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RESEARCH ARTICLE

# Information technology, the organizational capability of proactive corporate environmental strategy and firm performance: a resource-based analysis

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**Abstract**
The study of the relationships between information technology (IT), environmental organizational issues and firm performance is a cutting-edge research topic for the information systems (IS) community. However, at present we know very little about these relationships. Drawing on the perspective of IT-enabled organizational capabilities and the literature on organizations and the natural environment, our study introduces conceptually the construct organizational capability of proactive corporate environmental strategy to the IS field. We propose that IT capability may enable the implementation of a proactive environmental strategy and that this strategy could play a significant role in determining the business value of IT. Using structural equations modeling with data collected from 63 firms, we find that IT capability is an enabler of proactive environmental strategy and that this strategy plays a significant role in mediating the effects of IT on firm performance. Our study provides initial evidence on the role of IT in the implementation of proactive environmental practices. Our results suggest to IT executives that their decisions matter in shaping environmental sustainability, which in turn will generate business value from IT.
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## Introduction

Environmental issues are becoming increasingly important in organization theory and practice. The study of the relationships between information technology (IT), environmental organizational issues and firm performance is also a cutting-edge research topic for information systems (IS) scholars. Firms as Google are implementing IT-enabled environmental strategies to improve environmental performance while simultaneously improving their financial performance by lowering costs. Google has the largest data centers in the world and has managed to make them more energy-efficient than the average firm in its industry. Google has already begun to incorporate measures to control energy efficiency for servers and data centers into the agenda of its IT executives.

Prior research on organizations and the natural environment has studied the interface between the capability of environmental strategy and firm performance (Klassen & McLaughlin, 1996; Russo & Fouts, 1997; Christmann,

2000). It has been argued that the implementation of environmental strategies could be facilitated by the deployment of other resources and capabilities (Aragon-Correa & Sharma, 2003). Recent studies in this literature have found that some resource-based variables may enable this implementation. The set of variables identified includes international experience (Bansal, 2005), employee involvement and innovativeness (Etzion, 2007). The prior literature has focused on different resource-based variables related to other functional areas, but has not studied how the IT department and IT resources could enable the implementation of environmental strategies in the firm.

Further, past IS research has argued that IT is a key enabler of the development of higher-order process capabilities. Particularly, research has found that IT, if properly leveraged, could facilitate the development of capabilities such as firm agility (Sambamurthy *et al*, 2003), knowledge management (Tanriverdi, 2005) and new product development dynamic capabilities, and functional competencies (Pavlou & El Sawy, 2006). However, we know almost nothing about whether well leveraged IT could be translated into higher-order capabilities associated with the implementation of environmental strategies to enhance firm performance. Although prior IS research on IT-business strategic alignment (i.e., the fit between IT and business strategies) has evidenced that it is possible to translate this alignment into superior firm performance (Chan *et al*, 1997; Sabherwal & Chan, 2001), we know nothing about the effect of introducing sustainability into this strategic alignment. Our research is motivated by the complete lack of research on this topic.

This is the first paper that studies conceptually and empirically the relationships between IT capability, the capability of proactive corporate environmental strategy and firm performance. Our general purpose is to develop a deeper understanding of these relationships. To achieve this, we attempt to answer the following research questions: (a) Does IT capability have a positive effect on the capability of proactive environmental strategy? and (b) Does IT capability influence firm performance by means of the capability of proactive environmental strategy? This study is consistent with the resource-based theory (Barney, 1991), its extension into dynamic capabilities theory (Teece *et al*, 1997), the natural-resource-based theory of the firm (Hart, 1995), the perspective of IT-enabled capabilities (Rai *et al*, 2006) and the conceptual foundations of the prior research on IT-business alignment using resource-based theory (Kearns & Lederer, 2003).

## Dimensions of resource-based theory

### The resource-based theory of the firm and its extension to dynamic capabilities theory

The resource-based theory argues that the competitive advantage of a firm is determined by its resources, and that, under specific circumstances, these resources can generate superior long-term performance (Barney, 1991). This theory has used a variety of terms for the *firm's resources*, including *strategic assets*, *assets*, *competencies*, *capabilities*, *knowledge*, *skills* and so on (Wade & Hulland, 2004). To reduce the confusion that can arise from this terminological ambiguity, this paper uses the term *resources* with a double meaning, one specific and one general. Resources in a specific sense refer to *assets*, anything tangible or intangible that the firm can use in its processes for creating, producing and/or offering its products to a market. Resources in a general sense refer to both *assets* (i.e., resources in a specific sense) and *capabilities*, the firm's abilities to use its *assets* properly to create, produce and offer its products to a market (Wade & Hulland, 2004). Thus, the firm's set of resources in a general sense refers to the *assets* and *capabilities* available and useful for sensing and responding to market opportunities or threats.

Resource-based theory scholars have identified a set of attributes that the resources must possess to have a positive influence on a firm's competitive position. Only resources exhibiting all of these attributes can lead to a sustained competitive advantage for the firm. The literature on resource-based theory generally accepts that having resources that are valuable and rare and whose benefits can be appropriated by the owning (or controlling) firm will enable the creation of a temporary competitive advantage. When the attributes of these resources are also difficult to imitate, non-substitutable and imperfectly mobile, the firm will be able to sustain the competitive advantage it has created over the time (Wade & Hulland, 2004). A resource is valuable when it enables a firm to implement strategies that improve efficiency (Barney, 1991). Rarity refers to the condition where the resource is not available simultaneously to a large number of firms (Amit & Schoemaker, 1993). The appropriability of a resource indicates the degree to which the benefits generated by the resource can be appropriated by the owning firm (Amit & Schoemaker, 1993). According to Barney (1991), three factors can contribute to making a resource difficult to imitate: unique firm history, causal ambiguity and social complexity. The role of history reflects the importance of a firm's unique past, a past that other firms are no longer able to duplicate. Causal ambiguity exists when the link between a resource and the increased competitiveness is poorly understood. Social complexity indicates complex relationships within the firm and between the firm and key stakeholders (e.g., suppliers). A resource has low substitutability if there are few, if any, strategically equivalent resources that are themselves rare and inimitable (Amit & Schoemaker, 1993). Finally, resources are perfectly immobile if they cannot be traded (Barney, 1991).

Resource-based theory has been considered to be essentially static in nature, and thus inadequate to explain firms' competitiveness in changing environments (Barreto, 2010). To extend the resource-based

theory and to overcome this limitation, strategy scholars have proposed the dynamic capabilities theory. The conceptual foundations of this theory introduce the variable *changing environment* into the equation and focus attention on dynamic capabilities as the construct determining value creation in the firm. This conceptual framework was first developed in a seminal work by Teece *et al* (1997), which conceptualized the term *dynamic capability* as the firm's ability to integrate, build and reconfigure internal and external resources to address rapidly changing environments. Since this study, a wide array of different conceptualizations of dynamic capabilities has been proposed. For example, Eisenhardt & Martin (2000) conceptualize dynamic capabilities as a set of specific and identifiable processes by which managers integrate, reconfigure, gain and release resources. More recently, dynamic capabilities have been defined as firm's abilities to change its resource base to sense and seize opportunities, and to cope with threats to increase its competitiveness (Teece, 2007; Barreto, 2010).

Some dynamic capabilities theorists have assessed the theoretical foundations of this theory and the core elements of the different conceptualizations of the term *dynamic capability* using the following theoretical assessment criteria: nature, specific role, relevant context, creation and development mechanisms, heterogeneity assumptions, outcomes and purpose (Barreto, 2010). First, the dynamic capability has been conceptualized as a special ability of the firm (Teece *et al*, 1997; Teece, 2007), as the firm's processes (Eisenhardt & Martin, 2000) and, more recently, as the firm's potential (Barreto, 2010). Second, the specific role assigned to dynamic capabilities has generally been associated with change in the firm's resource base (Teece *et al*, 1997; Eisenhardt & Martin, 2000). More recently, this role has been extended to include sensing and seizing opportunities and coping threats, and solving problems (Barreto, 2010). Third, it is broadly accepted that dynamic capabilities are developed and are useful in rapidly changing environments (Teece *et al*, 1997). Fourth, we know that the genesis and evolution of dynamic capabilities are associated with the potential of learning mechanisms. The main mechanisms are likely to be repeated practice (and the resulting experience), trial and error, past mistakes, improvisation and imitation (Eisenhardt & Martin, 2000). Fifth, dynamic capabilities are heterogeneously distributed between firms due to the firms' specific paths, unique asset positions and distinctive processes (Teece *et al*, 1997). Finally, we agree with the accepted notion in the strategy literature that there is a direct positive link between dynamic capabilities and firm performance (Teece, 2007). This link seems rational since – to the extent that the resources that have been created or extended are valuable, rare, difficult to imitate, non-substitutable and imperfectly mobile, and possess benefits that can be appropriated by the firm – this new resource base will provide a long-term competitive advantage for the firm.

