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Research article

IS integration and business performance: The mediation effect of organizational absorptive capacity in SMEs

Chiara Francalanci[1], Vincenzo Morabito[2]

[1]Politecnico di Milano, Piazza Leonardo Da Vinci, 32, Milano 20133, Italy;
[2]Bocconi University and SDA Bocconi School of Management, Rontgen Street, 1 2036 – Milano, Italy

Correspondence:
C Francalanci, Politecnico di Milano, Piazza Leonardo Da Vinci, 32, Milano 20133, Italy.
Tel: +39 02 23993457;
Fax +39 02 23993411;
E-mail: francala@elet.polimi.it

Abstract

A fundamental result of the information technology (IT) and business performance literature is that IT is not a driver of performance *per se*. However, it can be associated with higher performance if accompanied by organizational change. The identification of the variables describing organizational change is still on-going work. This paper focuses on organizational absorptive capacity and analyses its effects on the relationship between IT and business performance in small and medium enterprises (SMEs). Organizational absorptive capacity measures the ability of an organization to complete a learning process. A significant learning effort is typically associated with IT, as it represents a complex technology. To cope with IT's complexity, implementation is typically incremental and is accompanied by a continuous integration effort of data and applications. The degree of integration of a company's information system (IS), called IS integration, is a proxy of IT maturity and quality. In this study, we explore the effect of IS integration on business performance through absorptive capacity, that is, we hypothesize that absorptive capacity has a *mediation role* between IS integration and business performance. The proposed research model is tested with data surveyed from 466 SMEs sited in Italy, for which exports constitute more than half of their revenues. Results indicate that organizational absorptive capacity has a mediation effect. Alternative models attributing to absorptive capacity a role different from mediation are found to be non-significant.
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Introduction

Research questions on the relationship between information technology (IT) and business performance have been studied extensively since the initial application of computers in business. Until the early 1990s, this area of research offers conflicting findings with evidence to both confirm and disconfirm IT's performance benefits (Willcocks, 1992; Brynjolfsson, 1993; Smith and McKeen, 1993; Wilson, 1993; Willcocks and Lester, 1997). Some authors (Brynjolfsson, 1993; Krueger, 1993; Mahmood and Mann, 1993; Barua *et al*., 1995; Hitt and Brynjolfsson, 1996; Siegel, 1997) suggest a positive relationship between IT and productivity, while other authors (Strassmann, 1990; Weill, 1992; Loveman, 1994; Powell and Dent-Micallef, 1997) instead propose a negative contribution from greater investments in technology.

Save for a few exceptions, these early studies assume a direct causal relationship between higher IT investments and productivity improvements. Evidence supporting this causal model is appealing to establish IT as a critical determinant of productivity, but is also subject to theoretical criticism. As far back as Robey (1977), researchers have discussed how technology alone is an insufficient predictor of variance in productivity. The exclusion of other variables in productivity models may distort the measurable influence of technology, thus providing results with lower explanatory value (Caves, 1980). Markus and Robey (1988) refer to the direct causal relationship between IT investments and productivity as the *technological imperative* and contrast it against the *organizational imperative*, which views productivity gains as a result of a deliberate alignment between managerial and technological choices.

The technological imperative is supported in different streams of literature. The contingency perspective points to classes of variables – organizational, human, and technological, that companies have to combine in order to compete successfully in different industries (Woodward, 1965; Lawrence and Lorsch, 1967). Compared to the external competitive environment, firm-specific integration of different resources, such as technology, skills, and organizational culture, underlies corporate performance (Rumelt, 1986). The strategy literature has welcomed these considerations and formulated the *strategic necessity hypothesis* asserting that IT, although a necessary factor, cannot in and of itself generate sustainable performance advantages (Clemons and Row, 1991b). Keen (1993) states explicitly that performance variance across companies originates in a management difference and not simply a technology difference.

From the mid-1990s, a number of studies have taken the organizational imperative's perspective. This second wave of literature on the relationship between IT investments and business performance has been recently reviewed in Menville and Kraemer (2004). Two research approaches are distinguished, referred to as *IT-enabled efficiency* and *focal firm change*. The first focuses on specific organizational processes and measures the impact of a single class of IT applications on process efficiency. The second searches for critical areas of organizational change that, combined with IT, led to greater business performance.

Within the first category of studies, Clemons and Row (1988) document widespread IT-enabled efficiencies at McKesson and its customers, the latter benefiting substantially from rationalizing operations in preparation for the new order entry and distribution system adopted by McKesson. Another study (Cooper *et al*., 2000) describes how at First American Bank a datawarehouse application, adopted as a consequence of a shift in corporate strategy and a radical organizational transformation, has led to improved business processes and competitive advantage. Similarly, in a study of how IT supports online buying and building to order, organization-wide application of IT, throughout a range of business processes, is found to provide competitive advantage (Kraemer *et al*., 2000). Further, other case and field studies examine the processes by which IT generates operational efficiencies and competitive advantage in the travel industry (Clemons and Row, 1991a), in the cotton industry (Lindsey and Cheney, 1990), and package delivery (Williams and Frolick, 2001).

At the focal firm level, IT business value is generated by the deployment of IT resources (including both technology IT resources and human IT resources) through a process that involves the deployment of complementary organizational resources. A number of studies assess the degree to which complementary organizational resources moderate or mediate IT's performance impact. Brynjolfsson and Hitt (2000) indicate that firms must not only customize, deploy and maintain IT, but also must manage IT together with non-IT resources, including organizational practices and structures. Empirically, the decentralization of decision authority is found to be greater in companies with higher levels of IT investment (Hitt and Brynjolfsson, 1996). Francalanci and Galal (1998) find that IT business value, as measured by productivity, differs according to worker composition: firms with higher IT investment that have also decreased their clerical and professional ranks show higher productivity. In the retail industry, complementarities leading to sustainable performance advantages exist between IT and organizational culture (Powell and Dent-Micallef, 1997).

However, the co-introduction of IT and complementary organizational changes may not result in immediate success. IT resources generate business value when they are *absorbed*, becoming a routinized element of a company's value-chain (Brynjolfsson and Hitt, 1996). In a study of the introduction of computer-integrated manufacturing at a medical products manufacturer, the authors found that despite an extensive set of organizational change initiatives, improved flexibility and responsiveness were not immediately attained (Brynjolfsson *et al*., 1997). At the core of the problem lies a difficulty in changing the behaviour of employees when new technologies and practices appear to contradict their tacit knowledge accumulated over the years. Similarly, in a study of the impact of the use of computers, TQM, profit sharing, and employee participation on labour productivity, Black and Lynch (2001) found synergies among various workplace practices, but no consistent evidence of synergies with the use of computers.

To explain the contextual ability of companies to translate change into performance, the literature has developed the theory of *absorptive capacity* (Cohen and Levinthal, 1990; Zahra and George, 2002a). Absorptive capacity has been initially defined as a firm's ability to identify, assimilate, and exploit knowledge from external sources (Cohen and Levinthal, 1990). This encompasses the ability to imitate other firms' products or processes, as well as the ability to exploit less commercially focused knowledge such as basic scientific research or new IT solutions. Absorptive capacity is recognized to be a strategically valuable capability as it is embedded in processes, knowledge, culture, and people (Zahra and George, 2002a, b).

This paper represents one of the first attempts to measure the impact of absorptive capacity on the relationship between IT and business performance. A significant learning effort is typically associated with IT, as it represents a complex technology. To cope with IT's complexity, implementation is typically incremental and is accompanied by a continuous integration effort of data and applications. The degree of integration of a company's information system (IS), called IS integration, can be considered a proxy of IT maturity and quality. The paper hypothesizes that IS integration leads to greater business performance through absorptive capacity, that is, that absorptive capacity has a *mediation role* (see Figure 1).

