How information technology influences opportunity exploration and exploitation firm's capabilities

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ABSTRACT

Understanding how and why some firms have proficiency in exploring and exploiting opportunities is a cutting-edge research problem. Our central thesis is that information technology (IT) performs a key role in firms' opportunity exploration and exploitation. We test the proposed theory using partial least squares path modeling on a combination of survey and secondary data from 203 Spanish firms. We find that: (1) IT infrastructure provides the foundation to build business experimentation and the flexibility to sense and explore business opportunities; and (2) IT-enabled business flexibility helps firms to develop the operational proficiency to exploit opportunities and increase their performance.

Keywords: IT infrastructure, business flexibility, exploration and exploitation, business opportunities, business value of IT.

INTRODUCTION

Firms' need to explore and exploit business opportunities to survive in the long term makes understanding of how and why some firms are better than others at exploring and exploiting new business opportunities, a cutting-edge research problem. Firms must explore and exploit new business opportunities (entering a new market, forming an alliance, completing a merger) to increase their performance and survive in the long term (Alvarez et al., 2013; Benitez et al., 2018a). Such actions are especially important in global and competitive environments, where emerging implementation of information technology (IT) can help in managing business opportunities (Teo et al., 2007; Tsai et al., 2013). For example, Genpact, a leading provider of technology services for global enterprises, runs SolutionXchange (an innovative IT platform) to bring together experts, employees, and customers with the aim of sharing knowledge and solving business problems

(Kaganer et al., 2014). This was also the case of Dell, who successfully leverages innovative ideas provided by users through their IT-based platform Dell's IdeaStorm (Bayus, 2013; Lee & Van Dolen, 2015). Yet some firms sense, seize, and exploit business opportunities better and faster than others. How and why is this the case? Do exploration and exploitation of business opportunities help firms to increase their performance? Our research tries to provide answers to these questions.

Prior research on exploration and exploitation mainly focused on the tradeoffs (Andriopoulos & Lewis, 2009; Kristal et al., 2010) or balance (Durcikova et al., 2011) of exploration and exploitation activities. In the context of business opportunities, there may be a sequence between exploration and exploitation. In this sense, exploration could be an antecedent of exploitation of business opportunities. This is one of the theses this study aims to argue and test.

Prior Information Systems (IS) research on IT, and exploration and exploitation has mainly focused on the balanced usage of exploration and exploitation of IT resources (Subramani, 2004; Gregory et al., 2015; Lee et al., 2015), and the role of IT in contextual ambidexterity (Im & Rai, 2014), but it remains unclear how IT infrastructure capability can lead to explore and exploit business opportunities. In this sense, our study tries to complete/answer two additional research gaps/questions in the IS literature: (1) Is there a sequence between opportunity exploration and exploitation firm's capabilities; (2) How IT enables firms to explore and exploit business opportunities? Specifically, whether and how IT can enable firms to sequentially explore and exploit business opportunities remains unclear (Gregory et al., 2015).

Our central thesis is that IT performs a key role in exploring and exploiting business opportunities in two ways: (1) IT can enable firms to explore new business opportunities by enabling business experimentation (Swanson & Ramiller, 2004; Chen et al., 2015) and providing the firm with business flexibility (Sambamurthy et al., 2003; Chen et al., 2017; Benitez et al., 2018a) and (2) IT-enabled business flexibility can facilitate firms' development of operational

competence (Xia & Zhang, 2010; Setia & Patel, 2013) to exploit business opportunities and increase its performance (Kearns & Lederer, 2003; Mithas & Rust, 2016). Zara (a leading Spanish firm in the apparel industry) seems to show an organizational behavior based on these two arguments. Zara optimizes its IT resource infrastructure well to sense and explore customer needs (business opportunities) before competitors do. Flexibility provided by Zara's IT infrastructure gives speed in sensing and exploring new opportunities. Once the opportunity is sensed and explored, Zara responds rapidly by exploiting its excellent locations and gross margin control capabilities to convert the opportunity into business gains (McAfee, 2004; Ghemawat & Nueno, 2006).

Drawing on the theory of dynamic and operational capabilities (Teece, 2007; Wu et al., 2010; Jha & Bose, 2016), the IT-enabled organizational capabilities perspective (Pavlou & El Sawy, 2006; Ajamieh et al., 2016), and prior literature on exploration and exploitation activities (Raisch & Birkinshaw, 2008; Uotila et al., 2009), this study proposes a theory in which IT infrastructure capability enables business experimentation and provides the firm with business flexibility, which in turn help the firm to develop the operational competence to increase firm performance. We thus examine three key mechanisms (business experimentation, business flexibility, and operational competence) through which IT infrastructure capability may influence exploration and exploitation of business opportunities. We test the proposed theory using a survey and secondary data set from a sample of 203 large firms in Spain.

This research contributes to the field of IS by explaining how IT infrastructure capability influences the firm's capabilities to explore and exploit opportunities. This is the first study to explain theoretically and present empirical evidence on business experimentation**,** business flexibility, and operational competence as three specific mechanisms and pathways through which IT infrastructure capability helps firms to explore and exploit business opportunities. This is the

primary contribution of this paper to the IS research. Other key contributions of this research are explained in the discussion and conclusions.

THEORY AND HYPOTHESES

Dynamic and operational capabilities-based theory and the IT-enabled organizational capabilities perspective

Dynamic capabilities refer to the firm's ability to integrate and reconfigure its resource base and/or to build new organizational capabilities in response to changes in the business environment (Teece, 2007; Pavlou & El Sawy, 2011; Benitez et al., 2018a). Operational routines are patterns of the activities/processes that a firm performs at the operations level, which can lead to superior firm performance. Operational capabilities are the firm's ability to use a collection of interrelated operational routines to solve operational problems and execute the operations strategy (Peng et al., 2008; Wu et al., 2010). The theory of dynamic and operational capabilities provides a strong theoretical framework to conceptualize IT infrastructure capability, business experimentation**,** business flexibility, and operational competence and to associate these constructs both with each other and with firm performance.

In the context of the business value of IT literature, the IT enabled-organizational capabilities perspective argues that IT infrastructure capability influences firm performance through intermediate/process (dynamic and operational) organizational capabilities such as organizational learning, knowledge management, talent management, new product development, business agility, and proactive environmental management (Tanriverdi, 2005; Pavlou & El Sawy, 2006; Mithas et al., 2011; Benitez et al., 2018a). For example, Mithas et al. (2011) showed that IT-enabled information management capability affects process and customer management capabilities, which in turn enhance firm performance. Chen et al. (2015) find that IT capabilities enable corporate entrepreneurship to increase product innovation performance. Our study builds on the IT-enabled

organizational capabilities perspective to conceptualize IT infrastructure capability and associate this capability theoretically with business experimentation and business flexibility. The two theoretical frameworks mentioned above are also useful in associating IT-enabled dynamic and operational capabilities theoretically with exploration and exploitation of business opportunities.

Prior literature on IT and exploration and exploitation

The literature lacks a good understanding of how firms sense, shape, and seize business opportunities (Alvarez et al., 2013; Benitez et al., 2018a). With a few exceptions (Im & Rai, 2014; Gregory et al., 2015; Lee et al., 2015), the study of the impact of IT on exploration and exploitation has been scarce in IS research to date. Overall, it remains unclear how IT infrastructure capability can lead to sequentially explore and exploit business opportunities. This is one of the important gaps that this study tries to complete in IS research.