### A natural-resource-based theory of the firm

Our research also builds on the conceptual foundations of the natural-resource-based theory of the firm. In a seminal work, Hart (1995) proposes a conceptualization of the natural-resource-based theory of the firm, a theory of competitive advantage based upon the firm's relationship to the natural environment. He introduces the natural environment into resource-based theory and indirectly into strategic management. Subsequently, an exceptional body of literature has used the natural-resource-based theory as its main conceptual framework (Aragon-Correa, 1998; Aragon-Correa & Sharma, 2003).

Within this body of literature, a research stream on corporate environmental strategy has developed. This stream focuses on incorporating the natural environmental approach into the strategic management of the firm, conceptualizing corporate environmental strategy and understanding how this strategy is generally developed to analyze its influence on firm performance (Aragon-Correa, 1998). An environmental strategy indicates a firm's strategy to manage the interface between its business and the natural environment (Aragon-Correa & Sharma, 2003). Environmental strategies can be classified along a continuum that ranges from reactive to proactive. At one end of the continuum, a reactive posture responds to changes in environmental regulations and stakeholder pressures via defensive lobbying and investments in end-of-pipe pollution control measures. At the other end, proactive postures involve anticipating future regulations and designing operations, processes and products to prevent negative environmental impacts (Aragon-Correa & Sharma, 2003). Associated with the proactive postures of the continuum, *the capability of proactive corporate environmental strategy* refers to the firm's ability to implement environmental management practices voluntarily in advance of future environmental regulations and social trends, designing or altering the behavior of all functional departments, business processes and products to prevent negative environmental impacts of business activities on the natural environment (Sharma & Vredenburg, 1998; Aragon-Correa & Sharma, 2003).

We argue that proactive environmental strategy is an organizational capability in general and a dynamic capability in particular for the following reasons. Prior strategy scholars (Slater *et al*, 2006) have generally argued that the capability of proactive strategy formation represents an example of dynamic capability for firms. Proactive environmental strategy is a dynamic capability and an ability of the firm (Teece *et al*, 1997; Sharma & Vredenburg, 1998). The voluntary implementation of sustainable business practices changes the firm's resource base (Christmann, 2000; Eisenhardt & Martin, 2000). Such sustainable strategic implementation takes advantage of perceived opportunities (e.g., to enhance corporate reputation), and helps cope with perceived potential threats associated with future environmental regulations and/or social trends. Because stakeholder pressure related to environmental sustainability is continuously and

increasing, the dynamic capability of proactive environmental strategy is more useful in changing business environments. Like other dynamic capabilities, the creation and evolution mechanisms of proactive environmental strategy relates to the firm's experience (i.e., trial and error) and its improvisation. The implementation of sustainable business practices is idiosyncratic, on one hand, because it involves unique managerial decisions. Managers of each firm perceive the voluntary sustainable practices, the social and regulatory trends, the related role of each functional department and the translation of these practices into business gains. On the other hand, it is firm specific and unique due to firms' specific paths, asset positions and distinctive processes (Teece *et al*, 1997). Proactive environmental strategy capability is also dynamic because it enables the firm to enhance its competitiveness directly. Such strategy has the characteristics of a dynamic capability that enables a firm to cope with change in the business environments (Aragon-Correa, 1998; Teece, 2007).

The resource- and dynamic capabilities-based theories and their extension to the research on organizations and the natural environment constitute a valuable conceptual framework in this research, since it enables us to relate the organizational resources that are determinants of proactive environmental strategy and to link this strategy with firm performance.

### A resource-based theory of IT

The resource-based theory has been used extensively by IS scholars since the mid-1990s. It has proven to be a useful paradigm in the IS field. According to Wade & Hulland (2004), this theory is useful for business value of IT research for two reasons. First, through resource attributes, this theory facilitates both the specification of IT resources and their comparison with business/non-IT resources. Second, since the resource-based theory establishes a clear link between resources and sustained competitive advantage through a well-defined dependent variable, it provides a useful way to measure the value of IT resources.

Many prior studies that use resource-based theory in IS research conceptualize and classify IT resources (Ross *et al*, 1996; Bharadwaj, 2000; Santhanam & Hartono, 2003). For example, Ross *et al* (1996) divide the IT construct into three IT assets which, together with IT processes, would generate business value. They classify these three IT assets into IT human assets (e.g., IT technical skills), IT technology assets (e.g., physical IT assets, databases) and relationship assets (e.g., partnerships with other functional areas). IT processes have been defined as planning ability, cost effective operations and support, and fast delivery. Powell & Dent-Micallef (1997) classify IT resources into three categories: human resources, business resources and technology resources. In this study, we focus on the construct IT capability which is defined as the firm's ability to mobilize, deploy and use IT-based resources such as IT infrastructure or human IT resources to improve the firm's business processes (Bharadwaj, 2000; Santhanam & Hartono, 2003).

The link between IT resources and firm performance has been investigated by a number of researchers, and their results have been mixed (Mata *et al*, 1995; Ray *et al*, 2005). It is generally accepted in the IS community that IT resources and capabilities *per se* do not enhance firm performance, although they can act as key enablers of higher-order organizational capabilities or interact with other business resources to increase firm performance. A significant number of IS scholars support what we call the *mediation hypothesis*, through which IT resources and capabilities do not seem to help the firm directly to improve competitive position, but can do so indirectly through the mediation of higher-order organizational capabilities. Prior research has found that several types of these capabilities act as intermediate variables on the interface between IT capabilities and firm performance. They include firm agility (Sambamurthy *et al*, 2003), knowledge management (Tanriverdi, 2005) and innovation-supportive organizational culture (Benitez-Amado *et al*, 2010). This research stream constitutes what has been termed the IT-enabled organizational capabilities perspective. Consistent with the *mediation hypothesis*, our study analyzes the role of environmental strategy in the generation of business value of IT. A complementary body of IS research is consistent with what we call the *moderation hypothesis*, which holds that IT resources and capabilities impact firm performance only when they interact with other resources (IT and non-IT/business resources). This means that the interface between IT resources and competitive advantage is reinforced by the presence of other resources and capabilities. This rationale incorporated into the stream of research is termed as the contingency or complementary approach (Powell & Dent-Micallef, 1997; Ray *et al*, 2005).

### A resource-based theory of IT-business strategic alignment

This research builds on the conceptual foundations of the literature on IT-business strategic alignment in resource-based theory, while also seeking to extend this theory to the interface between IT and the implementation of an environmental strategy in the firm. Preliminary research noted that IT could help to improve the efficiency of the organizational decision-making process, and to enable the implementation of corporate and business strategies in the firm (Tavakolian, 1989; Reich & Benbasat, 1996). IS research has subsequently developed a classic line of research termed IT-business strategic alignment, which studies the fit between IT and business strategies in a firm. This stream of research has also received significant study using the conceptual foundations of resource-based theory (Kearns & Lederer, 2003; Kearns & Sabherwal, 2006). The resulting body of literature has analyzed extensively the relationship between IT-business strategic alignment and firm performance (Chan *et al*, 1997). In general, prior empirical works have shown that this link is positive, particularly in the case of prospector and analyzer firms (e.g., Tallon, 2007). For example, Sabherwal &

Chan (2001) found that this alignment affected business performance in prospector and analyzer firms, but not in defenders.

Thus, research on IT-business strategic alignment has argued that IT is a key enabler of more efficient implementation of corporate and business strategies, while also arguing that it is plausible to fit IT and business strategies to generate business value. This higher competitive position enabled by IT-business alignment is also more likely in innovative and proactive firms. Proactive and innovative firms often both invest in IT and implement environmental strategies. To the extent that IT strategy is well aligned with the environmental strategy, IT capability may be a key enabler of the implementation of the firm's environmental strategy and to increase its competitiveness through this mediating variable. These interesting and previously unexplored research questions are the main relationships that we wish to test in this paper.