This hypothesis is tested on a sample of 466 small and medium enterprises (SMEs). The complexity of IT as a business tool is particularly challenging for SMEs, where access to scale economies is more difficult, IT literacy is often lower, and management attitude is rarely IT-oriented.

As a consequence, the impact of absorptive capacity is higher and is recognized as a fundamental driver of competitiveness to offset a smaller size with flexibility (Cragg and King, 1993; Iacovou *et al*., 1995; Grandon and Pearson, 2004).

The next section discusses IS integration. The section 'Organizational absorptive capacity' analyses the concept of organizational absorptive capacity in greater detail and defines the research hypotheses. The section 'Variable definition and operationalization' presents the variable definition and operationalization. The section 'Methodology, data analysis, and results' describes the methodology and presents the results of the empirical study that has been conducted to verify the research hypotheses. Conclusions are drawn in the section 'Discussion'. Finally, the limitations of this study are analysed in the last section.

IS integration

The chain of causal relationships leading from IT resources to organizational performance according to the focal firm approach is shown in Figure 2 (Menville and Kraemer, 2004). The model shows that IT resources are always associated with complementary organizational resources. A combination of IT and non-IT or complementary resources can exert an impact on business processes. According to the resource-based view of organizations, complementary resources represent any organizational resource that must change in combination with IT in order for companies to complete the IT business value generation process successfully (see Figure 2). In general, the resource-based view assumes that differentiation is obtained by means of a combination of resources. If these resources are difficult to imitate, they can provide a sustainable competitive advantage (Barney, 1991).

This paper proposes *IS integration* as a construct that measures a simultaneous change in IT and non-IT resources. IS integration is defined as the outcome of initiatives leading to greater technical standardization and broader user access to a common set of technical resources, infrastructure, data, or software applications (Hasselbring, 2000; Jhingran *et al*., 2002). From a technical perspective, IS integration encompasses both technical and human IT resources, since it typically accompanies a growth in IT awareness and quality, which cannot be obtained without IT management skills (Jhingran *et al*., 2002; Gattiker and Goodhue, 2005). It is also tightly bound to organizational change. A fundamental reason why organizations integrate their ISs is to enable greater inter-functional cooperation and reach a higher degree of process orientation (Hasselbring, 2000). An integration project is typically implemented in conjunction with a corresponding change in the organizational variables that enact process orientation, such as greater delegation, greater inter-functional communication, and a lower degree of individual specialization (Hasselbring, 2000). In this paper, the IS integration construct is considered as a general measure of a simultaneous change in IT and complementary organizational resources, leading to the first causal relationship of the integrated model reported in Figure 2.

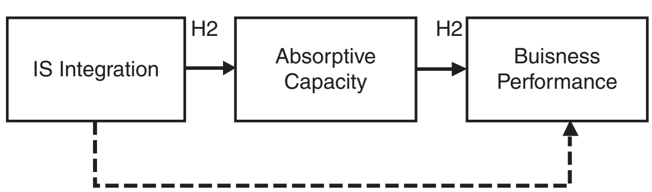

Figure 1 Absorptive capacity as a mediation variable.

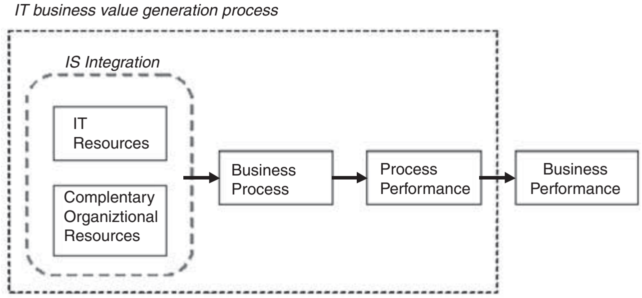

Figure 2 IS integration from the focal firm perspective.

Organizational absorptive capacity

Absorptive capacity is defined as a firm's ability to identify, assimilate, and exploit external knowledge to commercial ends (Cohen and Levinthal, 1990). This focus on external knowledge dates back to March and Simon (1958) who noted that most innovation results from borrowing rather than invention. An open view of organizations is particularly appropriate for IT, which is mostly provisioned, rather than developed internally. The majority of software applications is packaged and customized to a company's specific requirements, but rarely developed *ad hoc* (Van Everdingen *et al*., 2000). Other IT resources, such as hardware and communication equipment, are purchased and most often managed in outsourcing (Dibbern *et al*., 2004). SMEs' recourse to outsourcing is extensive, both in terms of percentage of companies depending on external IT operations (Dibbern *et al*., 2004) and of variety of services procured from IT suppliers (Dibbern *et al*., 2004).

There exists a tight relationship between absorptive capacity and the innovation ability of a company, that is, a company's ability to perform successful change (Cohen and Levinthal, 1990; Fichman and Kemerer, 1999). Absorptive capacity is high if companies can learn how to make use of new knowledge within their processes and implement a change that increases their competitiveness. With respect to the focal firm perspective, absorptive capacity embeds both business process and process performance, as shown in Figure 3. Absorptive capacity has been defined within the

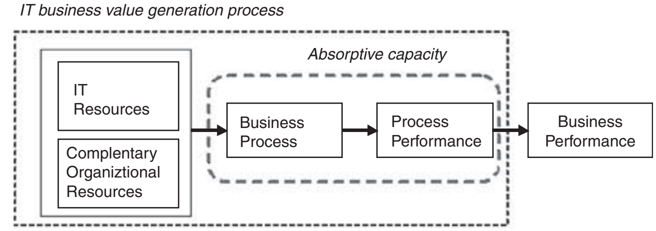

Figure 3 Absorptive capacity from the focal firm perspective.

innovation literature, to model a company's ability to innovate. Since, by definition, innovation requires the successful implementation of a change, a company's innovation ability necessarily embeds the causal relationship between business process and process performance. This leads us to the first research hypothesis (Figure 1):

Hypothesis 1: Absorptive capacity positively influences business performance.

Absorptive capacity represents a dynamic construct, which is appropriate to model the effect of knowledge resources that involve a learning effort (Cohen and Levinthal, 1990; Zahra and George, 2002a, b). A significant learning effort is typically associated with IT, as it represents a complex technology. The complexity of IT as a business tool is particularly challenging for SMEs, where access to scale economies is more difficult, IT literacy is often lower and management attitude is rarely IT-oriented. As a consequence, the impact of absorptive capacity is higher and is recognized as a fundamental driver of competitiveness to offset a smaller size with flexibility (Cragg and King, 1993; Iacovou *et al*., 1995; Grandon and Pearson, 2004).

According to the resource-based view of organizations, absorptive capacity represents the ability of a company to translate a change in a combination of input resources into organizational performance (Zahra and George, 2002a; Malhotra *et al*., 2005). Absorptive capacity's mediation effect between input resources and organizational performance is found to be particularly critical in the R&D context. Cohen and Levinthal (1990) have noted that R&D can act as a bottleneck and prevent innovation if companies fail to develop their learning abilities. In line with the above, the literature under the resource-based view considers absorptive capacity as a strategically valuable capability since it is a path-dependent, firm-specific, and socially embedded means to use other firms' knowledge to create competitive advantage (Lane *et al*., 2002). In other words, absorptive capacity has a strategic value since it is embedded in the business processes and culture of organizations as well as in the skills of employees.

A major empirical finding is that learning abilities are largely a function of a firm's level of prior related knowledge (Cohen and Levinthal, 1990). Cohen and Levinthal (1990) note that it is prior knowledge that confers an ability to recognize the value of new information. Given that a lack of investment early on an area of expertise can foreclose the future development of technical capabilities, absorptive capacity cannot be achieved unless a company's knowledge of a given resource is continuously improved.