Prior IS research on IT and exploration and exploitation has mainly focused on the balanced usage of exploration and exploitation of IT resources (Subramani, 2004; Gregory et al., 2015; Lee et al., 2015), and the role of IT in contextual ambidexterity (Im & Rai, 2014). Subramani (2004) studied the effect of the explorative and exploitative usage of supply chain management systems to create value. Gregory et al. (2015) focused on the ambidexterity theory to explain paradoxes managers face in transforming IT programs. They identified six ambidexterity areas to ensure success in IT transformation programs. Lee et al. (2015) studied how exploration and exploitation of IT (IT ambidexterity) influences organizational agility. IT ambidexterity refers to the balance between experimenting with new IT resources (IT exploration) and using existing IT resources (IT exploitation). They found that the dual capability to explore and exploit IT resources and practices enhanced the firm's organizational agility through the mediating effect of operational ambidexterity. Im and Rai (2014) studied the IT promotion of contextual ambidexterity in interorganizational relationships and how these relationships affect performance and quality

relationships. Contextual ambidexterity refers to the balance between pursuing alignment and adaptation of partners' goals and activities synergistically in the context of the interorganizational relationships. In this sense, prior IS research has focused on IT ambidexterity and contextual ambidexterity. Drawn from this prior IS research, in a different way, we examine the role of the firm's ability in leveraging its IT resources to acquire/provide information from/to key users (IT infrastructure capability) in the firm's capabilities of exploration and exploitation of business opportunities.

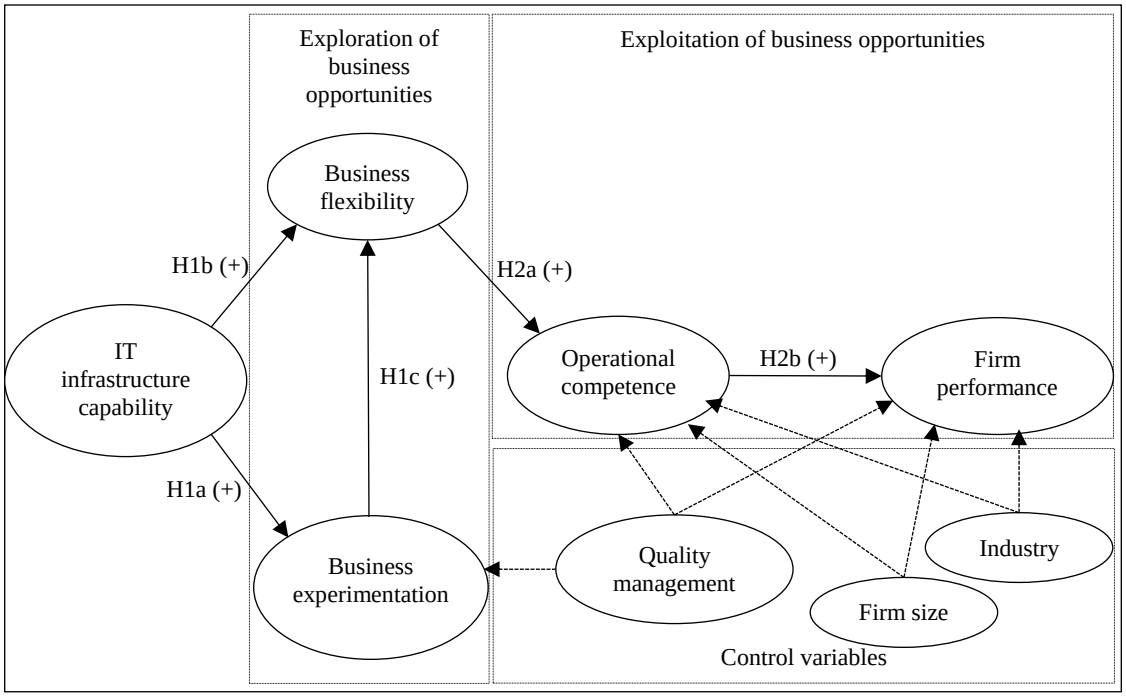
We draw on the prior works (Subramani, 2004; Im & Rai, 2014; Gregory et al., 2015; Lee et al., 2015) to examine three specific mechanisms (business experimentation, business flexibility, and operational competence) enabled by IT infrastructure capability through which large firms explore and exploit business opportunities in the business community of Spain. Figure 1 presents our theory, which argues that IT affects opportunity exploration firm's capability by enabling business experimentation and providing the firm with business flexibility, and that IT influences opportunity exploitation firm's capability by facilitating the development of the operational competence to exploit opportunities and increase its performance.

Conceptualization of constructs

IT infrastructure capability, business experimentation, business flexibility, operational competence, and firm performance are the key constructs of the proposed research model. IT infrastructure refers to the firm's set of shared technological, managerial, and technical IT resources that provide the basis for using multiple IT applications (Bharadwaj, 2000; Melville et al., 2004; Benitez & Walczuch, 2012; Benitez et al., 2018a). Technological IT resources include servers, computers, laptops, operating systems, software, electronic communication networks (email, Intranet, Extranet, wireless devices), and shared customer databases (Aral & Weill, 2007; Benitez & Ray, 2012). Managerial IT resources refer to IT managers' (IT and business) skills in

identifying and supporting IT-enabled business activities, approving IT innovation projects, deploying a portfolio of resources, searching for new business opportunities, and working effectively with business managers to execute the firm's business strategies (Benitez et al., 2018a). Technical IT resources are IT personnel's (IT and business) skills in designing databases, developing new IT applications, improving the efficiency of IT services, and using different programming languages (Ray et al., 2005; Benitez & Ray, 2012). IT infrastructure capability indicates the firm's ability to leverage its IT resources by using multiple IT applications to acquire/provide accurate, timely, reliable, secure, and confidential information from/to key users (managers, employees, suppliers, customers, shareholders, and regulators) (Bharadwaj, 2000; Mithas et al., 2011; Benitez & Walczuch, 2012). Drawn from Melville et al (2004), IT infrastructure capability is a second-order capability determined by technological, managerial, and technical IT resource infrastructure capabilities.

Figure 1: The proposed theory.



Business experimentation refers to the firm's ability in fostering experimentation, creativity, and innovation of new business opportunities among the organization's members (Chang et al., 2012; Camps et al., 2016; Zeng & Glaister, 2016). It exhibits the firm's proficiency in encouraging innovative behaviors and empowering organization's members to experiment and try new concepts and projects (Takeuchi et al., 2008; Flammer & Kacperczyk, 2016).[1]

Business experimentation can be interchangeably considered as an organizational strategy or capability because business strategies need organizational capabilities to be executed. We conceptualize business experimentation as an organizational capability. Prior literature has already defined business experimentation as an organizational capability (Chang et al., 2012; Zeng & Glaister, 2016). Chang et al. (2012) defined experimentation capability as an organizational capability needed to obtain radical innovation performance. Zeng and Glaister (2016) examined

[1] Business experimentation is a different construct from organizational culture. Xiao and Dasgupta (2009) examined the interaction between dynamic IT capabilities and organizational culture on its influence on firm performance. Management literature usually defines organizational culture as the degree to which a firm's members share beliefs, preferences, and values (Xiao & Dasgupta, 2009; Van de Steen, 2010). An organizational culture of innovation is a broader and more complex construct that is beyond business experimentation.

dynamic capabilities such as flexibility and experimentation and their role on a sustainable competitive advantage. There is some other bunch of literature that defines experimentation as components of organizational learning capability (Stan & Vermeulen, 2017) and mainly analyzes their impact on innovation performance. Our study considers business experimentation as a dynamic capability through which firms can explore and examine its effect on firm performance, which is consistent with prior literature. Dynamic capabilities refer to the ability of the firm in integrating and reconfiguring resources and in building new organizational capabilities in response to changes in the environment. Business experimentation implies the integration of new thoughts (knowledge) and leveraging of knowledge to build new organizational capabilities (business flexibility) to identify new business opportunities (Zhou & Wu, 2010). In this sense, business experimentation can be considered a dynamic organizational capability.