## Hypothesis development and proposed research model

### The business value of a proactive environmental strategy

The environmental awareness acquired by people and firms has increased significantly in recent decades. Firms generate an environmental impact – that is, an impact on their natural environment – simply through their interaction with it (Etzion, 2007). The stakeholder pressure for environmental issues has in recent decades required firms to implement environmental strategies, that is, strategies to manage the interface between their business and the natural environment properly (Aragon-Correa & Sharma, 2003). Drawing on previous research on organizations and the natural environment, we conceptualize *proactive corporate environmental strategy* as the firm's ability to implement environmental management practices voluntarily in advance of future environmental regulations and social trends, designing or altering the behavior of all functional departments, business processes and products to prevent negative environmental impact of business activities on the natural environment (Sharma & Vredenburg, 1998; Buysse & Verbeke, 2003). The rationale for such implementation is that the firm develops and implements voluntarily environmental management practices (e.g., an environmental management system according to the ISO 14001 standard, new products that have a less environmentally harmful impact) (Aragon-Correa, 1998; Christmann, 2000) to reduce its environmental impact, while simultaneously generating financial gains (e.g., cost savings, approval of capital projects), operational benefits (e.g., product quality improvements, improvements in firms' productivity, enhanced employee motivation and satisfaction) or commercial gains based on this reduction (e.g., improvements in corporate reputation or brand image, access to new markets, increase in market shares). Being voluntarily green is a competitive posture that is desirable and profitable for both the natural environment and the firm. Firms such as Nike, General Electric and Wal-Mart have implemented sustainable business initiatives to reduce their impact on the natural environment, while obtaining business benefits. For example, Nike has implemented proactive environmental practices in its new product development and manufacturing processes. It is developing eco-friendly shoes (e.g., the sole of the new Air Jordan is made with ground-up bits of old Nike sneakers) and making its operations practices more sustainable. Both kinds of practices generate business benefits, since these shoes are cheaper to make and the higher sustainability in operations reduces the amount of material wasted. These practices are clearly beneficial to the natural environment (Jana & Helm, 2009).

We argue that the capability of proactive environmental strategy leads to superior firm performance. This capability is valuable, as it enables a firm to implement proactive strategies that generate financial, operational and marketing benefits (Barney, 1991). The implementation of these strategies is not a common practice in firms, due to the skepticism among some executives about the business benefits to be gained from environmental challenges. Since sustainable development strategies are not being implemented in many firms, implementing them is a rare resource (Hart, 1995). It is also probable that the above-mentioned benefits derived from this implementation can easily be appropriated by the first-implementer firm (Amit & Schoemaker, 1993). We believe that the development of this capability is difficult to imitate for the following reasons. First, the implementation of this strategy requires the presence of other resources acquired due to a unique path through history (Barney, 1991). Second, this capability is people-intensive, decentralized and it depends on tacit skill development through employee involvement. The decentralized and tacit nature of this capability makes it difficult to observe in practice and hard to duplicate quickly (Hart, 1995). The development of the capability of proactive environmental strategy requires proper management of complex relationships within and across organizational boundaries. This capability has low substitutability and cannot be traded (Amit & Schoemaker, 1993).

We also argue that proactive environmental strategy is a good example of a firm's dynamic capability. As such, it may first imply a change in the firm's resource base (Teece, 2007). Insofar as this new resource base is also valuable, rare, difficult to imitate, non-substitutable and imperfectly mobile, and possesses benefits that can be appropriated by the firm, the new resource base may lead to greater value creation for the firm. Moreover, because this capability is developed, among other reasons, to exploit opportunities perceived by managers associated with reducing the impact of the firm's business activity on the natural environment, this exploitation may be translated into business gains (Hart, 1995; Barreto, 2010). Second, the implementation of sustainable business practices is idiosyncratic because it involves firm initiatives based on managerial discretion (Aragon-Correa &

Sharma, 2003) and the firm's unique past and complex internal and external relationships, which are necessary to its development. Thus, strategic implementation is difficult for competitors to duplicate and may lead to a better competitive position for the firm. Third, in accordance with prior understanding of dynamic capabilities (Teece, 2007) and of organizations and the natural environment (Aragon-Correa, 1998), it seems rational to link this capability directly to firm performance.

Previous research on organizations and the natural environment has also demonstrated empirically that implementing this kind of proactive strategy generates business benefits (Klassen & McLaughlin, 1996; Russo & Fouts, 1997; Sharma & Vredenburg, 1998). Such theoretical, anecdotal and empirical evidence leads us to believe that environmental strategy is a higher-order capability that could serve to generate business value for firms. We therefore hypothesize the following:

**H1:** *A proactive corporate environmental strategy has a positive effect on firm performance.*

### The effects of the IT capability on the proactive environmental strategy

IT capabilities are developed by managing IT resources such as IT infrastructure and human IT resources (Bharadwaj, 2000; Santhanam & Hartono, 2003). We believe that these IT capabilities are a key enabler of the development of capabilities associated with the implementation of an environmental strategy. In a general sense, our argument draws on both the IT-enabled capabilities perspective (Grant, 1996; Sambamurthy *et al*, 2003) and the natural-resource-based theory of the firm (Hart, 1995). The theoretical notion of higher-order capabilities and a hierarchy of capabilities have been used in recent research on business value of IT (Rai *et al*, 2006). This body of research has argued that there is a hierarchy among the various capabilities that a firm may possess, and that IT capability seems to behave more as an enabler of higher-order capabilities in the firm than as a higher-order capability in itself. This rationale is consistent with the stream of research termed the IT-enabled capabilities perspective (Tanriverdi, 2005). Thus, if proactive environmental strategy may be considered as a dynamic capability and if prior IS research has found that IT capability is a key enabler of other types of higher-order capabilities such as firm agility (Sambamurthy *et al*, 2003) or new product development dynamic capabilities and functional competencies (Pavlou & El Sawy, 2006), it seems plausible to propose that IT capability could also act as a key enabler of the development of environmental strategy capability. This rationale is also supported by prior literature on organizations and the natural environment, which notes that proactive environmental strategy will develop more easily if the firm possesses other enabler capabilities (Aragon-Correa & Sharma, 2003).

Several arguments suggest that IT capability could act as a key predictor of corporate environmental strategy. First, the greater the firm's degree of innovativeness, the greater its environmental proactivity (Aragon-Correa, 1998; Bansal, 2005) and its level of IT investment. It is thus rational to expect some connection between the level of technological IT effort and the implementation of eco-friendly approaches in the firm. Prospector and innovative firms usually implement advanced management techniques and styles in most functional areas, such that advanced approaches in IT and environmental management could coexist in the same firm. Thus, successful firms may have an IT capability and implement a proactive environmental strategy at the same time.

Second, firms interested in adopting proactive postures in advance of environmental law and social trends can use IT-enabled market intelligence to sense and shape opportunities associated with environmental sustainability and respond in a timely way by designing products and processes to take advantage of these opportunities (Sharma, 2000; Sambamurthy *et al*, 2003; Barreto, 2010). Agile firms could leverage IT to develop new products or enhance business processes in order to implement such proactive and advanced environmental management approaches.

Third, prior research on organizations and the natural environment has argued that investing in cleaner and more environmentally friendly technologies will be necessary in order to develop a more proactive approach to environmental strategy (Shrivastava, 1995).

Fourth, cross-functional capabilities and high involvement of human resources (Hart, 1995; Andersson & Bateman, 2000) are two resources that will help firms to develop proactive environmental strategies more easily. Thus, firms with IT capability will develop this kind of strategy more easily due to their greater ability to manage both the relationships between the IT department and other functional areas (Ray *et al*, 2005) and the firm's IT human resources in this implementation (Melville *et al*, 2004). Good management of the IT department and its relationships with other departments should also help in implementing advanced environmental management practices.

Fifth, the implementation of a proactive environmental strategy requires the firm to have an organizational culture that incorporates both practices such as empowerment, non-formalization, and decentralization and an organic structure (Russo & Fouts, 1997). Technological IT and managerial IT resources could be leveraged to develop an organizational culture in which employees have greater decision-making power (Benitez-Amado *et al*, 2010), that is, a culture associated with organic structure, which will in turn facilitate development of an environmental strategy capability.

Sixth, prior IS literature on IT-business alignment has argued that IT is a key enabler of the formulation and implementation of corporate strategies (Reich & Benbasat, 1996), and that the alignment between IT strategy and corporate strategy is a good predictor of firm performance (Kearns & Sabherwal, 2006). It thus seems rational to suggest

that IT capability could also be important to implementing eco-friendly strategies. Similarly, the level alignment between IT strategy and corporate environmental strategy should translate into business gains for organizations.

Finally, firms with proactive environmental strategies have a great need for information processing, such that firms that leverage their IT infrastructure properly will implement this kind of strategy more easily. Firms need an integrated IT infrastructure to exchange knowledge within and across organizational boundaries. On one hand, firms transfer tacit and explicit knowledge on regulations and best practices on environmental issues internally, that is, between headquarters and the business units or between the functional departments of a business unit (Sharma & Vredenburg, 1998). On the other hand, the firm will need external interaction across its boundaries to exchange information with its main stakeholders which in turn is more probable in a firm that invests heavily in IT resources. Consistently with the above arguments, we hypothesize the following:

**H2:** *IT capability has a positive effect on the development of a proactive corporate environmental strategy.*

### The impact of IT on firm performance through the capability of proactive environmental strategy

One of the long-term debates among IS scholars is whether IT influences firm performance directly or indirectly. We are interested in testing whether proactive environmental strategy acts as a mediator in the interface between IT capability and firm performance. This mediation seems logical for three reasons. First, the rationales presented above link IT capability to the development of an environmental strategy (H2) and support a positive predictive relationship between this strategy and firm performance (H1).