As discussed in the previous section, IS integration measures the quality of the IT resource, involving both technical and complementary organizational resources. The degree of integration of a company's IS is the outcome of a continuous improvement of the IT resource, starting from isolated automation initiatives and progressively integrating infrastructures, data, and applications along organizational processes to reach a higher degree of process orientation and overall organizational flexibility. This paper posits that IS integration measures the cumulative knowledge of a company in the IT area of expertise. This leads us to the second research hypothesis (Figure 1):

Hypothesis 2: IS integration positively influences absorptive capacity.

Note that absorptive capacity is a characteristic of individuals, who develop context-specific innovation abilities. It has been demonstrated how continuity is critical at an individual level, due to the obsolescence of knowledge, contextual change, and an individual need for frequent testing of his/her skills. The absorptive capacity of an organization depends on absorptive capacity at an individual level. However, the absorptive capacity of an organization is not merely the sum of the absorptive capacities of its employees. It is the cooperation among individuals that enables the exploitation of new external knowledge and, hence, successful change (Zahra and George, 2002a; Malhotra *et al*., 2005). Isolated individuals may change, but cannot innovate without cooperation. It is well known from the organizational literature how cooperation requires inter-functional communication (Galbraith, 1973, 1974, 1977; Zahra and George, 2002a; Gattiker and Goodhue, 2005). IS integration constitutes a fundamental lever of process orientation and, therefore, represents an enabler of inter-functional communication that facilitates the process of absorption and transformation of knowledge into action and helps employees perform their work. This reinforces the relationship between IS integration and absorptive capacity posited by Hypothesis 2.

Hypotheses 1 and 2 relate to the paths through which IS integration affects business performance. In this study, IS integration is hypothesized to be one of the determinants of organizational absorptive capacity, which, in turn, is hypothesized to affect business performance.

Variable definition and operationalization

In this section, the subsections 'IS integration' and 'Organizational absorptive capacity' discuss the variables that define the IS integration and absorptive capacity constructs. Business performance variables are then discussed in the subsection 'Business performance and sustainable competitive advantage'.

IS integration

A company's IS is composed of multiple vertical components corresponding to different organizational units. Each component is typically structured in three architectural layers, application, data, and infrastructure (Hasselbring, 2000). The application architecture defines the software modules and the main information exchanges among them. The data architecture defines the databases and their content, called *schema*. The infrastructure defines the hardware and network components of the system. The vertical components of the IS are not independent of each other, since they support a common set of business processes. This requires the cross-functional integration of all architectural layers (Hasselbring, 2000; Jhingran *et al*., 2002). In this paper, we define IS integration as the

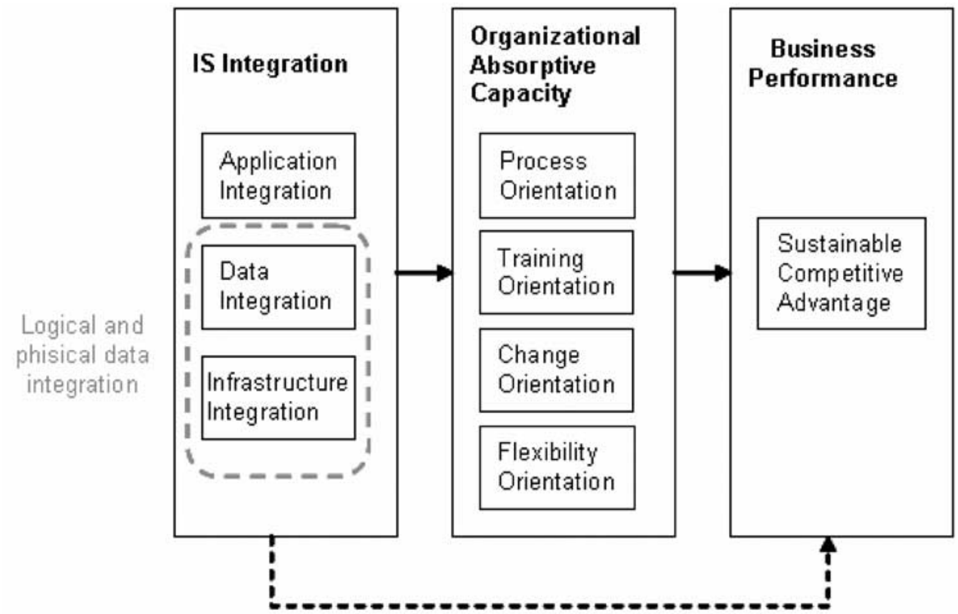

Figure 4 Definition of constructs.

combination of application, data, and infrastructure integration (see Figure 4).

Two applications are integrated if they can exchange data and recall each other's functionalities (Hasselbring, 2000). The application layer of a company's IS is totally integrated if all vertical components are integrated. It is only partly integrated if only subsets of vertical components are integrated. Typical subsets are sales and procurement, warehouse and accounting, accounting and reporting (Van Everdingen *et al.*, 2000). Different degrees of application integration are achieved if integration is implemented within one or multiple subsets of vertical components.

Data can be either logically or physically integrated. They are logically integrated if they are accessed through one logical schema (such as a data warehouse schema). In this case, data can be stored in separate databases, on different machines and in distinct organizations, but they are reconciled in real time or through periodical alignment operations. They are physically integrated, if all applications access the same databases and data are not duplicated (Jhingran *et al.*, 2002). We refer to this latter case as infrastructure integration. If data are duplicated, the customers' or products' databases are not unique (Goodhue *et al.*, 1992). Accordingly, the questionnaire measures both logical and physical data integration (see Table 1).

Organizational absorptive capacity

Absorptive capacity has been widely studied by organizational and innovation researchers. Most research focuses on the identification of the determinants of absorptive capacity for different types of knowledge (Cohen and Levinthal, 1990; Lane *et al.*, 2002; Lenox and King, 2002; Zahra and George, 2002a; Malhotra *et al.*, 2005). To the best of our knowledge, the literature does not provide a study addressing IT-related knowledge. However, Zahra and George (2002a) provide a general model that conceptualizes absorptive capacity as a dynamic construct with four underlying organizational capabilities, acquisition, assimilation, transformation, and exploitation. Acquisition represents the ability to identify new knowledge and realize its potential benefits. Assimilation is the process of internalization that allows employees to reach a deep understanding of new knowledge. Transformation represents the individual ability to accept the change in one's own job necessary to make use of new knowledge. Exploitation represents the result of enacting change and reaping benefits at an organizational level.

We complement Zahra and George's (2002a) model of absorptive capacity from an IT perspective and derive the four organizational capabilities that influence the absorptive capacity of new IT-related knowledge. We posit that process, training, change, and flexibility orientation correspond to the general capabilities of Zahra and George's (2002a) model from an IT perspective.