Business flexibility is the firm's ability to sense and seize opportunities for competitive action by changing the operational processes, organizational structure, and business strategies (Sambamurthy et al., 2003; Tallon & Pinsonneault, 2011; Benitez et al., 2018a). Business flexibility is a second-order concept determined by operational, structural, and strategic flexibility (Volberda, 1996; Benitez & Ray, 2012). Operational flexibility is the firm's ability to sense and seize business opportunities by changing operational processes (Lu & Ramamurthy, 2011). Structural flexibility refers to the firm's ability to sense and seize business opportunities by changing organizational structure and decision and communication processes (Benitez et al., 2018a). Strategic flexibility is the firm's ability to sense and seize business opportunities by changing strategies (Benitez & Ray, 2012; Chen et al., 2017). Business flexibility can be considered as a dynamic capability because it contributes to the development of new organizational

capabilities and the reconfiguration of the resource base to sense and seize business opportunities (Overby et al., 2006; Teece, 2007; Benitez & Ray, 2012; Chen et al., 2017).[2]

Operational competence refers to the firm's ability to exploit its portfolio of operational capabilities for business benefits (Tatikonda et al., 2013; Benitez et al., 2018b). Operational capabilities are the firm's ability to use a set of operational activities to solve operational problems and achieve superior firm performance (Peng et al., 2008; Wu et al., 2010). Drawn from the works of Tatikonda et al. (2013) and Benitez et al. (2018b), this study focuses on two key operational capabilities: operational excellence and gross margin management. Operational excellence refers to the firm's ability to develop and execute operation routines to manufacture products and supply them to the market with agility (Kim, 2014; Kortmann et al., 2014; Benitez et al., 2018b). Gross margin management is the firm's ability to estimate/manage proper product margins (Tatikonda et al., 2013; Benitez et al., 2018b). These two internal operational capabilities, which play a key role for firms in getting a better position among competitors, set up the operational competence portfolio (Tatikonda et al., 2013; Benitez et al., 2018b). We assess firm performance in financial terms (Mithas et al., 2011; Benitez et al., 2013). Definitions of the key constructs are summarized in Table 1.

[2] Business experimentation and business flexibility are two clearly distinct mechanisms for exploration. While business experimentation is the extent to which the firm provides the organization's member the infrastructure to experiment, pursue creativity, and discover new ideas, business flexibility refers to the ability to rapidly change operational processes, organizational structure, and business strategies. While business experimentation provides the openness to develop new products and business models to identify internal opportunities, business flexibility provides the responsiveness to identify external business opportunities.

Table 1. Definitions of key constructs.

Construct	Definition	Key informing source
IT infrastructure capability	Firm's ability to leverage its IT resources by using multiple IT applications to acquire/provide accurate, timely, reliable, secure, and confidential information from/to key users. IT infrastructure capability is a second-order concept determined by technological, managerial, and technical IT resources	Bharadwaj (2000), Pavlou and El Sawy (2006), Mithas et al. (2011), Benitez et al. (2018a)
Business experimentation	Business experimentation refers to the firm's ability to foster experimentation, creativity, and innovation among the organization's members	Chandler et al. (2000), Van den Steen (2010), Flammer and Kacperczyk (2016)
Business flexibility	Business flexibility is the firm's ability to sense and seize opportunities for competitive action by changing the operational processes, organizational structure, and business strategies. Business flexibility is a second-order concept determined by operational, structural, and strategic flexibility	Sambamurthy et al. (2003), Fink and Neumann (2009), Tallon and Pinsonneault (2011), Roberts and Grover (2012), Benitez et al. (2018a)
Operational competence	Operational competence refers to the firm's ability to exploit its portfolio of operational capabilities (operational excellence and gross margin) for business benefits	Tatikonda et al. (2013), Kim (2014), Kortmann et al. (2014), Benitez et al. (2018b)
Firm performance	Financial profits (return on assets) of the firm	Mithas et al. (2011), Benitez et al. (2013)

Mechanisms of exploration and exploitation of business opportunities

The opportunity exploration firm's capability refers to the firm's ability to seek and/or shape business opportunities within and/or throughout the firm (e.g., experimenting with new ideas). We study opportunity exploration firm's capability by examining business experimentation and business flexibility. As exploration includes experimentation and flexibility, we examine exploration of business opportunities through business experimentation and business flexibility (Beckman, 2006; Piao & Zajac, 2016). Business experimentation provides the openness to develop new products and business models to identify internal business opportunities, and business flexibility provides the responsiveness to identify external business opportunities (Benitez et al., 2018a).

The opportunity exploitation firm's capability refers to the firm's ability to take advantage of the benefits of business opportunities (e.g., refinement, selection, and implementation of new

operational knowledge) (March, 1991; Im & Rai, 2008). We study the opportunity exploitation firm's capability by focusing on operational competence and its influence on firm performance. As exploitation includes production, efficiency, and implementation, we examine exploitation of business opportunities through operational competence. Operational competence refers to the firm's ability to exploit its portfolio of operational capabilities (operational excellence and gross margin management) for business benefits. Exploiting business opportunities requires the usage of operational capabilities to achieve reliability, efficiency, and lower costs, which suggests that the firm's operational competence is a critical pathway to exploit business opportunities (Kristal et al., 2010; Patel et al., 2012). In this sense, operational competence provides the control to exploit business opportunities (Benitez et al., 2018a).

We argue that there may be a sequence between exploration and exploitation of business opportunities. In this sense, exploration would be an antecedent of exploitation of business opportunities. The association between business flexibility and operational competence is the way we connect exploration and exploitation of business opportunities. Table A1 (in the appendix) shows the sequence between exploration and exploitation of business opportunities. Firms can leverage business experimentation and business flexibility to sense and explore new business opportunities (i.e., new merger and acquisition opportunities) (Benitez et al., 2018a). The new opportunity needs to be previously explored before exploiting it (i.e., seize it). Once firms know about the new opportunity (i.e., it has been sensed and explored), they can proceed by exploiting it (e.g., refining their process to effectively implement it).

IT infrastructure capability, business experimentation, and business flexibility

IT infrastructure capability can enable business experimentation. A firm's ability to leverage IT resource infrastructure can facilitate business experimentation. Firms that use primarily IT-based management systems are better able to explore innovative solutions (Durcikova et al., 2011; Kleis

et al., 2014). Technological IT resource infrastructure enables firms to provide their managers and employees with accurate real-time information and thus to learn and experiment with new product concepts and/or business processes improvements (Kim et al., 2011; Jean et al., 2012; Gao et al., 2015). IT can facilitate collaboration among employees and improve the access to hidden knowledge, then propelling creative thinking among the organization's members (Schoenherr & Swink, 2015). Through IT resources employees have the opportunity to propose, suggest, or clarify viewpoints, then enabling experimentation and innovative behavior (Luo et al., 2012).