Second, our proposal is logically consistent with prior IS research on IT-enabled capabilities and what we have called the *mediation hypothesis*. Drawing on this hypothesis, IS researchers have argued that IT is too far removed from firm performance for a direct effect to be detected, and thus does not support positive direct effects between IT and the firm's competitive position. From a resource-based analysis (Ray *et al*, 2005), IT resources have generally been characterized as valuable (Mata *et al*, 1995; Bharadwaj, 2000) and relatively rare (Benitez-Amado *et al*, 2010). While it is generally difficult to determine the exact degree of appropriability of benefits generated by IT resources, Wade & Hulland (2004) argue that this degree varies and find it to be high, low-medium and medium for IT infrastructure, IT managerial skills and IT technical skills, respectively. IT resources such as IT infrastructure are easy to imitate (Powell & Dent-Micallef, 1997). In the case of human IT resources, it is generally accepted that IT managerial and IT technical skills are relatively easy to imitate by hiring relevant IT managerial and/or technical expertise via existing labor markets or by interacting with external consultants (Melville *et al*, 2004; Wade & Hulland, 2004). Finally, since IT resources are relatively substitutable and marketable, it will be difficult for a firm to generate long-term business gains only by possessing or controlling them (Ray *et al*, 2005).

Third, the stream of research outlined above assumes the theoretical notion advanced by Grant (1996) of the existence of a hierarchy of capabilities in the firm, in which IT capability is considered a 'lower-order' capability that impacts the generation of business value positively and indirectly through the development of higher-order process capabilities. For instance, Tanriverdi (2005) conclude that the impact of IT relatedness on firm performance is mediated by knowledge management capability. Thus, it seems rational to expect that developing environmental strategy capability could act as a mediator in the generation of business value of IT for the firm and to test whether this is the case (Figure 1). The following hypothesis is derived from these arguments:

**H3:** *A proactive corporate environmental strategy mediates the link between IT capability and firm performance.*

## Methodology, data analysis and results

### Data

We combine data from several primary sources. First, for IT capability, environmental strategy, firm size and talent development practices implementation, we use the 2007 edition of the database 'Top Performers for Working in Spain' (CRF Spain, 2007). This data set includes a subjective evaluation on a scale from 0 to 10 of an interesting set of business practices in a group of Spanish firms. These practices include work atmosphere and environment, working conditions, talent development practices implementation, environmental management practices, and the implementation of innovation and IT management practices. The specific data set collection process and data assessment were developed by CRF Spain (i.e., a consulting firm) as follows. First, the consultant created a list of potential participant firms in Spain by considering the specific characteristics of the Spanish business environment and the possible degree of implementation of the business practices to be assessed. The consultant discussed the design of the population of firms with a group of Spanish scholars who collaborated on the project. This group was composed of scholars with proven expertise in the fields of management science and IS. The consultant also advertised the project in order to encourage firms not included on the list mentioned to participate. The deadline to register in the project was 31st May 2007. Second, before 30th June 2007, a senior business executive from each firm completed an online questionnaire composed of 75 questions related to the business practices to be assessed. This questionnaire was developed jointly by experts from the consulting firm Accenture and two scholars with noted expertise in the

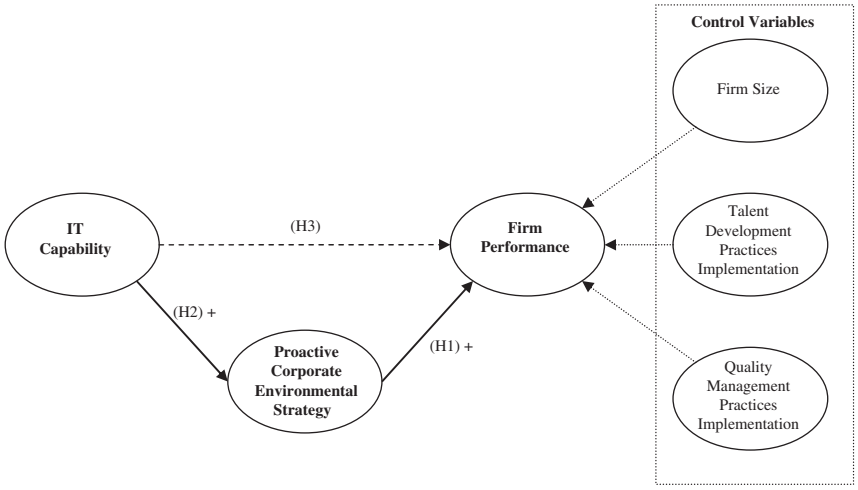


**Figure 1** Proposed research model.

fields of management science and IS. These two scholars also participated in the first stage of the data collection process. CRF Spain assured us that the questionnaire was developed rigorously, but due to secrecy considerations, they were not willing to share with us the exact details of the questionnaire items used. Third, CRF Spain checked to confirm that the key informant had understood the questions included in the survey correctly. To do this, the editorial team of CRF Spain visited some participating firms. This team was composed of journalists with extensive experience covering news on topics related to business administration who had worked for recognized Spanish business newspapers such as Expansión and Cinco Días, or business magazines such as Actualidad Económica or Capital. Following these visits, managers and the editorial team of CRF Spain, together with the previously mentioned experienced scholars and some experts, created an initial results report for each firm that included an initial rating from 0 to 10 for each of the business practices assessed. Fourth, CRF Spain submitted its results reports to Grant Thornton Spain (a firm specializing in audit, tax, advisory and consulting services) to determine whether there were any errors in the answers provided by the firms and to validate the results reports initially developed by CRF Spain. In each case for which Grant Thornton Spain found a mistake or missing answer to a question, it contacted the participant and organized a meeting for a personal interview with the participant's office to correct the mistake/s found. At the end of this stage (completed by 30th July 2007), Grant Thornton Spain provided the final results reports to CRF Spain. Fifth, using those reports, CRF Spain selected the participant firms to be included in the 2007 edition of the database. The firms selected were included in the database and awarded certification as Top Performers for Working in Spain. The database was presented to the Spanish business community in October 2007. Finally, interaction with participants was concluded from October to December 2007, during which time CRF Spain held an additional personal meeting with several senior executives from each participant firm to provide them with specific feedback on their own results, and an exhaustive comparison with the average results and their peer group's results. The purpose of this feedback was to help the participant firms to improve implementation of their business practices.

We recognize that the main limitation of using this data set is the lack of measurement items and the lack of a procedure for validating their psychometric properties. We believe, however, that this type of data is extremely valuable and has the potential to offer rich insights into the phenomenon studied here for the following reasons. First, the administration of the survey was developed following a very rigorous procedure with the participation of well-known scholars from the fields of management science and IS, experts from the consultant Accenture and journalists from the editorial team of CRF Spain with extensive expertise in topics of business administration. Second, each questionnaire was completed online by a senior business executive with a high level of competency to answer the questions. Moreover, since the participant firms registered voluntarily, we can assume that they had a high level of interest in the project, a logical assumption given that they were entitled to receive a free benchmarked analysis of the main business practices and, if selected, to be granted an award by CRF Spain. It is likely that this high level of interest translated into rigorous completion of the survey. Third, several confirmations were performed to ensure both that the key informants understood the questions and that all questions were answered, through both visits and personal interviews to complement the data collection process. Fourth, the rating of each business practice was developed jointly by CRF Spain managers and the editorial team, experienced management science and IS scholars, and experts. Fifth, the initial rating was audited

and validated by Grant Thornton Spain. CRF Spain then decided which participants would ultimately be included in the database. Sixth, CRF Spain assured us that its measures have validity and reliability. Finally, similar assessments developed by external consultants have been used previously in IS research and have been shown to be valid and extremely useful (Tallon, 2007). Thus, we believe that the value to be gained from this kind of assessment outweighs the limitation that the items cannot be published and that our decision to test our hypotheses using this set of measurements and data is appropriate.

We collected the data for measuring firm performance from the database Actualidad Económica. Actualidad Económica is a Spanish business magazine that develops an annual ranking of the most prestigious firms in different activity sectors based on revenue obtained in the past year. The Actualidad Económica database has been used before in the literatures on business value of IT (Benitez-Amado *et al*, 2010) and organizations and the natural environment (Aragon-Correa, 1998). Finally, we measured the variable quality management practices implementation through the information gathered from the Spanish Association for Standardisation and Certification database. The Association is an organization dedicated to the development of standardization and certification in all industries. The database used contains detailed information on firms that have implemented a management system according to different standards (e.g., ISO 9001). We match the records on firms starting from the sample of firms in the 2007 CRF Spain database, which included the names of these firms. We then collected the above-mentioned measurements for each firm from the remaining data sources.

