patel, P.C. (2013), "Too much of a good thing? Absorptive capacity, firm performance, and the moderating role of entrepreneurial orientation", *Strategic Management Journal*, Vol. 34 No. 5, pp. 622-633.

Walter, A., Auer, M. and Ritter, T. (2006), "The impact of network capabilities and entrepreneurial orientation on university spin-off performance", *Journal of Business Venturing*, Vol. 21 No. 4, pp. 541-567.

Wang, C.L. and Ahmed, P.K. (2004), "The development and validation of the organisational innovativeness construct using", *European Journal of Innovation Management*, Vol. 7 No. 4, pp. 303-313.

Wang, C.L. and Ahmed, P.K. (2007), "Dynamic capabilities: a review and research agenda", *International Journal of Management Reviews*, Vol. 9 No. 1, pp. 31-51.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5 No. 2, pp. 171-180.

Westerberg, M., Singh, J. and Häckner, E. (1997), "Does the CEO matter? An empirical study of small Swedish firms operating in turbulent environments", *Scandinavian Journal of Management*, Vol. 13 No. 3, pp. 251-270.

Zaheer, A. and Venkatraman, N. (1994), "Determinants of electronic integration in the insurance industry: an empirical test", *Management Science*, Vol. 40 No. 5, pp. 549-566.

Zaheer, A. and Zaheer, S. (1997), "Catching the wave: alertness, responsiveness, and market influence in global electronic networks", *Management Science*, Vol. 43 No. 11, pp. 1493-1509.

Further reading

Madrid-Guijarro, A., Garcia, D. and Van Auken, H. (2009), "Barriers to innovation among Spanish manufacturing SMEs", *Journal of Small Business Management*, Vol. 47 No. 4, pp. 465-488.

Appendix

Table AI.
Item loading for ICT capabilities and dynamic capabilities

		Loading
	The extent to which your company uses ICT in this area …	
ICT internal efficiency ($\alpha = 0.75$)	… access information (e.g. market, customer)	0.69
	… enable strategic planning	0.79
	… enable cost savings	0.69
	… enable competence/skills development for employees	0.61
ICT collaboration ($\alpha = 0.78$)	… maintain collaboration with existing business partners	0.84
	… establish business collaborations with new partners	0.78
	… enable work flexibility (e.g. work outside the office)	0.63
ICT communication ($\alpha = 0.75$)	… handle communication within the firm (e.g. intranet)	0.66
	… handle external communication with the firm's stakeholders (e.g. extranet)	0.85
	… promote marketing activities	0.57
ICT capabilities ($\alpha = 0.76$)	ICT internal use	0.85
	ICT collaboration	0.80
	ICT communication	0.81
	In our company …	
Adaptive capability ($\alpha = 0.68$)	… we encourage people to challenge old traditions/practices	0.71
	… we are flexible enough to allow ourselves to respond quickly to changes in our market	0.68
	… we evolve rapidly to respond to shifts in our business	0.61
Absorptive capability ($\alpha = 0.78$)	… we are able to recognize and understand new external knowledge	0.76
	… we are able to combine newly acquired knowledge with our existing knowledge successfully	0.80
	… we are able to use the new combined knowledge for new commercial edge of technology	0.72
Innovation capability ($\alpha = 0.85$)	… we are often first to introduce new ways of working	0.79
	… we often introduce new products and services which are at the cutting-edge of technology	0.83
	… we are often first to market new products and services	0.86
Coordination ($\alpha = 0.74$)	… we analyse what we would like and desire to achieve with which partner	0.78
	… we develop relations with each partner based on what they can contribute	0.68
	… we discuss regularly with our partners how we can support each other	0.73
Relational skills ($\alpha = 0.83$)	… we have the ability to build good personal relationships with our business partners	0.69
	… we can deal flexibly with our partners	0.78
	… we almost always solve problems constructively with our partners	0.83
Partner knowledge ($\alpha = 0.87$)	… we know our partners' markets	0.83
	… we know our partners' products/procedures/services	0.82
	… we know our partners' strengths and weaknesses	0.86
Internal communication ($\alpha = 0.76$)	… we have regular meetings for every project	0.75
	… employees develop informal contacts among themselves	0.87
	… managers and employees often give feedback to each other	0.79
Network capability ($\alpha = 0.73$)	Coordination	0.84
	Relational skills	0.78
	Partner knowledge	0.75
	Internal communication	0.60

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