For example, Siemens makes use of IT to manage and share internal creative and innovative ideas. Looking for the goal to get the whole innovation topic in the mind of employees, Siemens developed a sustainability contest that consisted in disseminating employees' knowledge about sustainability practices. Siemens, then encouraged employees to join and share their creativity through the contest platform (Lakhani et al., 2015). Similarly, IT managers' and employees' (IT and business) skills can enable firms to innovate and reconfigure the firm's IT resource base (i.e., IT application development) to ensure experimentation and learning in the long term (Kane & Alavi, 2007; Iyengar et al., 2015). We therefore hypothesize the following:

H1a: There is a positive relationship between IT infrastructure capability and business experimentation.

We expect IT infrastructure capability to have a positive effect on the firm's business flexibility, both directly and indirectly through business experimentation. With the expansion of information technologies throughout the firm's business processes, the firm can leverage IT infrastructure to become more flexible and innovative (Lu & Ramamurthy, 2011; Tafti et al., 2013).

IT infrastructure capability can influence operational, structural, and strategic flexibility, thus enabling business flexibility. This capability enables firms to share information throughout the

supply chain and facilitates real-time collaboration with partners to increase operational flexibility (Devaraj et al., 2007; Benitez et al., 2018a). IT infrastructure capability can also enable managers to provide employees with real-time information and thus to decentralize decision rights and empower employees to make timely and informed decisions, increasing structural flexibility (Benitez et al., 2018a). Further, IT infrastructure facilitates cross-functional virtual teams that enable rapid reconfiguration of organizational structures (Majchrzak et al., 2000; Benitez & Ray, 2012). The ability to leverage IT infrastructure enables firms to capture and share real-time information from the business environment (e.g., customer data), and thus to sense new opportunities and respond with/to competitive actions (e.g., developing new products, entering new markets, forming an alliance) by changing their strategy, thereby increasing the firms' strategic flexibility (Benitez et al., 2018a). We thus hypothesize the following:

H1b: There is a positive relationship between IT infrastructure capability and business flexibility.

The firm's ability to encourage experimentation and innovation can help to achieve business flexibility. Building a firm's capability to allow for failure fosters the ability to generate solutions for unsolved problems in operational and decision-making processes, increasing operational and structural flexibility (Chandler et al., 2000). For instance, the capability of business experimentation on Bosch India promotes the faster development of innovations capable of fulfilling changing customer demands and regulatory requirements (Jha et al., 2016). Toyota's employees, who work in a constantly challenging environment, feel free and empowered to expose their opinions and generate innovative ideas to pull ahead competitors and solve problems in an agile way (Takeuchi et al., 2008). Business experimentation can also encourage members of the firm to use analytics and recommend new product concepts and markets, making it easier for the

firm to change its strategies and increasing the firm's strategic flexibility (Kristal et al., 2010; McAfee & Brynjolfsson, 2012). We thus hypothesize that:

H1c: There is a positive relationship between business experimentation and business flexibility.

Business flexibility, operational competence, and firm performance

IT can be leveraged to transform digitally firm's activities to pursue opportunity exploitation capabilities (Kristal et al., 2010). We argue that IT infrastructure can facilitate development of operational competence to increase firm performance through business flexibility. We posit that there may be a sequence between exploration and exploitation of business opportunities. In this sense, exploration would be an antecedent of exploitation of business opportunities. Once a firm has sensed and explored an opportunity, it needs to develop the operational competence to seize and exploit that opportunity by taking advantage of its business benefits.

Business flexibility can enable the development of an operational competence. Flexible firms can adapt their operational and communication processes, as well as their operations strategy to develop/improve operational routines quickly to pursue operational excellence (Rindova & Kotha, 2001; Srivastava et al., 2007; Wright & Bretthauer, 2010). Ford's rigidity hindered its transition to new production process design, making the firm unable to respond to market changes to preserve first-mover advantage and giving more flexible firms such as General Motors an opportunity to lead the market (Shih, 2013a, 2013b). Estimating/managing successful margins for new products/markets requires time, experience, and collaboration throughout the supply chain. Because flexible firms sense and assimilate new product opportunities before competitors do (Benitez & Ray, 2012), they can take advantage of having more time and experience to manage new product margins and ultimately prompt development of gross margin capability (Kortmann et al., 2014; Benitez et al., 2018b). We therefore hypothesize the following:

H2a: There is a positive relationship between business flexibility and operational competence.

Operational competence can increase financial performance, enabling firms to exploit business opportunities. Better execution of operational routines and proficiency in managing product margins can save costs and increase revenues, which in turn increases the firm's financial performance (Barua et al., 2001; Tatikonda et al., 2013; Benitez et al., 2018b). Such is the case of Privalia, an online fashion outlet firm that has based its competitive advantage on the operational efficiency of its production department by performing operations as quickly as possible to match production and sales, while ensuring both quality and service margin control (Serra & Martinez, 2014). We thus hypothesize the following:

H2b: There is a positive relationship between operational competence and firm performance.

RESEARCH METHODOLOGY

Sample and data

Prior IS research has mainly focused on investigating how US or UK firms leverage IT to create business value (Benitez et al., 2018a); thus, in an attempt to broaden our understanding of IT business value in the field of IS, we focused our sample on Spanish firms. We tested the proposed theory with survey and secondary data for a sample of 203 large firms in Spain drawn from a list of the 1046 most admired firms in Spain in the 2007 Actualidad Economica database (http://www.actualidadeconomica.com/). Actualidad Economica is the premier business magazine in Spain. It plays a role for Spanish executives/scholars similar to that of Fortune and Forbes in the U.S. Actualidad Economica annually designs, publishes, and sells several databases that compile public information on sales, innovation effort, employer brand value, and executive compensation for the most admired firms in Spain (Benitez & Walczuch, 2012; Benitez et al., 2013; Benitez et al., 2018a). We focused on these firms because they lead in sales and performance and are thus frequently involved in many different types of business opportunities, providing an excellent context to this study. We carefully designed a questionnaire by adapting scales from prior research

and pre-tested the questionnaire with 15 faculty members from five European and North American Business Schools. We then performed a pilot test with eight top executives (four IT and four business executives) from firms located in the south of Spain. Before administering the questionnaire items as a survey, we performed a Q-sorting test with six Ph.D. students particularly knowledgeable on IT management. The Q-sorting tests is useful in determining if measures for a construct belong together and are distinguishable from the measures of other constructs (Rai & Tang, 2010). Our six sorters correctly classified 78% of the items in the intended constructs. These results suggested a good level of agreement and hence acceptable construct validity and quality measures (Anderson & Gerbing, 1991; Moore & Benbasat, 1991).

The questionnaire and a cover letter were mailed to senior IT/business executives in the 1046 firms on the list mentioned above. The letter informed recipients that a web-based version of the survey was available and provided them with an individual password to access the survey. Several reminders were sent by email and a final reminder by phone (Tanriverdi, 2005). We received 203 valid questionnaires from December 2007 to April 2008. These questionnaires came from 203 firms, giving a response rate of 20.240%, a rate satisfactory and consistent with that obtained in prior literature (Byrd & Davidson, 2003; Lawson et al., 2015). The firms belong to 25 industries: 39 firms (19.212%) operated in the wholesale industry, 35 (17.241%) in real estate and/or construction, 15 (7.389%) in communications and graphic design, 15 in the chemical industry (7.389%), 12 (5.911%) in the retail sector, 10 (4.926%) in nonmetal mining, 9 (4.433%) in consulting services, 8 (3.941%) in food, drink, and tobacco, and the rest (60 firms, 29.558%) in other industries. Nonresponse bias was assessed by verifying that early and late respondents did not differ in their responses. All possible t-test comparisons between the means of the two groups of respondents showed nonsignificant differences. On average, the sample firms' total revenues in 2007 were 1050.691 million Euros, and they had about 2401 employees.