## Measures

Using the three primary sources described above, we compiled a database of Spanish firms for which IT capability data, environmental strategy data, firm performance data and control variables data exist for the period 2007, with the exception of the variable firm performance, for which we gathered data for the years 2007, 2008 and 2009. The resultant study sample includes 63 firms representing a total of 22 industries that reflect the most important industries in the Spanish economy. Taking into account our proposed research model, in which the maximum number of latent constructs leading to a given latent construct (i.e., firm performance) is five and our assumption of reflective constructs, the minimum sample size would be 50 (Gefen *et al*, 2000). Our sample size thus permits us to estimate the proposed model. Table 1 presents the characteristics of the sample.

**Table 1 Characteristics of the sample**

| *Industry* | *Number of companies* | *Percent* |
|---|---|---|
| Banking and insurance | 12 | 19.048 |
| Electronics and IT | 10 | 15.873 |
| Chemical and pharmaceutical | 7 | 11.111 |
| Consulting and outsourcing | 6 | 9.524 |
| Telecommunications | 6 | 9.524 |
| Food and beverage | 3 | 4.762 |
| Other industries (e.g., aerospace, airports and aeronautics, apparel, ceramics, construction, cosmetics, health and consumption) | 19 | 30.158 |
| **Total** | **63** | **100** |

***IT capability*** We measured IT capability through the subjective evaluation on a scale from 0 to 10 of so-called *technological IT effort*, as reflected in the micro-data associated with the 2007 CRF Spain database. These data were provided by the consulting firm. This evaluation refers to each firm's investment in IT infrastructure (i.e., hardware and software) and to the management practices developed in the IT department in order to improve operations efficiency. We requested the survey items used to perform this evaluation of technological IT effort from CRF Spain. Unfortunately, internal policy of confidentiality prevented CRF Spain from providing the questionnaire, and we could not gain access to the specific items. However, the consultant explained that they were related to level of the firm's annual investment in IT infrastructure and several IT management practices to improve operations efficiency, and that the questionnaire included a question on the degree of importance of IT investment for the firm's business model. The composite score of this measure for each firm was determined collectively by the managers and the editorial team of CRF Spain, experienced scholars in management science and IS, and experts. These ratings were then audited and validated by Grant Thornton Spain. We believe that the measurement that we have used is a good proxy of IT capability for several reasons. First, there is good conceptual alignment between the construct and the measurement used. IT capability refers to the firm's ability to use and leverage IT resources (e.g., IT infrastructure) (Bharadwaj, 2000). Similarly, technological IT effort refers to the firm's investment in both IT infrastructure and IT management practices to enhance operations efficiency. These practices could certainly include abilities to deploy and use the IT infrastructure. Alignment in the conceptualization of the IT resources is also high. Second, the literature on IT business value shows that it can be appropriate to measure the IT construct from single measures (Ray *et al*, 2005). Finally, the IS literature has previously measured IT construct conceptualization in terms of IT capability using secondary data (Santhanam & Hartono, 2003).

***Proactive corporate environmental strategy*** We measured corporate environmental strategy in a similar way, through the subjective evaluation on a scale from 0 to 10 of the term *implementation of environmental*

*management practices*. These micro-data were associated with the 2007 CRF Spain database and were provided by the consulting firm. This measurement refers to the firm's implementation of management practices to contribute actively to preserving the natural environment, such as controlling consumption, managing recycling appropriately, increasing the environmental sensitivity of employees and so on. We were also unable to access the questionnaire items used to construct this variable. CRF Spain explained, however, that the items were related to whether or not each firm had implemented environmental management practices such as controlling consumption, managing recycling appropriately or training employees in environmental issues and environmental management. The composite score for this measure was developed in a way similar to the measure of *technological IT effort*. Due to their strong conceptual proximity, the data used are a good proxy to assess the level of proactivity of each firm's environmental strategy. In particular, both the subjective evaluation and the construct refer to how the firm manages the interface between its business activities and the natural environment to reduce environmental impact. Both also lead explicitly to the implementation of proactive and innovative sustainable business practices. For example, control of consumption and environmental training are practices that could help the firm to implement environmental strategies. Finally, prior research on organizations and the natural environment has focused on the implementation of best environmental practices to assess the firm's environmental proactivity (Christmann, 2000).

***Firm performance*** According to Benitez-Amado *et al* (2010), firm performance can be assessed in terms of sectoral excellence. Sectoral excellence refers to the degree to which a firm is better than its competition in terms of sectoral positioning or performance. Sectoral excellence can be measured from secondary data contained in any known ranking of firms by calculating a rate of sectoral excellence (RSE) in the following way: RSE = 1−(Ranking position of firm in the business sector in the database analyzed/Total number of firms in the business sector in the database analyzed). RSE will have a value between 0 and a value very close to 1 (termed the sector's maximum value). The closer the RSE is to 1, the greater the firm's sectoral excellence. Thus, the closer the RSE is to the maximum value for the sector, the better the competitive position of the firm (Benitez-Amado *et al*, 2010).

We calculated the RSE for all firms in our sample for the years 2007, 2008 and 2009, using the information contained in the 2007–2009 editions of the Actualidad Económica database. The final score of RSE measurement was estimated by averaging over this 3-year period to smooth out performance fluctuations in unusually good or bad years and create a more balanced view of performance. We believe that this measurement is a good proxy of firm performance for several reasons. First, Wade & Hulland (2004) suggest that any dependent variable used in a resource-based study must exhibit three key attributes: (a) it should provide an assessment of performance; (b) it should incorporate a competitive assessment element; and (c) it should address the notion of performance over time. Our dependent variable clearly exhibits these attributes, as it evaluates firm performance relative to key competitors. RSE enables assessment of whether a firm is better than its competition in terms of sales-focused sectoral positioning. Furthermore, this measurement focuses on the long term, since it is estimated for a 3-year period.

Second, prior literature has assessed the variable firm performance in terms of firm growth in general, sales volume and sales growth (Chan *et al*, 1997), market share (Bharadwaj, 2000) and revenues growth (Rai *et al*, 2006). RSE is estimated from the information contained in a known ranking that use revenues and sales as the main criteria for classifying the firms. This measurement is thus clearly related to the measurements used previously in the literature cited above. Finally, RSE is a measure of firm performance in commercial terms, and a relevant body of research claims the assessment of superior performance using market-focused measurements (Malhotra *et al*, 2005). Prior research has found that results obtained using RSE and survey-based market performance are similar and that these two ways of assessing marketing performance are positively correlated (Benitez-Amado *et al*, 2010).

***Control measures*** Firm size, implementation of talent development practices and quality management practices implementation are proposed as control variables. Firm size has traditionally been used as a control variable when firm performance is used as a dependent variable. Large firms may be in a better position to achieve superior firm performance due to their ability to garner efficiencies of scale (Tanriverdi, 2005). Further, large firms can develop higher-order capabilities such as environmental strategy to a greater extent due to the extra resources at their command (Russo & Fouts, 1997). This variable was measured as the natural logarithm of the total number of a firm's employees (Zhu & Sarkis, 2004), using information extracted from the 2007 CRF Spain database. The implementation of talent development practices can influence the impact of environmental strategy on firm performance. Thus, scholars in the field of organizations and the natural environment have indicated the importance that human resource management practices have in high-performance corporate environmental behavior and their impact on the firm's competitiveness (Andersson & Bateman, 2000). This variable has been modeled through the subjective evaluation from 0 to 10 of *talent development practices implementation* in each firm through information collected from the 2007 CRF Spain database. Since the implementation of quality management practices has been suggested as an important enabler of firm performance (Benitez-Amado *et al*,

2010), this variable was also included as control variable. To estimate it, we created a dummy variable to indicate the presence or absence of implementation of a quality management system according to the ISO 9001 standard. This information was gathered from the Spanish Association for Standardisation and Certification database. Prior research has used the degree of implementation of ISO 9001 certification as a proxy to assess the level of implementation of quality management practices (Zhu & Sarkis, 2004).

## Data analysis and results

***Introduction to data analysis and results*** Data analysis was conducted with partial least squares (PLS), a structural equations modeling (SEM) technique commonly used in the IS literature. The analysis was performed using the software SmartPLS 2.0.M3 (Ringle *et al*, 2005). Because of the small size of the sample and the study's predictive and exploratory nature, PLS is more appropriate than other SEM techniques such as LISREL and EQS (Barclay *et al*, 1995; Chin, 1998a).

We assessed whether our data suffered any problem of multicollinearity. To do this, we analyzed the correlations among the principal variables and examined the variance inflation factor (VIF) for each of the independent variables (Petter *et al*, 2007). The correlation matrix does not indicate any exceptionally correlated variables (highest correlation among principal variables is $r=0.351$, $P<0.01$). VIFs were calculated using SPSS 15.0 by regressing the single measure for firm performance on the remaining measures in the model. A general cut-off value of 3.3 is recommended for identifying suspect variables, with values above 10 indicating that multicollinearity is a serious problem (Petter *et al*, 2007). The results indicated that all VIF scores were below the suggested cut-off point of 3.3, as they ranged from 1.311 to 1.355 when we considered only the main independent variables and from 1.034 to 1.539 when we included the control variables. This provides evidence that there are no problems of multicollinearity with the constructs (Table 2).