Process orientation

Process orientation was first introduced by Michael Porter (1985), who has thoroughly discussed its relationship with improved cross-functional interaction. A number of authors have studied process orientation thereafter (Keen, 1993; Boar, 1994). Keen's (1993) model strongly emphasizes the integration between IT and business processes and Boar (1994) suggests that IT solutions must be aligned with business process redesign. This tight relationship between IT and business processes has been broadly studied by the vast literature on business process reengineering (Hammer and Champy, 1993). Hammer and Champy (1993) suggest that implementing new ITs within traditional functionally driven structures is equivalent to 'paving the cow paths'. Process reengineering supporters argue that traditional functional structures camouflage value-creating processes and that managers should accompany the implementation

Table 1 Factor and reliability analysis

Measurement item	α	*Factor loadings*
Dependent variable		
• Competitive advantage	0.828	
y_1 – Over the past 3 years, our economic performance has been higher than that of our competitors		0.874
y_2 – Over the past 3 years, our financial performance has been higher than that of our competitors		0.868
y_3 – So far, we have been able to achieve our organizational objectives more effectively than our competitors		0.761
y_4 – My estimate of our economic and financial performance for the next 3 years is better than that of our competitors		0.747
Independent variables		
IS integration	0.894	
• Data integration		
x_1 – In my company, the customer database is unique for all software applications		0.867
x_2 – In my company, the product database is unique for all software applications		0.872
x_3 – In my company, all software applications use the same databases		0.862
x_4 – In my company, we use batch procedures to align duplicated data across databases		0.886
• Application integration	0.785	
x_5 – In my company, all software systems are designed to be fully integrated		0.778
x_6 – In my company, the sales and purchasing systems are integrated		0.832
x_7 – In my company, the warehouse and invoicing systems are integrated		0.801
x_8 – In my company, the accounting and reporting systems are integrated		0.712
Organizational absorptive capacity		
• Training orientation	0.892	
x_9 – Over the past 3 years, our training investments have increased		0.874
x_{10} – In the next 2 years, our training investments are going to increase		0.819
x_{11} – In my company, all employees regularly attend training courses		0.890
x_{12} – In my company, employees are used to acquiring new skills by attending training courses		0.889
• Change orientation	0.815	
x_{13} – In my company, people can easily accept a change in their organizational roles		0.777
x_{14} – In my company, people can easily accept a change in the software applications that they use		0.859
x_{15} – In my company, people are proactive in requesting changes in the software applications that they use in order to exploit new ITs		0.789
x_{16} – In my company, people are proactive in requesting changes in the software applications that they use in order to meet new operating requirements		0.780
• Process orientation	0.735	
x_{17} – In my company, cross-functional cooperation is common practice		0.825
x_{18} – In my company, cross-functional cooperation has helped in reducing time-to-market		0.823
x_{19} – In my company, we are able to create cross-functional task forces to solve urgent business problems		0.785
• Flexibility orientation	0.829	
x_{20} – My company can quickly adjust production capabilities to variations of market demands		0.924
x_{21} – My company can quickly adjust commercial offerings to variations of market demands		0.920

of IT with greater process orientation. According to Hammer and Champy (1993), 'technology is an essential enabler … Merely throwing computer at an existing business problem does not cause it to be reengineered. In fact, the misuse of technology can block reengineering altogether by reinforcing old ways of thinking and old behaviour patterns'. A business-process-orientated culture is cross-functional, customer-oriented, and IT-enabled.

The literature provides evidence supporting the relationship between process orientation and the ability to exploit IT towards greater performance (Mukhopadhyay *et al*., 1997). In particular, process-oriented organizations have the ability to identify the benefits of inter-functional information exchanges to enhance management processes (Mooney *et al*., 1996). The greater the integration of a company's IS, the faster the overall planning and control cycles (Gattiker and Goodhue, 2004). In contrast, a traditional hierarchical structure (equipped with legacy systems) cannot make use of cross-functional information, due to its inability to understand the benefits of inter-functional cooperation in terms of process performance (Kelly *et al*., 1999).

The questionnaire measures process orientation by means of three items (see Table 1) assessing the cross-functional view of the business, the awareness of process outcome in terms of customer orientation, and the development of an organizational structure that enables cross-functional cooperation. The first question inspects whether a company takes the correct perspective on its business, the second and the third questions evaluate the actual implementation of a process-oriented view of business.

Training orientation

Training activities increase pre-existing know-how and skills and represent an enabler of the assimilation of new knowledge (Fichman and Kemerer, 1999). There exist different types of trainings, ranging from lecturing or formal training, to on-the-job learning (Powell and Dent-Micallef, 1997). IT researchers advocate that formal training is a necessary complement to on-the-job learning to increase computer literacy and is especially required as part of the deployment of new software applications (Winter, 1987; Hall, 1993). Cohen and Levinthal (1990) argue that a firm's absorptive capacity is a function of its level of prior related knowledge. Acquiring knowledge related to a new IT domain by investing in training can help evaluate future opportunities that may be offered by technological development over time.

The questionnaire (see Table 1) measures training orientation by assessing the existence of regular training initiatives as a consolidated organizational practice and the familiarity of employees with formal training sessions. Two additional questions investigate the growth of training investments, both past and planned for the future. Growth represents a tangible indicator of managers' support to training.

Change orientation

The organizational literature defines change orientation as the extent to which managers and employees favour change (Damanpour, 1991) and oppose organizational inertia. This definition is close to Zahra and George's (2002a, b) definition of transformation as the individual ability to accept the change.

A change-oriented enterprise fosters an organizational culture that supports the exploration, assimilation, and application of new technologies and related business solutions (Armstrong and Sambamurthy, 1999). On the other hand, organizations may develop a resistance to learning if the management has a clearly negative attitude towards change (Armstrong and Sambamurthy, 1999). Change orientation is also found to be an enabler of proactivity (Hage and Aiken, 1973), which, in turn, improves scouting and discovery of new external knowledge (Aiken *et al*., 1980).

A positive attitude towards change is also found to influence the outcome of investment decisions (Damanpour, 1991). For example, it can affect the allocation of resources in research and development, which is critical in developing the organizational ability to innovate (Lenox and King, 2002).

Change orientation can encourage individuals to engage in activities that contribute to the transformation of their jobs by means of new knowledge (Aiken *et al*., 1980; Damanpour, 1991). These activities include environmental scanning to acquire new knowledge and trends as well as regular dialogue across functional and hierarchical boundaries to ease knowledge sharing and integration. Through these mechanisms, the knowledge base of organizational members can be extended and, eventually, transformed into new information processing tasks.

Change orientation has been operationalized with a four-item scale (see Table 1). The first two questions evaluate the ease with which employees accept change, while questions three and four assess proactivity towards change.

Flexibility orientation

The literature defines flexibility as 'the ability to adapt or change…organizational processes and products with relatively little time or cost penalties' (Swink *et al*., 2005). Researchers have conceptually argued (Koste and Malhotra, 1999) and empirically demonstrated (Upton, 1995, 1997; Dean and Snell, 1996; Suarez *et al*., 1996) that two types of flexibility can be distinguished: process flexibility and new product flexibility. This paper's operationalization of flexibility accommodates this distinction with a two-item scale addressing both types of flexibility (see Table 1). Flexibility enables a constant organizational change, consistent with Zahra and George's (2002a) definition of exploitation. As an organizational technology, IT is found to be a fundamental driver of flexibility (Upton, 1997) and to deliver benefits by either reducing the cost of flexibility (Palanisamy, 2004) or enabling higher degrees of flexibility (Cooper and Quin, 1992). IT enables the process of organizational adaptation (Shrivastava, 1983), resulting in organizational experience and learning (Cyert and March, 1963) and thereby creating, acquiring, and transferring organizational knowledge (Garvin, 1993). Besides, the level of organizational adaptation depends on the maturity of IT.

Business performance and sustainable competitive advantage

The idea of sustainable competitive advantage surfaced in 1984, when Day discussed the types of strategies that may help to 'sustain the competitive advantage' (Day, 1984). The actual term sustainable competitive advantage emerged in 1985, when Porter discussed low cost and differentiation as the basic types of competitive strategies. Barney (1991) has provided a formal definition of sustainable competitive advantage: 'A firm is said to have a sustainable competitive advantage when it is implementing a value-creating strategy not simultaneously being implemented by any current or potential competitor and when these other firms are unable to duplicate the benefits of this strategy' (Barney, 1991).

Zahra and George (2002a) conceptualize absorptive capacity as a dynamic capability pertaining to knowledge creation and utilization that enhances a firm's ability to gain and sustain competitive advantage. Since IS integration is a management as well as a technological approach, a 'common knowledge base' or 'prior knowledge' requires a learning process and a corresponding organizational change. This learning process is firm-specific and difficult to imitate among organizations.