Before the data collection, we performed a statistical power analysis to determine the minimum sample size required to estimate the proposed model. Assuming an anticipated effect size of 0.150, a desired statistical power level of 0.800, eight predictors (number of links received by the construct business experimentation), and confidence level of 0.95, the minimum required sample size to estimate the model was 108 (Benitez et al., 2017). Our sample size was 203, adequate to estimate the proposed model. This analysis suggested that our study had sufficient statistical power to detect the effects of interests. Moreover, Henseler et al. (2014) demonstrated that confirmatory composite analysis can detect various forms of model misspecification at a sample size of about 100 or greater.

Questionnaires were completed by senior IT executives (i.e., Chief Information Officer, IT Vice President, IT Manager) or business executives (i.e., Chief Executive Officer, Operations Vice President, Corporate Development Officer). On average, the key informants had about 13 years of managerial experience working in their firm. We also asked the key informants for a self-evaluation of their degree of expertise and competence needed to answer the survey. The item "In general, the degree to which I am qualified to complete the survey is…" (1: Very low, 7: Very high) was included at the end of the questionnaire (Tanriverdi, 2005). The average value for this item was 5.390 (S.D.: 1.040). Overall, the above information suggests that the key informants had a high level of competence to answer the questions included in the survey.

We used survey data to measure IT infrastructure capability, business experimentation**,** business flexibility, and quality management (control variable). Operational competence, firm performance, firm size (control variable), and industry (control variable) are measured with information collected from the Actualidad Economica and SABI (https://sabi.bvdinfo.com/) databases. SABI is a well-known database produced by Bureau van Dijk, which provides abundant financial information for Spanish and Portuguese firms (Benitez et al., 2018a). Our study thus combines survey and

secondary data to measure exogenous and endogenous variables, an approach preferable to using perceptual data only because it minimizes the problem of common method bias (Ahmad & Schroeder, 2003).

Measures

There are two types of formative measurements: composite-formative and causal-formative measurements (see Henseler, 2017). In composite-formative measurement, (1) the indicators make up the construct, (2) high correlations among the indicators are common but not required, (3) the indicators do not involve measurement error, and (4) dropping an indicator alters the composite and may change its meaning. By contrast, in causal-formative measurement, (1) the indicators cause the construct, (2) correlations between indicators are not expected, (3) there is measurement error at construct level, and (4) dropping an indicator increases measurement error on the construct level (Benitez et al., 2017; Henseler, 2017). Causal-formative measurement models require estimation of a complementary reflective measurement model (Henseler, 2017). All constructs of the proposed model except firm performance were specified as composite-formative (in short, composite) constructs. Firm performance was specified as a factor and was estimated with sum scores. The composite construct serves as a proxy for the concept under investigation. The composite model can be understood as a recipe for how ingredients (indicators/dimensions or measures) should be mixed and matched to form the composite (Henseler, 2015; Benitez et al., 2017). Selection of the ingredients thus also represents how an author team understands the concept (composite) under investigation (Rueda et al., 2017).

IT infrastructure capability was specified as a second-order composite construct determined by technological, managerial, and technical IT infrastructure capabilities. We measured technological IT infrastructure capability through annual investment in technological IT resource infrastructure per employee (Ray et al., 2005). We included a single-item question on annual investment in

technological IT resources (servers, computers, laptops, operating systems, software, electronic communication networks, and shared customer databases) in the questionnaire. The annual investment in technological IT resources data were divided by average number of employees in 2007-2008 with information collected from the Actualidad Economica database. As technological IT infrastructure is a single-item measure, specifying it as composite or reflective yields identical results. We measured managerial and technical IT infrastructure capabilities by adapting the scales from Byrd and Davidson (2003) and Ray et al. (2005). These two constructs were specified as composite at the first-order level.

Business experimentation was specified as a composite first-order construct, using a scale adapted from Chandler et al. (2000). Business flexibility is a composite second-order construct determined by operational, structural, and strategic flexibility (Benitez & Ray, 2012; Benitez et al., 2018a). We measured operational, structural, and strategic flexibility by creating a scale based on Volberda (1996). We specified these three constructs as composite at the first-order level.

We measured operational competence as a composite construct through operational excellence and gross margin management (Tatikonda et al., 2013; Benitez et al., 2018b). We measured operational excellence by average rate of operational sectoral excellence (RSE) for the period 2007-2011, with information gathered from Actualidad Economica database. The RSE, an objective measure of firms' sectoral excellence in sales (Benitez & Walczuch, 2012; Benitez et al., 2018a), can be estimated from secondary data contained in any known sales ranking of firms in the following way: RSE = 1 - (Sales ranking position of firm/Total number of firms in the industry). This rate will range from zero to one (termed the industry's maximum value of operational excellence). The closer the RSE is to the industry's maximum value of operational excellence, the better is the firm's operational excellence. We measured gross margin management through the

average gross margin for the period 2007-2011 using information collected from the SABI database (Tatikonda et al., 2013; Benitez et al., 2018b).

Firm performance was measured through the average firm return on assets for the period 2007-2011, with information also collected from the SABI database, which is consistent with prior literature that uses profitability-based measures to assess business value of IT (Sabherwal & Jeyaraj, 2015). This five-year period for collection and estimation smooths out the bias derived from a good or bad year (Tanriverdi, 2005; Benitez et al., 2013). This study controlled for the effect of quality management on business experimentation, operational competence, and firm performance (Molina et al., 2007) as the variance observed in the firm outcomes can be associated with the level of quality management practices performed by the company. We also controlled for firm size and industry on operational competence and firm performance. Quality management was measured with a scale of two composite indicators adopted from Zhu and Sarkis (2004). We computed firm size as the natural logarithm of the average number of employees for the period 2007-2011 with information collected from Actualidad Economica database (Benitez & Walczuch, 2012). Industry was measured as a dummy variable (0: Manufacturing, 1: Service firm).

EMPIRICAL ANALYSIS

We performed a partial least squares (PLS) path modeling to test the hypotheses and examine the mediation effects proposed in the model. This estimation method was appropriate for two reasons. First, PLS is a full-fledged structural equation modeling (SEM) approach that can test for exact model fit and be used for confirmatory research (Henseler et al., 2016; Benitez et al., 2017). Second, PLS is the optimal method to estimate pure composite models, and models that combine composite and factor constructs, as the proposed research model (Henseler et al,. 2014; Rigdon et

al., 2014; Henseler et al., 2016; Benitez et al., 2017). We used the statistical software package Advanced Analysis for Composites (ADANCO) 2.0 Professional for Microsoft Windows (http://www.composite-modeling.com/) (Henseler & Dijkstra, 2015). ADANCO is modern software for variance-based SEM. It models composites, common factors, and single-indicator constructs and facilitates causal and predictive modeling. To estimate the level of significance of weights, loadings, and path coefficients, we used the bootstrapping algorithm with 5000 subsamples (Benitez et al., 2017).