***Testing the proposed research model*** The proposed research model was tested with SmartPLS 2.0.M3. Bootstrap analysis was performed with 500 subsamples (Chin, 1998a). To test H1 and H2, we estimate a research model (labeled as full mediation model) in which we link IT capability to proactive environmental strategy and the latter to firm performance. The results of path analysis for the full mediation research model are presented in Figure 2.

Proactive environmental strategy has a significant direct impact on firm performance ($\beta=0.284$, $P<0.05$), supporting H1. Moreover, IT capability has a significant impact on proactive environmental strategy ($\beta=0.351$, $P<0.01$), supporting H2 and indicating that there is a link between IT and the implementation of environmental management practices in organizations. Consistent with prior literature, the variable firm size was significant ($\beta=0.407$, $P<0.001$). Quality management practices implementation was weakly significant ($\beta=0.193$, $P<0.10$). Surprisingly, the variable talent development practices implementation did not turn out to be significant and presented a sign opposed to that hypothesized ($\beta=-0.203$, not significant).

In a PLS analysis, the significance of the relationships among the constructs, $R^2$, the effect size $f^2$ and the $Q^2$ are measures of how well a model is performing (Chin, 1998b). First, the structural path from IT capability to the environmental strategy was statistically significant, as was the path from this strategy to firm performance. Second, $R^2$ is 0.123 and 0.262 for the variables environmental strategy and firm performance, respectively. Third, effect size $f^2$ is a measure that assesses the relevance of the change in $R^2$, that is, whether the impact of a specific independent on a dependent variable is substantive (Chin, 1998b). The effect size $f^2$ can be calculated as: $f^2=(R^2 \text{ included}-R^2 \text{ excluded})/(1-R^2 \text{ included})$, where $R^2$ included and $R^2$ excluded are the $R^2$ provided on the dependent variable when the predictor variable is used or omitted in the structural equation, respectively (Chin, 1998b). The $f^2$ for firm performance was 0.069, indicating that the impact of proactive environmental strategy on firm performance is small. Fourth, the cross-validated redundancy index ($Q^2$)

**Table 2 Descriptive statistics and correlation matrix**

| *Variables* | *Minimum value* | *Maximum value* | *Mean* | *SD* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. IT capability | 4.5 | 10 | 6.841 | 1.510 | 1 | | | | | |
| 2. Proactive corporate environmental strategy | 4.5 | 9.5 | 6.548 | 1.095 | 0.351*** | 1 | | | | |
| 3. Firm performance | 0.198 | 0.970 | 0.789 | 0.160 | 0.211* | 0.301** | 1 | | | |
| 4. Firm size | 2.650 | 5.630 | 4.265 | 0.830 | 0.304** | 0.271** | 0.407**** | 1 | | |
| 5. Talent development practices implementation | 5 | 9.5 | 7.571 | 1.035 | 0.425**** | 0.477**** | 0.110 | 0.375*** | 1 | |
| 6. Quality management practices implementation | 0 | 1 | 0.430 | 0.499 | 0.135 | 0.021 | 0.172 | −0.004 | 0.127 | 1 |

$N=63$; * Significant at $P<0.10$; ** significant at $P<0.05$; *** significant at $P<0.01$; **** significant at $P<0.001$ (all tests are two-tailed).

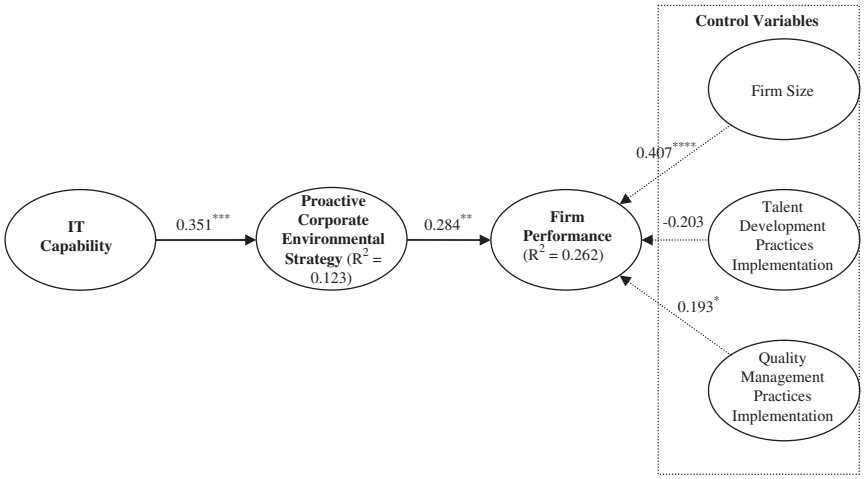


**Figure 2** Results of path analysis for the full mediation research model.

has been proposed as a good index for evaluating the predictive capacity of models estimated using PLS analysis. The $Q^2$ measures the goodness of fit with which the values observed are reconstructed by the model and its parameters (Chin, 1998b). It is generally accepted that a model has predictive relevance when the $Q^2>0$ for its dependent variables. Using the blindfolding procedure, we estimated $Q^2$ for firm performance ($Q^2=0.147$), which was greater than zero, as is recommended. These values show a satisfactory predictive power for the proposed model.

***Testing the mediating role of proactive environmental strategy in the relationship between IT and firm performance*** We test H3 in two ways. First, we develop the causal steps procedure for testing the mediation hypothesis proposed by Baron & Kenny (1986). These authors have discussed four steps for evaluating whether a variable mediates the given relationship: (a) estimating and testing a path between the predictor variable and the criterion variable; (b) estimating and testing a path between the initial and the mediator variable; (c) estimating and testing two paths, one between the initial variable and the mediator, and the other between the mediator and the outcome variable; and (d) incorporating into the third step a direct link between the initial and the outcome variable, where this path should be non-significant. If all four of these conditions are fulfilled, the data are consistent with the hypothesis that the mediator variable fully mediates the $X-Y$ relationship. If the first three steps but not the fourth are fulfilled, partial mediation is indicated.

The condition in step (a) is not met. Although Baron & Kenny (1986) claim that this step should be satisfied for mediation to exist, an important body of subsequent literature on organizational research methodology (Preacher & Hayes, 2008) argues that this step is not necessary for mediation to occur. According to this literature, we believe that IT could impact firm performance through intervening variables such as proactive environmental strategy. Theoretically, this is also consistent with the rationales previously argued in IS research regarding IT-enabled capabilities and the hierarchy of firm's capabilities (Grant, 1996). It thus seems rational to believe that, since IT is a 'lower-order' capability too far removed from long-term business gains for a significant direct positive effect to be detected, our result is consistent with this idea and with the rationale that the link between IT capability and firm performance is positive but weak or not significant in specific circumstances (Pavlou & El Sawy, 2006). On the other hand, steps (b), (c) and (d) are supported. If we accept that step (a) is not necessary for mediation to occur, in the context of our research model, the capability of proactive environmental strategy may fully mediate the IT capability-performance interface, thus supporting H3. Figure 3 presents the results of path analysis for the partial mediation research model.

Second, we also compared the model that proposes full mediation with a competing model that proposes both direct and mediated effects or partial mediation model. Since the models are nested, they can be compared statistically using PLS results (Rai *et al*, 2006). The $R^2$ for firm performance in the partially mediated model was 0.265, as compared with 0.262 in the fully mediated research model. The effect of the extra path in the partially mediated model is assessed using a procedure similar to that used to test competing models in stepwise linear regression. Accordingly, the $f^2$ statistic, which is based on the difference in $R^2$ between the two models, was first computed and then used to compute the pseudo $F$ statistic (Rai *et al*, 2006). On the basis of the results of the two competing models for our sample, $f^2$ was 0.004082 and the pseudo $F$ (3, 60) statistic was 0.240838, which was insignificant ($P=0.868$). The analysis suggests that the additional variance explained by introducing the direct path from IT capability to firm

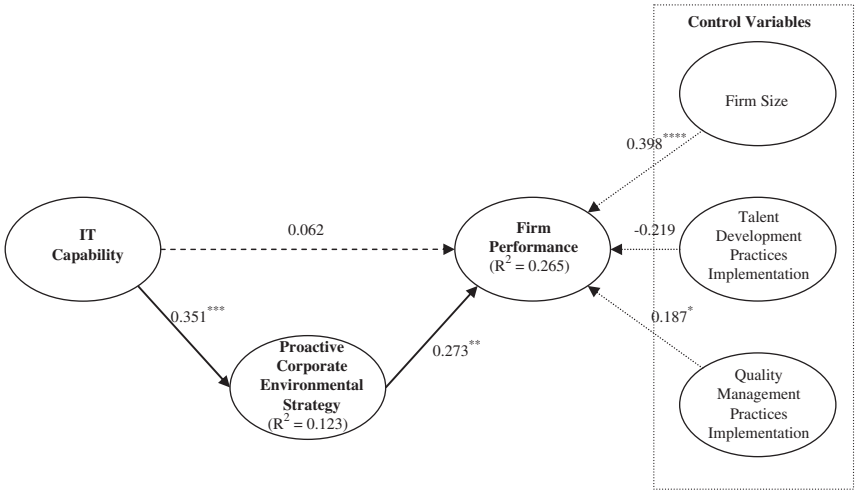


**Figure 3** Results of path analysis for the partial mediation research model.

performance does not significantly add to the variance explained in the dependent variable. The data are definitely consistent with our hypothesis: IT capability impacts firm performance through the capability of environmental strategy (Table 3).