Sustainable competitive advantage has been measured with a four-item scale (see Table 1). The four questions assess long-term economic and financial performance, both past and expected. Positive economic and financial results over an extended period of time represent an indicator of sustainable competitive advantage (Porter, 1985). Note that subjective measures of organizational performance have been widely used in organizational research (Lawrence and Lorsch, 1967; Dess, 1987; Powell and Dent-Micallef, 1997), and are often preferred to financial indicators that are more subject to short-term accounting choices (Powell and Dent-Micallef, 1997). However, as will be discussed in the subsection 'Data collection and scale development', the correlation between our subjective measure of competitive advantage and classical financial indicators of performance is also tested (see Table 2).

Methodology, data analysis, and results

Data collection and scale development

The survey has been administered to the CIOs of 466 Italian SMEs. Not all companies had a CIO role. Other top managerial roles, such as CEOs, CFOs, and VPs, have been surveyed when they also played the CIO role (see Table 3). The questionnaire was initially addressed to 8000 companies, with a 6% response rate. Tables 4 and 5 show the demographics of the respondents, in particular size and per cent distribution of companies into different industries. Data were collected between September 2004 and October 2005.

Our sample is consistent with the structure of the Italian economy. In the Italian economic context, SMEs represent over 95% of the total number of companies. 33.4% of our sample of companies is comprised of family businesses, consistent with the Italian average (Unioncamere, 2005).

The answers to the questions reported in Table 1 have been measured on a seven-point Likert scale. A pre-test was conducted with a panel of 15 CIOs to ensure that questions were clearly stated and understandable. Unlabelled sorting has been used to improve the quality of the final questionnaire. Company size was included to be used as a control variable. To obtain a minimum of 10 values for each item, we needed a total of 240–250 responses, while we were able to collect 466 complete responses.

Measurement model (CFA)

Data were analysed by means of SPSS and AMOS. The research model was tested mainly through structural equation modelling (SEM) with AMOS. The two-step approach (Anderson and Gerbing, 1988; Segars and Grover, 1993) has been used to assess the quality of our measures (referred to as the confirmatory factor analysis (CFA) stage) and to test our hypotheses through the structural model (the SEM stage). The CFA stage was performed on the entire set of items simultaneously, with each observed variable restricted to load on one factor. Maximum likelihood estimations were employed to assess the model. All the steps necessary for the measurement model validation and reliability assessment were conducted (Gefen *et al*., 2000).

A two-step analysis was performed in order to validate the convergent validity and reliability of the variables measuring our constructs. In the first step, the answers addressing the same construct have been validated by measuring their mutual reliability. Questions with a loading factor higher than 0.7 and with an inter-item Cronbach's alpha equal to or higher than 0.7 have been selected to measure the corresponding construct. Results are reported in Table 1.

In the second step, we have carried out a principal component analysis. As indicated in Table 6, results reveal that all constructs were clearly delineated and that no cross-loading was above 0.40.

Table 2 Competitive advantage and economic/financial index correlation table

	Comp Adv	*Net Op. Inc.*	*ROE*	*ROI*	*Liq. index*	*Debt index*
Comp Adv	1					
Net Op. Inc.	0.214*	1				
ROE	0.223*	0.372**	1			
ROI	0.167***	0.410**	0.578**	1		
Liq. index	0.182*	0.142*	0.151**	0.236**	1	
Debt index	−0.230*	−0.263**	−0.454**	−0.429**	−0.372**	1

*Correlation is significant at 0.05 level (two-tailed). **Correlation is significant at 0.01 level (two-tailed).

Discriminant validity was assessed by testing whether the correlations between pairs of construct items (Table 7) were significantly different from one. Moreover, as discussed in the 'Variable definition and operationalization' section, we have assumed IS integration and organizational absorptive capacity to be second-order factors. In particular, IS integration consists of application integration and data integration; organizational absorptive capacity consists of process, training, change, and flexibility orientation.

These assumptions have been assessed in two steps. In the first step, we have filled the zero-order correlation table shown in Table 7. Application, data, and infrastructure integration have been found to be strongly correlated with each other. Process, training, change, and flexibility orientation were also strongly correlated. On the contrary, inter-group mutual correlations were insignificant.

In the second step, a CFA of all variables has been performed to assess the validity of the model and the existence of a second-order structure. The model has been tested by means of AMOS and results have confirmed the use of a second-order factor in testing our hypotheses. Figure 5 shows the results of CFA.

All regression coefficients are significant at 99% confidence level, apart from the regression of IS integration on data integration and application integration, which is significant at 95% level.

Table 3 Goodness-of-fit for the structural model

	Research model	*Desired levels*
χ^2	6.68	Smaller
d.f.	3	
χ^2/d.f.	2.22	<3.0
P	0.083	
RMSEA	0.05	<0.06
NFI	0.91	>0.90
CFI	0.85	>0.90

The fit indices reported show a convergent, proper solution with a low χ^2 per degree of freedom and a reasonable fit. In addition to the adequate model fit, it is worth noting that non-significant correlation error terms were found that, if allowed to be estimated, would yield a better fit model. Overall, the model fit indices, factor loadings, and reliability measures suggest that the indicators account for a large portion of the variance of the corresponding latent construct and, therefore, provide support for the validity of the measure.

Testing the structural model

We used AMOS 6 to examine the structural model through SEM. In particular, we performed a path analysis using the composite scores for the first-order factors identified in the CFA. The composite scores were created by calculating the mean values of the first-order factors. To assess the fit of the model, several indices were used. The ratio of the χ^2 value to the degrees of freedom less than 3 indicates a good fit for the hypothesized model (Carmines and McIver, 1981). We have examined root mean square error of approximation (RMSEA), which is a fit measure that encompasses the error of approximation in the population and the precision of the fit measure itself (Brown and Cudeck, 1993). Our value of RMSEA$=$0.04 is far below 0.06, which indicates an excellent fit (Hu and Bentler, 1999). In addition, we have computed normed fit index (NFI) and comparative fit index (CFI). The NFI is the measure that compares the hypothesized model to the null model, with a value close to 1 indicating a perfect fit. The value of NFI is close to the recommended 0.90

Table 5 Demographics of respondents

Title	*CEO*	*VP*	*CIO/IT director*	*CFO*	*Other*
N	58	57	262	21	68
%	12.4	12.2	56.2	5	14.2

Table 4 Descriptive statistics of the sample

	Industry	*N*	*Percentage (%) or standard deviation (SD)*
Type of business	Manufacturing	241	51.7%
	Service	192	41.2%
	Other	33	7.1%
Ownership	A family	156	33.4%
	Other	310	66%
Part of a holding structure	Yes	173	37.1%
	No	293	63.9%
Size	SME[a]	396	84.9%
	Large companies[b]	70	15.1%
	Number of employees	149 (mean)	300.9 (SD)

[a]SMEs were defined as companies with a number of employees ranging from 6 to 500.
[b]Large companies were defined as companies with more than 500 employees.