Measurement model evaluation

We evaluated whether the indicators of all first-order constructs and the dimensions of second-order constructs contained the full domain of the construct. Evaluation ensured the content validity of all constructs included in our study, where possible, using scales previously validated in prior research (Pavlou & El Sawy, 2006). We pre-tested the questionnaire with 15 faculty members, performed a pilot test with eight top executives, and made a Q-sorting test with six Ph.D. students. We also checked the validity of our structures of composite constructs by performing a confirmatory composite analysis. This analysis is able to detect wrong assignment of indicators to constructs or wrong number of constructs (model misspecification) and provides an overall exact model fit for the measure structure at first- and second-order levels (Henseler et al., 2014). Table 2 shows the results of the confirmatory composite analysis.

In performing the confirmatory composite analysis, we evaluated goodness of fit of the saturated model (a model that enables free correlation among the measurements) at first- and second-order levels (Table 2). We thus examined the standardized root mean squared residual (SRMR), unweighted least squares (ULS) discrepancy (d_{ULS}), and geodesic discrepancy (d_G) to evaluate goodness of saturated model fit (Henseler et al., 2014; Henseler & Dijkstra, 2015). These measures of goodness of fit evaluate the discrepancy between the empirical correlation matrix and the model-

implied correlation matrix (Henseler, 2015; Benitez et al., 2017; Benitez et al., 2018a). The lower they are, the better the fit of the proposed model (Henseler & Dijkstra, 2015). As all values of the discrepancies were below the 95%-quantile of the bootstrap discrepancies (HI_{95} values), the measurement model should not be rejected based on the alpha level of 0.05, which means that we can ensure with a probability of 5% that the measurement structure of our composite constructs is correct. We can thus proceed to evaluate the specific properties of our composite constructs.

Table 2: Results of the confirmatory composite analysis.

Discrepancy	First-order constructs			Second-order constructs			Control variables constructs		
	Value	HI_{95}	Conclusion	Value	HI_{95}	Conclusion	Value	HI_{95}	Conclusion
SRMR	0.068	0.338	Supported	0.022	0.026	Supported	0.025	0.043	Supported
d_{ULS}	4.549	113.398	Supported	0.010	0.014	Supported	0.006	0.019	Supported
d_G	1.976	60.533	Supported	0.009	0.011	Supported	0.002	0.006	Supported

We estimated the proposed model by a two-step approach (Chin, 2010). In the first step, all the first-order constructs were freely correlated to obtain the latent variable scores. In the second step, the latent variable scores of the dimensions were used as the measures of the multidimensional constructs IT infrastructure capability and business flexibility. Table A2 (in the appendix) provides detailed information on survey items. The correlation matrix is presented in Table A4 (in the appendix).

We also tested for multicollinearity, weights, loadings, and significance level of the composite first- and second-order constructs (Cenfetelli & Bassellier, 2009; Benitez et al., 2017). We tested for multicollinearity by checking whether the dimension and indicator variance inflation factors (VIFs) are lower than 10 (Petter et al., 2007; Benitez et al., 2017). VIFs values ranged from 1.006 to 2.977 at first-order level and from 1.435 to 1.973 at second-order level, well below 10, suggesting that multicollinearity is not a problem in our composite constructs (Benitez & Ray, 2012). Composite indicator and dimension should be retained irrespective of whether its weight is significant or not, but loading is significant (Petter et al., 2007; Benitez et al., 2018a). The analysis

yielded two weights referring to indicators of operational flexibility and structural flexibility that were not significant. However, all first- and second-order loadings were significant at the 0.001 level. Overall, the analysis suggests good properties for our composite measures (Henseler, 2015; Henseler et al., 2016).

Structural model evaluation

We tested the proposed theory by performing a PLS estimation and analyzing the effect size (f^2) for the hypothesized relationships (Dijkstra & Henseler, 2015). We examined the path coefficients, level of significance, and f^2 and R^2 values. Figure 2 shows the results of the test of hypotheses. We found support for H1a, H1b, and H1c at 0.001, 0.001, and 0.05 levels respectively, suggesting that IT infrastructure capability influences business flexibility both directly and indirectly through business experimentation. The empirical analysis also provides support for H2a and H2b at the 0.001 level, indicating that business flexibility facilitates development of operational competence to increase firm performance. Of the control variables, quality management has a significant positive effect on business experimentation (0.001 level) and firm performance (0.05 level). Firm size has a significant positive effect on operational competence (0.001 level) and a negative effect on firm performance (0.05 level). Industry has a significant negative effect on operational competence (0.001 level) and firm performance (0.05 level).

In a PLS estimation, the values of the path coefficients, their significance level, and the f^2 and R^2 values are individual measures of the explanatory power of the model. Path coefficients around 0.200 are considered as economically significant, and R^2 values above 0.200 indicate good explanatory power of the model's endogenous variables (Chin, 2010; Benitez et al., 2018a). The main path coefficients in our model ranged from 0.157^{*} to 0.537^{***}. The effect size (f^2) specifies the relative size of each incremental relationship included in the model. f^2 values lower than 0.020, higher than 0.150, and higher than 0.350 indicate, respectively, weak, medium, or large effect size

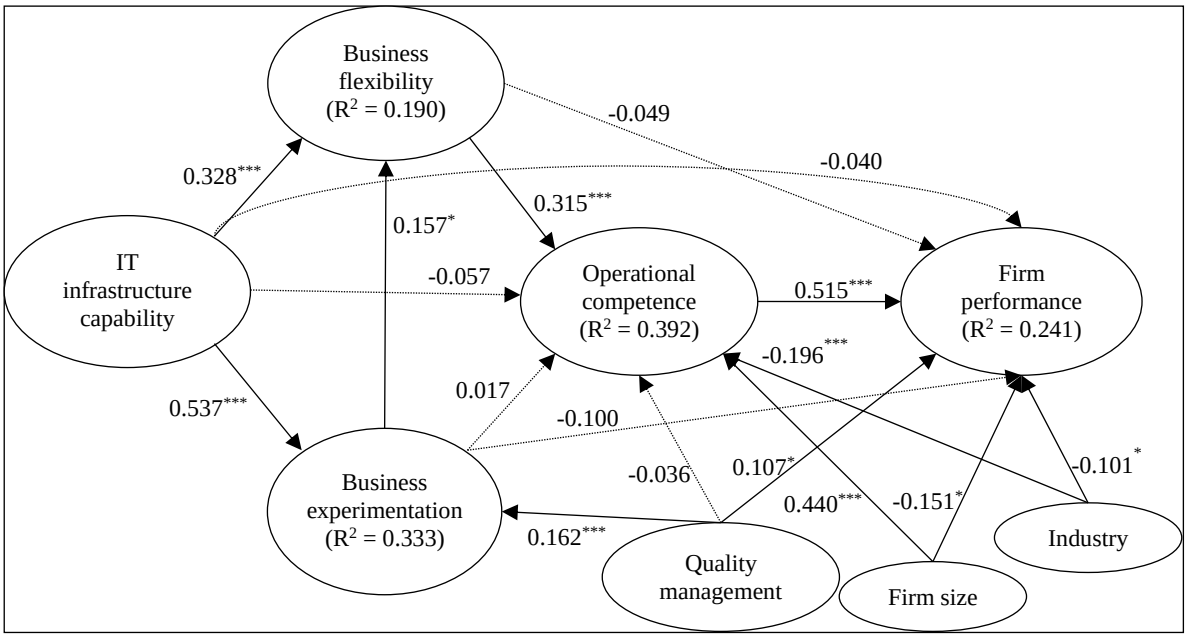
of adding a link between an exogenous and endogenous variable (Henseler & Fassott, 2010). The f^2 value of the links involved in the hypothesized relationships ranged from 0.021 to 0.428 (Table A3 in the appendix). The R^2 values for the endogenous variables ranged from 0.190 to 0.392. Overall, this analysis suggests good explanatory power for the proposed model.