## Discussion and implications for executives

We find that IT capability enables the development of the capability of proactive environmental strategy. Moreover, the results indicate that IT-based capabilities increase firm performance indirectly by means of the capability of environmental strategy. These findings have important and cutting-edge implications for both IT and business scholars and executives.

Our study introduces the IS community conceptually to the construct *organizational capability of proactive corporate environmental strategy*. This capability refers to the firm's ability to implement sustainable business practices voluntarily by altering the behavior of all functional departments, business processes and products to manage more effectively the interface between its business and the natural environment (Aragon-Correa & Sharma, 2003). Thus, our study responds to the recent call for research on the role of IT in shaping environmental sustainability (Melville, 2010) by establishing a new discourse on the relationship between IT capability and environmental sustainability. This is a preliminary attempt at examining whether and how IT capabilities enable the implementation of environmental strategies. Our contribution is indeed more valuable since it considers that proactive environmental strategy as a dynamic capability that creates value for the firm.

Our study shows that IT capability enables the generation of the organizational capability of proactive environmental strategy. This result is consistent with prior literature on organizations and the natural environment (Aragon-Correa & Sharma, 2003) that argues that the generation of the capability of environmental strategy is developed through other resources and capabilities. Our finding extends this stream of research by conceptually and empirically introducing IT capability as a new determinant of proactive environmental strategy. This means that IT managerial decisions play a critical role in transforming business processes and practices in organizations to make them more sustainable (Melville, 2010). Our results indicate that firms can exploit their ability to leverage IT infrastructure and human IT resources to implement sustainable business practices such as developing new products or redesigning business processes to make them more environmentally sustainable. This is rational since prospector and innovative firms implement advanced management techniques and styles in most of the functional areas, such that advanced approaches in IT and environmental management could coexist in the same firm. We believe that our conceptual and empirical explanations generate value for academics interested in determining which initial resource-based variables generate an environmental strategy-based competitive advantage. This result is also fundamental for the IS community for several reasons. First, one of the major challenges largely untackled in IS research is to study the role of IT capabilities to implement sustainable business practices in the firm. This is the first study that addresses this research problem by empirically analyzing the relationship between IT and proactive corporate environmental strategy. Second, this result has important implications for theory building on the IT-enabled capabilities perspective. Past research on business value of IT has found that IT capability leads to the development of a set of higher-order process capabilities such as firm agility or innovation-supportive culture (Benitez-Amado *et al*, 2010). We extend this body of research by showing evidence on the role of IT to enable the generation of the dynamic capability of proactive environmental strategy. Finally, this result also has important implications for literature on IT-business

**Table 3 Summary of the most relevant information in contrasting H3**

| *Paths* | *Firm performance* |
|---|---|
| *Analysis for testing mediation hypothesis proposed by* Baron & Kenny (1986): *Steps* | |
| *Step (a)* | |
| (a.1) IT capability → Firm performance | 0.109 |
| (a.3) $R^2$ IT capability → Firm performance | 0.211 |
| *Step (b)* | |
| (b.1) IT capability → Proactive environmental strategy | 0.351*** |
| (b.2) $R^2$ IT capability → Proactive environmental strategy | 0.123 |
| *Step (c)* | |
| (c.1) IT capability → Proactive environmental strategy | 0.351*** |
| (c.2) $R^2$ IT capability → Proactive environmental strategy | 0.123 |
| (c.3) Proactive environmental strategy → Firm performance | 0.284** |
| (c.4) $R^2$ Proactive environmental strategy → Firm performance | 0.262 |
| *Step (d)* | |
| (d.1) IT capability → Firm performance | 0.062 |
| (d.2) IT capability → Proactive environmental strategy | 0.351*** |
| (d.3) $R^2$ IT capability → Proactive environmental strategy | 0.123 |
| (d.4) Proactive environmental strategy → Firm performance | 0.273** |
| (d.5) $R^2$ Proactive environmental strategy → Firm performance | 0.265 |
| *Evaluation of the increase in $R^2$ in the partial mediation model* | |
| $f^2$ | 0.004082 |
| $F$ (3, 60) | 0.240838 |
| $P$-value of the pseudo $F$ statistic (3, 60) | $P = 0.868$ |

alignment. Prior literature has emphasized the enabling role of IT on the implementation of corporate and business strategies and the value creation from the IT-business alignment. Our paper extends this prior understanding to a specific type of corporate strategy and suggests that the alignment between IT and environmental strategy may be profitable. Further research should empirically test this last causal relationship.

Last, our study shows that IT-enabled proactive environmental strategy leads to superior firm performance. Our results show that this strategy fully mediates the impact of IT on firm performance. These results are consistent with the perspective on IT-enabled capabilities, which as mentioned earlier, argues that IT do not lead directly to superior firm performance but do lead to it indirectly through the development of higher-order organizational capabilities. Proactive environmental strategy is another important intermediate organizational capability through which the benefits of IT are converted into performance effects at firm level. We thus find a new missing link which is an important contribution to the IS field, since it help us to better understand how investments in IT capabilities can be converted into increased competitiveness for the firm.

### Implications for executives

Our research introduces IT executives conceptually to the context and rationale for implementing a proactive environmental strategy in the firm. Traditionally, the decision power for this implementation has been associated with the environmental executive. However, our research suggests that IT executives should also participate in the implementation of sustainable business practices. Both IT and business executives should be aware that sustainable practices such as the implementation of an environmental management system or the development of green products may generate business gains. Thus, IT and business executives should collaborate to achieve these sustainability-based benefits. Our results also suggest to these executives that IT capability enhances the firm's ability to implement proactive environmental strategies. Specifically, IT leaders should deploy and leverage IT resources to collaborate with business executives to transform business processes and practices in organizations to make them more sustainable. In sum, our results imply that IT executives and the IT function matter in shaping environmental capabilities. Finally, our research also suggests to IT executives that IT-enabled environmental strategies increase firm performance. Specifically, our study shows that the capability of proactive environmental strategy is an important intermediate capability through which IT capabilities are converted into business gains.

### Limitations and suggestions for future research

Our research has several limitations. First, the study is cross-sectional in nature, and its results are only generalizable to 22 sectors of Spanish firms. Subsequent research could perform longitudinal studies and test the validity of these results with samples of firms in different countries (e.g., U.S. firms). Second, our study focuses on large firms. Future studies could test our investigation in the context of smaller firms. Third, three of the measures that we used in the empirical analysis are based on a subjective evaluation developed by a consulting firm. Since the internal policy of this firm prevents it from providing the survey items used to make its assessments, we are not able either to provide the item descriptions or to validate the psychometric properties of these three measurements. We believe, however, that these types of data are extremely valuable and has the potential to offer rich insights related to the questions formulated in this research, although we recognize that our empirical analysis is limited by lack of information concerning

the items. IS scholars interested in these topics are encouraged to develop survey-based measures and to validate them in confirmatory research projects that extend our study. Fourth, we analyzed the proactive environmental strategy on a firm-wide level. Since, in the context of large firms, some business units may develop specific environmental strategies, we believe that it would be interesting to analyze whether the research model tested is also robust if the analysis is developed at business unit level. Moreover, future research could extend our work by studying the moderating effects of some business resources (e.g., organizational learning) on the relationships analyzed in this paper.