Table 6 Principal component analysis[a]

Items	*Factors*						
	1	*2*	*3*	*4*	*5*	*6*	*7*
Dependent variable							
• *Competitive advantage*							
y_1 – CoAdv1	**0.864**	0.025	0.111	0.038	0.046	0.139	0.056
y_2 – CoAdv2	**0.843**	0.053	0.091	0.196	0.052	0.094	0.033
y_3 – CoAdv3	**0.650**	0.053	0.089	0.045	−0.036	0.230	0.273
y_4 – CoAdv4	**0.732**	0.069	0.022	0.100	0.194	−0.113	0.164
Independent variables							
IS Integration							
• Data integration							
x_1 – DtInt3	0.021	**0.842**	0.207	−0.090	0.043	0.073	0.017
x_2 – DtInt2	0.063	**0.891**	0.112	0.149	0.102	0.016	0.027
x_3 – DtInt3	0.079	**0.790**	0.244	0.151	0.007	0.060	0.179
x_4 – DtInt4	0.064	**0.834**	0.284	−0.007	0.093	−0.067	0.050
• Application integration							
x_5 – ApInt1	−0.147	0.366	**0.649**	−0.024	0.024	−0.101	0.170
x_6 – ApInt2	0.207	0.200	**0.788**	−0.063	−0.055	0.104	−0.085
x_7 – ApInt3	0.071	0.322	**0.702**	−0.085	−0.006	0.055	0.026
x_8 – ApInt4	−0.147	0.366	**0.649**	−0.024	0.024	−0.101	0.170
Organizational absorptive capacity							
• Training orientation							
x_9 – TtOrn1	0.130	0.019	0.034	**0.764**	0.087	0.254	0.153
x_{10} – TtOrn2	0.143	0.054	−0.109	**0.729**	0.198	0.137	−0.008
x_{11} – TtOrn3	0.079	0.040	−0.023	**0.882**	0.087	0.115	0.121
x_{12} – TtOrn4	0.043	0.033	0.008	**0.831**	0.212	0.112	0.142
• Change orientation							
x_{13} – ChOrn1	−0.144	0.099	0.043	0.308	**0.688**	0.158	0.189
x_{14} – ChOrn2	0.139	0.081	−0.015	0.069	**0.873**	0.124	0.150
x_{15} – ChOrn3	0.127	−0.009	0.078	0.086	**0.804**	0.036	−0.014
x_{16} – ChOrn4	0.101	0.139	0.098	0.385	**0.617**	0.090	0.228
• Process orientation							
x_{17} – PrOrn1	0.163	0.000	−0.031	0.131	0.370	**0.743**	0.012
x_{18} – PrOrn2	0.104	−0.044	−0.005	0.241	0.059	**0.701**	0.380
x_{19} – PrOrn3	0.065	0.085	0.004	0.265	0.029	**0.724**	−0.018
• Flexibility orientation							
x_{20} – FlOrn1	0.239	0.116	0.051	0.197	0.187	0.109	**0.808**
x_{21} – FlOrn1	0.248	0.142	−0.009	0.182	0.225	0.090	**0.764**

[a]Rotation method: Varimax with Kaiser normalization. Rotation converged in seven iterations.

Table 7 Correlation table

	Competitive_ advantage	*Application_ integration*	*Data_ integration*	*Change_ orientation*	*Process_ orientation*	*Flexibility_ orientation*	*Training_ orientation*
Competitive_advantage	1						
Application_integration	0.221**	1					
Data_integration	0.113	0.558**	1				
Change_orientation	0.212**	0.101	0.71	1			
Process_orientation	0.254**	0.050	0.126*	0.446**	1		
Flexibility_orientation	0.361**	0.122	0.121*	0.357**	0.319**	1	
Training_orientation	0.176**	0.006	0.111	0.420**	0.451**	0.256**	1

*Correlation is significant at 0.05 level (two-tailed). **Correlation is significant at 0.01 level (two-tailed).

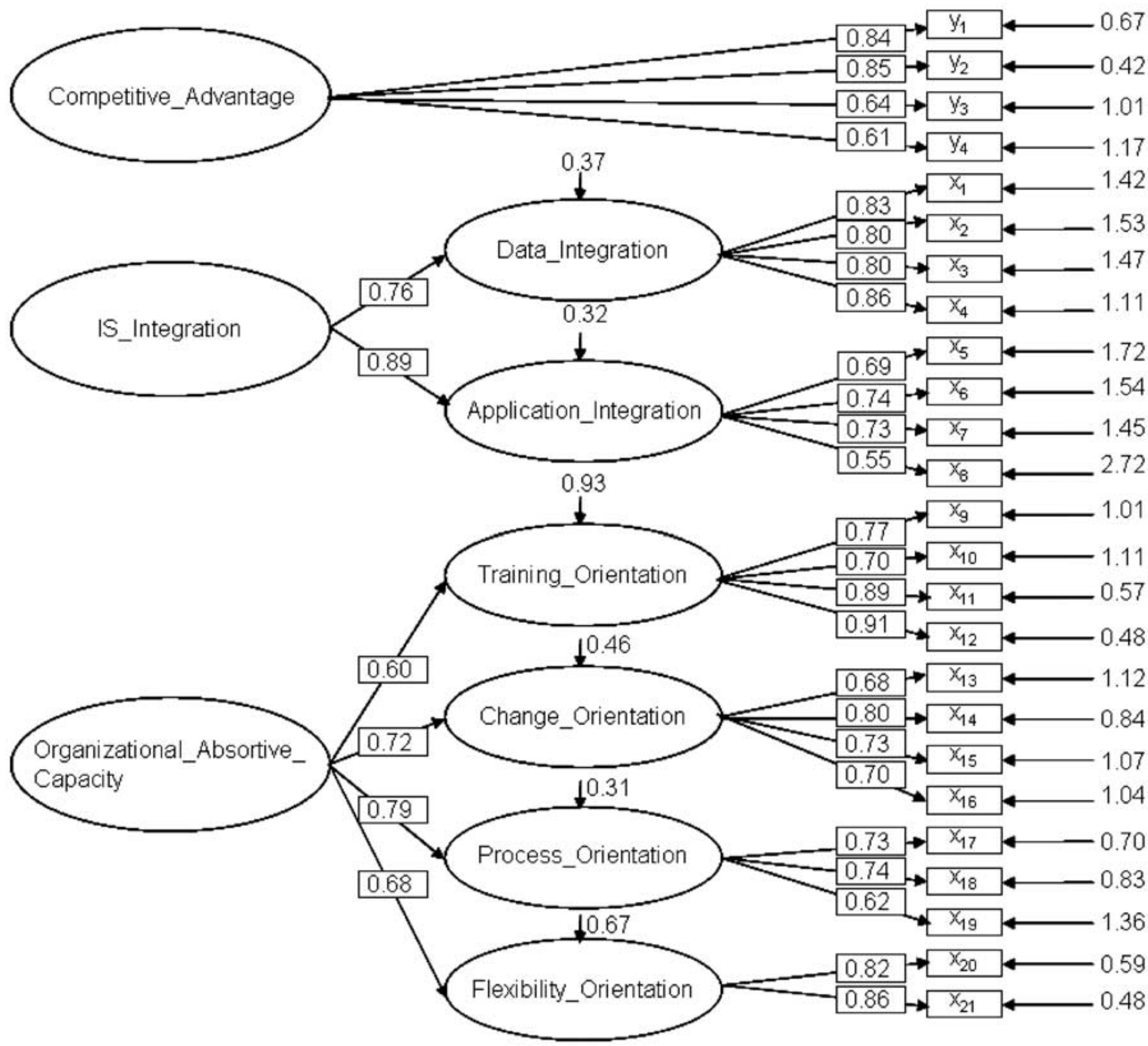

Figure 5 Results of confirmatory factor analysis. $\chi^2 = 582.79$; d.f. $= 266$; χ^2/d.f. $= 2.19$; RMSEA $= 0.050$.

(Hair *et al.*, 1995). The CFI accounts for the reduction in model misfit of the hypothesized model relative to the null model (Bentler, 1990). Values of CFI exceeding 0.90 are recommended (Hu and Bentler, 1999; Bhattacherjee, 2001). Table 3 shows that the overall model fit is satisfactory.