This study also examined the SRMR, d_{ULS}, and d_G to evaluate the goodness of estimated model fit (Henseler et al., 2014; Henseler & Dijkstra, 2015). These measures of goodness of fit evaluate the discrepancy between the empirical correlation matrix and the model-implied correlation matrix of the estimated model (Henseler, 2015; Benitez et al., 2017). The lower they are, the better the fit of the estimated model (Henseler & Dijkstra, 2015). The estimated model should not be rejected based on the alpha level of 0.05, as all discrepancies are below the 95%-quantile of bootstrap discrepancies (Table 3), which means that with a probability of 5% we can thus ensure that the proposed model represents a good theory to explain how the world of IT management works in companies (Benitez et al., 2017).

Table 3: Estimated model fit evaluation.

Discrepancy	Value	HI_{95}	Conclusion
SRMR	0.080	0.201	Supported
d_{ULS}	2.065	13.127	Supported
d_G	0.465	6.602	Supported

Figure 2: Test of hypotheses. ($^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$).



Mediation analysis

We conducted a mediation analysis to examine the indirect effects involved in the proposed model. Specifically, we added a link to the proposed model between: (1) IT infrastructure capability and operational competence/firm performance, (2) business flexibility and firm performance, and (3) business experimentation and operational competence/firm performance. We performed a mediation analysis based on Zhao et al.'s (2010) approach.[3] A very high number of recent studies published in the best IS and Management journals have employed this approach (Rueda et al., 2017;

[3] The Baron and Kenny's approach has been recently criticized and reconsidered because it emphasized the analysis in testing the existence of full mediation instead of testing whether the indirect effect is significant (Zhao et al., 2010). The approach by Zhao et al. (2010) is considered now as the most accepted one in performing a mediation analysis. This is evidenced by the 3300 citations in Google Scholar, which this paper has received in about seven years. Baron and Kenny's mediation approach bases on the Sobel z-test. The Sobel test cannot be applied when using PLS for the following reasons: (1) path coefficients are not independent and raw unstandardized when using PLS, as Sobel test requires (Sosik et al., 2009); (2) Sobel test assumes a standardized multivariate distribution in the indirect effect and the indirect effect seldom follows a normal distribution when working with finite samples (Preacher & Hayes, 2008); (3) Sobel test requires large sample size (Preacher & Hayes, 2008). In this situation, a recommended approach for testing the level of significance of the indirect effect is the bootstrapping method (Preacher & Hayes, 2008; Zhao et al., 2010). Testing the "bootstrap" indirect effects is more powerful than Sobel's test. Preacher and Hayes (2008) asserted that the sample distribution of the indirect effect using Sobel's z is not normal, and then 95% confident interval can erroneously include zero. Bootstrap test solves the problem by generating X subsamples (i.e., 5000) distributing the indirect effect (ab), and estimating ab as the mean of these estimates. For all these reasons, we do not use the Baron and Kenny's approach and Sobel test in the analysis.

Benitez et al., 2018a; Buyl et al., forthcoming). We used a bootstrapping of 5000 subsamples to determine the significance level for the indirect effects involved in the research model. We performed the following steps: (1) estimate the significance of indirect effects by a bootstrapping analysis; and (2) evaluate whether the indirect effect is significant (the only requirement for mediation) to determine the type of mediation. If the indirect effect is significant and the direct effect is not, we have an indirect-only mediation. If the indirect effect is not significant but the direct effect is, we have a direct-only mediation. If both the indirect and direct effects are not significant, we have no mediation. If both the indirect and direct effects are significant, we have a complementary or competitive mediation (Zhao et al., 2010; Benitez et al., 2017).

Indirect effects were significant (ranging from 0.049^{*} to 0.162^{***}) except for the relationship between IT infrastructure capability and firm performance (-0.032) and between business experimentation and firm performance (0.027). This mediation analysis reinforces the results obtained in the test of hypotheses. The effects of IT infrastructure capability on operational competence through business experimentation and business flexibility are significant, while the direct effect is not. Similarly, the effect of business experimentation on operational competence through business flexibility and the effect of business flexibility on firm performance through operational competence are significant (Zhao et al., 2010), while the direct effects are not significant. Accordingly, we have three indirect-only mediations. In addition, the direct and indirect effects of IT infrastructure capability on business flexibility are both significant and positive, showing a complementary mediation. Table 4 provides the details of this mediation analysis.

Table 4: Mediation analysis.

Relationship	Direct effect	Indirect effect	Total effect
IT infrastructure capability → Business flexibility	0.328^{***} (4.252) [0.164, 0.468]	0.084^{*} (1.864) [0.003, 0.181]	0.413^{***} (6.775) [0.287, 0.526]
IT infrastructure capability → Operational competence	-0.057 (-0.454)	0.139^{***} (2.888)	0.082 (0.708)

	[-0.344, 0.157]	[0.046, 0.232]	[-0.187, 0.278]
IT infrastructure capability → Firm performance	-0.040 (-0.463) [-0.223, 0.112]	-0.032 (-0.399) [-0.195, 0.121]	-0.071 (-1.118) [-0.200, 0.053]
Business experimentation → Operational competence	0.017 (0.231) [-0.129, 0.164]	0.049* (0.716) [0.001, 0.114]	0.067 (0.918) [-0.074, 0.207]
Business experimentation → Firm performance	-0.100 (-1.155) [-0.256, 0.091]	0.027 (0.653) [-0.049, 0.114]	-0.073*** (-0.726) [-0.254, 0.141]
Business flexibility → Firm performance	-0.049 (-0.696) [-0.172, 0.109]	0.162*** (3.326) [0.064, 0.259]	0.113† (1.571) [-0.019, 0.262]

Test of endogeneity

Endogeneity between two variables may be caused by the omission of variables on a proposed model and by the existence of feedback loops (Benitez et al., 2018a). Because it is debatable whether greater business experimentation has a positive association with IT infrastructure capability, we performed a test of endogeneity on the relationship between IT infrastructure capability and business experimentation. Using the competitor aggressiveness in carrying out competitive attacks as an instrumental variable of IT infrastructure capability, the Hausman test reveals that the relationship between IT infrastructure capability and business experimentation appears unaffected by endogeneity ($\chi^2 = 0.000354$, d.f. = 1, $p = 0.985$). This analysis indicates that omitted variables and reverse causality are not a problem in this relationship (Benitez et al., 2018a).

Test of robustness

Because it may be discussed that flexibility can support the firm in explorative innovation (Zhou & Wu, 2010) and that business experimentation may affect operational competence (Takeuchi et al., 2008), we performed a robustness test. We tested for the robustness of the proposed theory by testing these two alternative arguments. We tested three alternative models. In the first alternative model, business flexibility affects business experimentation. In the second alternative model, business experimentation affects operational competence leaving free correlation between business

flexibility and business experimentation. The third alternative model aggregates the latter two alternative models reversing the direction of causality between business flexibility and business experimentation and adding a link from business experimentation to operational competence.