## Conclusions

This paper provides the first conceptual and empirical analysis of the relationships between IT, environmental strategy and firm performance. Our study introduces conceptually the construct *proactive corporate environmental strategy* to IS research. This capability can be enabled by IT, a link poorly understood to date. Similarly, we extend the alignment between IT and business strategies to environmental strategies, a contribution of interest for IT alignment scholars. Our research also contributes to the literature on organizations and the natural environment, which has analyzed previously how other functional areas and managerial decisions influence the development of environmental strategies, but has not studied the key role that the IT department could play in this development. We argue conceptually that IT capabilities have positive effects on the implementation of proactive environmental strategies and that these IT-enabled strategies could also translate into direct business benefits. Our empirical analysis confirms that positive relationships exist between the implementation of a proactive environmental strategy and firm performance, that IT capability is a good determinant of this strategy, and that there is a positive predictive relationship between IT and superior firm performance through the exploitation of this environmental strategy. Our research provides seminal empirical evidence on the role of IT in the implementation of sustainable business practices and suggests IS scholars to extend this area based on our findings. Our results imply that IT executives are able to contribute to shape environmental sustainability, which in turn will generate business value.

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## References

AMIT R and SCHOEMAKER PJH (1993) Strategic assets and organizational rent. *Strategic Management Journal* **14(1),** 33–46.

ANDERSSON LM and BATEMAN TS (2000) Individual environmental initiative: championing natural environmental issues in U.S. business organizations. *Academy of Management Journal* **43(4),** 548–570.

ARAGON-CORREA JA (1998) Strategic proactivity and firm approach to the natural environment. *Academy of Management Journal* **41(5),** 556–567.

ARAGON-CORREA JA and SHARMA S (2003) A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review* **28(1),** 71–88.

BANSAL P (2005) Evolving sustainably: a longitudinal study of corporate sustainable development. *Strategic Management Journal* **26(3),** 197–218.
BARCLAY D, HIGGINS C and THOMPSON R (1995) The partial least squares (PLS) approach to causal modeling: personal computer adoption and use as an illustration. *Technology Studies* **2(2),** 285–309.
BARNEY JB (1991) Firm resources and sustained competitive advantage. *Journal of Management* **17(1),** 99–120.
BARON RM and KENNY DA (1986) The moderator-mediator variable distinction in social psychological research: conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology* **51(6),** 1173–1182.
BARRETO I (2010) Dynamic capabilities: a review of past research and an agenda for the future. *Journal of Management* **36(1),** 256–280.
BENITEZ-AMADO J, LLORENS-MONTES FJ and PEREZ-AROSTEGUI MN (2010) Information technology-enabled intrapreneurship culture and firm performance. *Industrial Management & Data Systems* **110(4),** 550–566.
BHARADWAJ AS (2000) A resource-based perspective on information technology capability and firm performance: an empirical investigation. *MIS Quarterly* **24(1),** 169–196.
BUYSSE A and VERBEKE A (2003) Proactive environmental strategies: a stakeholder management perspective. *Strategic Management Journal* **24(5),** 453–470.
CHAN YE, HUFF SL, BARCLAY DW and COPELAND DG (1997) Business strategic orientation, information systems strategic orientation, and strategic alignment. *Information Systems Research* **8(2),** 125–150.
CHIN WW (1998a) Issues and opinion on structural equation modeling. *MIS Quarterly* **22(1),** vii–xv.
CHIN WW (1998b) The partial least squares approach to structural equation modeling. In *Modern Methods for Business Research* (MARCOULIDES GA, Ed.), Lawrence Earlbaum Associates, Mahwah, NJ.
CHRISTMANN P (2000) Effects of 'best practices' of environmental management on cost advantage: the role of complementary assets. *Academy of Management Journal* **43(4),** 663–680.
CRF SPAIN (2007) *Empresas Top para Trabajar en España: Líderes en el Desarrollo del Talento 2007*. LID Editorial Empresarial, Madrid, Spain.
EISENHARDT K and MARTIN J (2000) Dynamic capabilities: what are they? *Strategic Management Journal* **21(10–11),** 1105–1121.
ETZION D (2007) Research on organizations and the natural environment, 1992-present: a review. *Journal of Management* **33(4),** 637–664.
GEFEN D, STRAUB DW and BOUDREAU MC (2000) Structural equation modelling and regression: guidelines for research practice. *Communications of the Association for Information Systems* **4(7),** 1–78.
GRANT R (1996) Prospering in dynamically-competitive environments: organizational capability as knowledge integration. *Organization Science* **7(4),** 375–387.
HART SL (1995) A natural-resource-based view of the firm. *Academy of Management Review* **20(4),** 986–1014.
JANA R and HELM B (2009) Nike quietly goes green. *Business Week* 50 (22 June): 56.
KEARNS GS and LEDERER AL (2003) A resource-based view of strategic IT alignment: how knowledge sharing creates competitive advantage. *Decision Sciences* **34(1),** 1–29.
KEARNS GS and SABHERWAL R (2006) Strategic alignment between business and information technology: a knowledge-based view of behaviors, outcome, and consequences. *Journal of Management Information Systems* **23(3),** 129–162.
KLASSEN RD and MCLAUGHLIN CP (1996) The impact of environmental management on firm performance. *Management Science* **42(8),** 1199–1214.
MALHOTRA A, GOSAIN S and EL SAWY OA (2005) Absorptive capacity configurations in supply chains: gearing for partner-enabled market knowledge creation. *MIS Quarterly* **29(1),** 145–187.
MATA FJ, FUERST WL and BARNEY JB (1995) Information technology and sustained competitive advantage: a resource-based analysis. *MIS Quarterly* **19(4),** 487–505.
MELVILLE NP (2010) Information systems innovation for environmental sustainability. *MIS Quarterly* **34(1),** 1–21.
MELVILLE NP, KRAEMER KL and GURBAXANI V (2004) Review: information technology and organizational performance: an integrative model of IT business value. *MIS Quarterly* **28(2),** 283–322.
PAVLOU PA and EL SAWY OA (2006) From IT leveraging competence to competitive advantage in turbulent environments: the case of new product development. *Information Systems Research* **17(3),** 198–227.
PETTER S, STRAUB D and RAI A (2007) Specifying formative constructs in information systems research. *MIS Quarterly* **31(4),** 623–656.
POWELL TC and DENT-MICALLEF A (1997) Information technology as competitive advantage: the role of human, business, and technology resources. *Strategic Management Journal* **18(5),** 375–405.
PREACHER KJ and HAYES AF (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods* **40(3),** 879–891.
RAI A, PATNAYAKUNI R and SETH N (2006) Firm performance impacts of digitally enabled supply chain integration capabilities. *MIS Quarterly* **30(2),** 225–246.
RAY G, MUHANNA WA and BARNEY JB (2005) Information technology and the performance of the customer service process: a resource-based analysis. *MIS Quarterly* **29(4),** 625–652.
REICH BH and BENBASAT I (1996) Measuring the linkage between business and information technology objectives. *MIS Quarterly* **20(1),** 55–81.
RINGLE CM, WENDE S and WILL A (2005) SmartPLS 2.0.M3 (beta). University of Hamburg, Hamburg, Germany, http://www.smartpls.de, accessed 29 April 2008.
ROSS JW, BEATH CM and GOODHUE DL (1996) Develop long-term competitiveness through IT assets. *MIT Sloan Management Review* **38(1),** 31–42.
RUSSO MV and FOUTS PA (1997) A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal* **40(3),** 534–559.
SABHERWAL R and CHAN YE (2001) Alignment between business and IS strategies: a study of prospectors, analyzers, and defenders. *Information Systems Research* **12(1),** 11–33.
SAMBAMURTHY V, BHARADWAJ AS and GROVER V (2003) Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly* **27(2),** 237–263.
SANTHANAM R and HARTONO E (2003) Issues in linking information technology capability to firm performance. *MIS Quarterly* **27(1),** 125–153.
SHARMA S (2000) Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy. *Academy of Management Journal* **43(4),** 681–697.
SHARMA S and VREDENBURG H (1998) Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities. *Strategic Management Journal* **19(8),** 729–753.
SHRIVASTAVA P (1995) Environmental technologies and competitive advantage. *Strategic Management Journal* **16(S1),** 183–200.
SLATER SF, OLSON EM and HULT GTM (2006) The moderating influence of strategic orientation on the strategy formation capability-performance relationship. *Strategic Management Journal* **27(12),** 1221–1231.
TALLON PP (2007) A process-oriented perspective on the alignment of information technology and business strategy. *Journal of Management Information Systems* **24(3),** 227–268.
TANRIVERDI H (2005) Information technology relatedness, knowledge management capability, and performance of multibusiness firms. *MIS Quarterly* **29(2),** 311–334.
TAVAKOLIAN H (1989) Linking the information technology structure with organizational competitive strategy: a survey. *MIS Quarterly* **13(3),** 309–317.
TEECE DJ (2007) Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal* **28(13),** 1319–1350.
TEECE DJ, PISANO G and SHUEN A (1997) Dynamic capabilities and strategic management. *Strategic Management Journal* **18(7),** 509–533.
WADE M and HULLAND J (2004) Review: the resource-based view and information systems research: review, extension, and suggestions for future research. *MIS Quarterly* **28(1),** 107–142.
ZHU Q and SARKIS J (2004) Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of Operations Management* **22(3),** 265–289.