Results of testing the structural model

The estimation results of the structural model are shown in Figure 6. As shown in Table 3, all fit indices of the SEM estimation (normed χ^2, RMSEA, CFI, and Tucker–Lewis index (TLI)) are desirably at or well above the recommended threshold values except for the CFI value.

Hypothesis 2 posits that IS integration positively influences absorptive capacity, which consists of that process, training, change, and flexibility orientation. Estimation results support Hypothesis 2 ($b = 0.174$, $t = 2.73$, $P < 0.01$). Hypothesis 1 in Figure 1 posits that absorptive capacity affects organizational performance. Estimation results support Hypothesis 1 ($b = 0.410$, $t = 4.603$, $P < 0.001$). Overall, results indicate that IS integration has a significant effect on absorptive capacity, which, in turn, influences business performance.

Test of the mediating effect of organizational absorptive capacity

In the sections 'IS integration' and 'Organizational absorptive capacity', we argue that organizational absorptive capacity mediates the effect of IS integration on competitive advantage. To verify this argument, we have conducted a mediation test using alternative models and examining the strength of the relationship between IS integration and competitive advantage (Bollen, 1989). Figure 7 shows the results of the test (the SMC for competitive advantage is 0.124).

To test whether IS integration significantly affects the dependent variable without the mediator, the first alternative model excluded absorptive capacity. This model resulted in a coefficient between IS integration and the dependent variable equal to 0.182 at level $P < 0.01$. The relationship between IS integration and the dependent variable became insignificant (dashed line in Figure 7) when absorptive capacity was included in the model. The

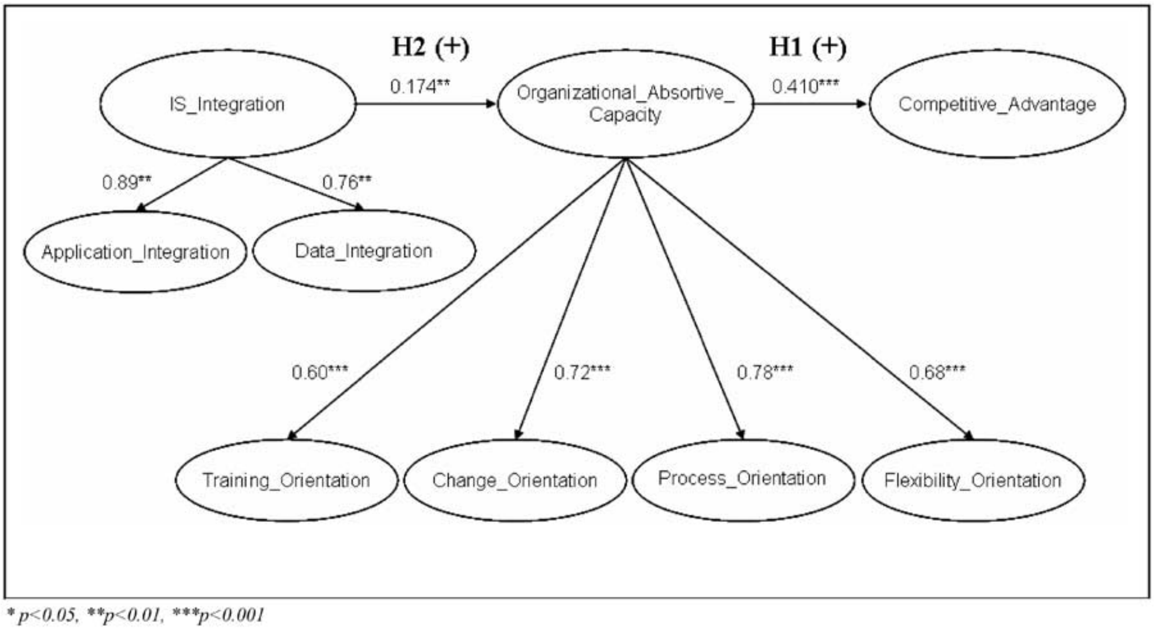

Figure 6 The estimated structural model. $*P<0.05$, $**P<0.01$, $***P<0.001$.

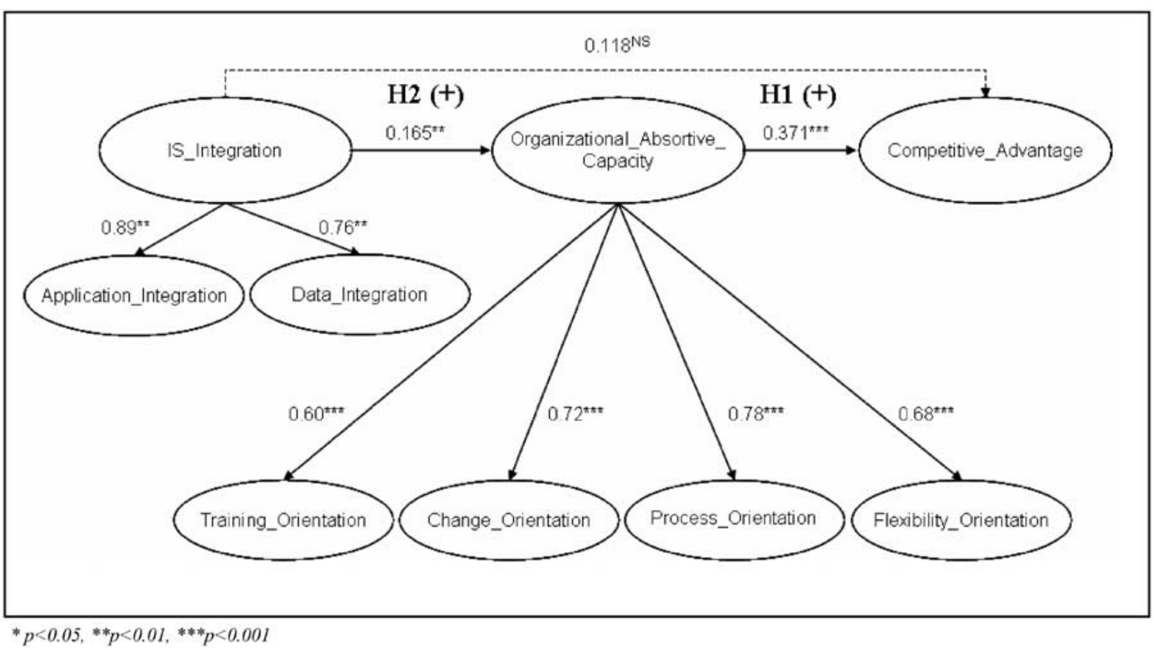

Figure 7 The mediating effect model. $*P<0.05$, $**P<0.01$, $***P<0.001$.

relationship between IS integration and competitive advantage is completely mediated by absorptive capacity (Baron and Kenny, 1986).

Discussion

Findings support the mediation effect of organizational absorptive capacity between IS integration and firm sustainable competitive advantage. This finding has important theoretical and managerial implications, which are discussed in the next two sections.

Theoretical contribution

As discussed in the first two sections, previous research works in the IT-performance literature concur that IT *per se* does not have a positive impact on business performance. Recent research contributions assert that firms cannot gain a performance advantage unless they deploy IT resources together with complementary organizational resources (Brynjolfsson and Hitt, 2000). Furthermore, the co-introduction of IT and complementary organizational resources generate business value only if they are *absorbed*, becoming a routinized element of a company's value-chain

(Brynjolfsson and Hitt, 1996). To explain this contextual ability of companies to translate change into performance, the literature has developed the theory of *absorptive capacity* (Cohen and Levinthal, 1990; Zahra and George, 2002a). This paper represents a first attempt to measure the mediation effect of absorptive capacity between IT and business performance.

We have noted in the section 'IS integration' how the evolution of the IT resources of an organization can be seen as a sequence of changes aimed at reaching a higher degree of integration, which has been defined as the outcome of initiatives leading to greater technical standardization and broader user access to a common set of technical resources, infrastructure, data, or software applications (Hasselbring, 2000; Jhingran *et al*., 2002). The concept of IS integration is broadly studied in the literature, either as the outcome of enterprise application integration initiatives or as a consequence of the adoption of packaged solutions increasing the degree of standardization and sharing of IT resources (Goodhue *et al*., 1992; Lee *et al*., 2003; Zahir *et al*., 2003; Gattiker and Goodhue, 2005). During our pilot interviews (see the subsection 'Measurement model (CFA)') managers have demonstrated that they were familiar with the concept of IS integration and that they view it as the overall target of their IT investments.

IS integration is found to have a direct positive impact on sustainable competitive advantage. In and of itself, this finding supports the relevance of the IS integration construct as a driver of business performance. Previous literature has found that data integration is advantageous in organization-wide coordination and decision making (Goodhue *et al*., 1992; Gattiker and Goodhue, 2005).

However, the impact of IS integration on sustainable competitive advantage is mediated by organizational absorptive capacity. In fact, IS integration projects are usually coupled with reengineering, change, and training projects for facilitating the use of integrated IS for supporting operating and strategic decision making. Thus, an IS integration project is conducted typically by implementing a corresponding change in the organizational variables that enact organizational absorptive capacity. Our definition of organizational absorptive capacity is based on Zahra and George's (2002a) model that identifies four underlying organizational capabilities that drive absorptive capacity, acquisition, assimilation, transformation, and exploitation. We have provided four corresponding IT-related capabilities, namely, process, training, change, and flexibility orientation. With Hypothesis 2, we have hypothesized that IS integration is associated with greater absorptive capacity. This hypothesis is verified, suggesting that a higher degree of IS integration is associated with a greater process, training, change, and flexibility orientation. The relationship between IT and a process view of organizations is among the most broadly studied within the MIS literature (Davenport, 1998; Ng *et al*., 1999; Gattiker and Goodhue, 2005). The positive association between IT and flexibility represents the hypothesis underlying the vast literature on business process reengineering (Powell and Dent-Micallef, 1997; Brown *et al*., 2000; Palanisamy, 2004; Swink *et al*., 2005). This paper's contribution is to support the validity of Zahra and George's (2002a) model by showing the mutual correlation between process, training, change, and flexibility orientation. This indicates that these variables should not be studied in isolation, but, constitute different aspects of a more general construct, namely organizational absorptive capacity.

The positive association between IS integration and this paper's operationalization of absorptive capacity suggests that the integration of a company's IS increases together with firms' ability to take advantage of a higher-quality IT in terms of greater process orientation and flexibility. Furthermore, absorptive capacity mediates the impact of IS integration on competitiveness. This confirms the role of absorptive capacity as a necessary organizational capability enabling the measure of IT performance benefits.

Managerial implications

The managerial literature reports that over 45% of CIOs are budgeting substantial investments in IS integration projects (Kanakamedala *et al*., 2006) and more than 40% of overall IT spending is allocated to integration projects (Jhingran *et al*., 2002). Proving the benefits of IT investments is a major managerial difficulty. IT benefits are often considered intangible, since IT is an organizational technology that has an impact on effectiveness that is significantly more difficult to measure than efficiency (Powell and Dent-Micallef, 1997). IT is also a complex technology that affects multiple organizational variables simultaneously and it is difficult to disentangle IT's from other resources' benefits (Powell and Dent-Micallef, 1997; Dewan and Kraemer, 2000; Brynjolfsson *et al*., 2002).

Complex technologies are associated with a learning curve (Menville and Kraemer, 2004). Results suggest that companies that have been able to manage this learning process have obtained benefits from their IS integration initiatives. Although benefits are intangible, they are difficult to estimate *ex ante*, but they can be measured *ex post*, as posited by Brynjolfsson *et al*. (2002). This result is general, given the cross-industry composition of our sample (see section 'Methodology, data analysis, and results').

IS integration is typically achieved incrementally, along an integration path that is difficult to bring to a close over a short period of time (Hasselbring, 2000; Bajwa *et al*., 2004). These time requirements accompanied by the inherent complexity of IT, make IS integration difficult to imitate. As noted before, IS integration is part of a learning process and, due to its breadth and generality, represents an aggregate indicator of the maturity of a company's ITs. Consequently, IS integration is a technological driver of the sustainability of competitive advantage, as suggested by our findings. Note that the concept of IS integration is likely to remain valid over time, although its scope will probably broaden to encompass inter-organizational ITs (Halevy *et al*., 2005; Sharif and Irani, 2005).

Results indicate that IS integration is associated with greater business performance only if managers simultaneously increase their company's absorptive capacity. This substantiates a well-known managerial principle stating that 'the information resources of a firm must be driven by business strategy and integrated into the product and process dimensions of the enterprise' (Kettinger *et al*., 1994). Companies that improve their organizational absorptive capacity also improve their ability to integrate or 'embed' ITs inside their processes.

However, the concept of absorptive capacity indicates that companies must improve a set of abilities simultaneously. It is a set of abilities that makes learning successful and drives performance. Our findings indicate that these abilities include process orientation that is managers' awareness of the importance of cross-functional cooperation, training, which is necessary to increase computer literacy, an organizational culture that promotes change, and, finally, flexibility, which represents the outcome of the whole learning process in terms of process change, in compliance with Menville and Kraemer's (2004) model. It must be noted that this paper's operationalization of absorptive capacity builds on Zahra and George's (2002a) model. The generality of their model suggests that the variables considered in this paper may not be the only drivers of absorptive capacity. This reinforces the complexity of managerial solutions, which can be seen as a coherent set of organizational variables, as per the resource-based view of the firm.

A most interesting finding is the measurable increase of sustainable competitive advantage. This is consistent with the low imitability and appropriability of our independent variables, IS integration and organizational absorptive capacity. It also demonstrates that the learning curve associated with complex technologies extends over significantly long periods of time (Fichman and Kemerer, 1999).

Concluding remarks

This study has several limitations. First, we have measured IS integration at an organizational level, while there exists a number of specific IT implementation initiatives that deliver benefits at a process or business-unit level. Future research should test alternative measures of IS integration by focusing on key business processes or units. We also acknowledge that the relationship between IS integration, absorptive capacity, and competitive advantage may unfold through cyclical causal relationships. For example, a high competitive advantage may facilitate further developments of absorptive capacity and IS integration. Our study does not address these cycles of causal relationships.

The main contribution of this study is to provide evidence to support the mediation role of absorptive capacity. The organizational literature emphasizes the relevance of absorptive capacity as a construct involving several organizational variables that concur towards the ability to innovate. However, few studies have studied absorptive capacity from an IT perspective. Future research could benefit from the positive associations uncovered by this study and provide additional evidence of absorptive capacity's mediation role.

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About the authors

Chiara Francalanci is an Associate Professor of Information Systems at Politecnico di Milano. She has a master's degree in Electronic Engineering from Politecnico di Milano, where she has also completed her Ph.D. in Computer Science. As part of her post-doctoral studies, she has worked for 2 years at the Harvard Business School as a Visiting Researcher. She has authored articles on the economics of information technology and on feasibility analyses of IT projects, consulted in the financial industry, both in Europe and the US, and is a member of the editorial board of the *Journal of Information Technology*.

Vincenzo Morabito is Assistant Professor of Organization and Information Systems at the Bocconi University of Milan where he teaches management information systems, information management and organization. He is also Director of the Master of Management Information Systems at the Bocconi University. He has recently published on the *Communications of the ACM*, *European Journal of Information Systems*, *International Journal of Technology Management* and *Journal of Information Technology*.