The first alternative model yielded results similar to those obtained in the proposed model (Figure 2), but the direction of association between business flexibility and business experimentation was not significant (0.10 level). In the second alternative model, the link between business experimentation and operational competence was nonsignificant. Similar results were obtained when aggregating the reverse direction of business flexibility on business experimentation and the link of business experimentation on operational competence (with and without the direct effects involved). The empirical analysis shows that business flexibility does not affect business experimentation and that business experimentation does not influence the development of an operational competence. Table A3 (in the appendix) provides the details of the robustness test. As the model fit of the proposed theory was not statistically worse than the model fit of these three alternative models, we can claim that the proposed theory is stronger than these alternative arguments (Henseler et al., 2014; Benitez et al., 2017; Benitez et al., 2018a).

DISCUSSION AND CONCLUSIONS

Summary of results and contributions to IS research

Although firms need to explore and exploit new business opportunities (entering in a developing country) to increase their performance and survive in the long term, our knowledge of how firms explore and exploit opportunities is still emerging. For example, we need to understand why some firms explore and exploit business opportunities better and faster than others. This study examines how IT infrastructure capability influences opportunity exploration and exploitation firm's capabilities by arguing that business experimentation and business flexibility are two mechanisms through which firms explore business opportunities, and operational competence is the

mechanism/capability through which firms exploit business opportunities. The proposed theory was tested on a sample of firms in Spain, and the empirical analysis gives good support to the theory. Specifically, we find that: (1) IT infrastructure capability enables business experimentation and the business flexibility to sense and explore business opportunities before competitors do, thus enabling exploration of opportunities; and (2) IT-enabled business flexibility helps firms to develop the operational proficiency to seize and exploit the sensed opportunities, thus facilitating to survive in the long run.

We analyzed the effect of IT infrastructure capability and exploration capabilities. We found that IT infrastructure capability transforms business activities through business experimentation and business flexibility, with a larger effect on business experimentation. The effect size of the link between IT infrastructure capability and business experimentation ($f^2 = 0.428$) is four times the effect size of the association between IT infrastructure capability and business flexibility ($f^2 = 0.092$). IT infrastructure transforms business activities through business experimentation and business flexibility, with a larger effect on experimentation. This larger effect on business experimentation can have the following theoretical explanation: IT infrastructure provides organization's members the foundation to use collaborative tools to organize information in an intuitive manner, handle projects in a collaborative way, and provide new ideas and improvements to the firm. The firm's IT infrastructure also facilitates organization's members task automation, tool integration, and mobility solutions that enable and make easier to pursue creativity. In this sense, the effects of IT infrastructure on collaboration and creativity seem to be stronger than the effect of IT infrastructure on the firm's ability to change processes, structure, and strategies (business flexibility). This result suggests a sequence in the role of the mechanisms for exploring business opportunities as follows: business experimentation enables business flexibility.

We also analyzed the relationship between IT infrastructure capability and exploitation capabilities, and the relationship between exploration and exploitation firm's capabilities. IT-enabled business flexibility facilitates the development of operational competence to exploit business opportunities. In this sense, operational competence is the mechanism through which firms exploit business opportunities to increase their business benefits. The empirical analysis suggests that there is no direct effect of IT-enabled business experimentation on operational competence in the context of this research. There seems to be an indirect-only mediation between business experimentation and operational competence through business flexibility (Table 4). The empirical analysis suggests that business experimentation and business flexibility are two key mechanisms to explore business opportunities.

We argue that exploration of business opportunities is an antecedent of exploitation of business opportunities, that is, there is a sequence from exploration to exploitation. We found that exploration and exploitation mechanisms are linked through business flexibility. Once an opportunity (let's say the opportunity A) is sensed and explored, the company's business flexibility provides the operational flexibility (responsiveness) to select the most critical operational processes and align them to the sensed opportunity (A) to exploit the opportunity (A) and achieve the business benefits. For example, once Amazon has sensed and explored an opportunity (Amazon Go: launching automated supermarkets with no presence of workforce), it responds rapidly by exploiting its excellent supply chain and gross margin control capabilities to convert this opportunity into business gains. Our research design included perceptual data collected in 2007-2008 for business experimentation and business flexibility and secondary data collected in 2007-2011 for operational competence and firm performance. The unit of the analysis of the study was the firm-level. This research design used lagged measurements and enabled us to test and achieve

some support to our theory-driven thesis on the sequence between exploration and exploitation. However, this research design precludes us to discriminate at the opportunity-level analysis.[4]

This research has four contributions to the IS research. First, this study is one of the first to explain theoretically and examine empirically exploration and exploitation of business opportunities in the field of IS. Prior IS research on IT and on exploration and exploitation has mainly focused on the balanced usage of exploration and exploitation of IT resources (Subramani, 2004; Gregory et al., 2015; Lee et al., 2015), and the role of IT in contextual ambidexterity (Im & Rai, 2014), but it remains unclear how IT infrastructure capability can lead to explore and exploit business opportunities. We contribute to this literature by examining three specific mechanisms (business experimentation,[5] business flexibility, and operational competence) enabled by IT infrastructure capability through which firms explore and exploit business opportunities.

This study makes an incremental theoretical contribution from the studies by Lee et al. (2015) and Im and Rai (2014). Lee et al. (2015) studied how exploration and exploitation of IT (IT ambidexterity) influences organizational agility. IT ambidexterity refers to the balance between experimenting with new IT resources (IT exploration) and using existing IT resources (IT exploitation). Im and Rai (2014) studied the IT promotion of contextual ambidexterity in interorganizational relationships and how these relationships affect performance and quality relationships. Contextual ambidexterity refers to the balance between pursuing alignment and adaptation of partners' goals and activities synergistically in the context of the interorganizational

[4] In this sense, the research design did not enable us to examine whether companies could explore a new opportunity (let's say the opportunity B) while exploit a previously sensed opportunity (opportunity A). However, this argument does not demonstrate that our thesis of the sequence is wrong but invites to perform future research in the role of new digital technologies in exploration and exploitation of business opportunities at the opportunity level (e.g., merger, joint-venture).

[5] Experimentation has been traditionally conceptualized as an organizational learning capability needed to innovate (Stan & Vermeulen, 2017). We introduce the concept of business experimentation by linking Innovation Management literature with IS literature explaining the relationship between IT infrastructure capability and business experimentation in the context of business opportunities.

relationships. In this sense, prior IS research has focused on IT ambidexterity at the firm level and contextual ambidexterity at the interorganizational level. Drawn from this prior IS research, in a different way, we examine the role of the firm's ability in leveraging its IT resources to acquire/provide information from/to key users (IT infrastructure capability) in the firm's capabilities of exploration and exploitation of business opportunities.

Second, our study explains theoretically, and demonstrates empirically how IT infrastructure capability can enable a sequence between opportunity exploration and exploitation firm's capabilities, where IT infrastructure influences exploration, which in turn affects exploitation firm's capabilities. Prior literature has mainly considered the tensions and tradeoff between exploration and exploitation activities (Andriopoulos & Lewis, 2009; Kristal et al., 2010). Others appealed to the simultaneous or balanced use of exploration and exploitation (ambidexterity) as the solution to this tension (Durcikova et al., 2011). However, our study contributes to exploration and exploitation literature by explaining the sequential effect of exploration and exploitation capabilities enabled by IT infrastructure capability in the context of business opportunities. In this context, the firm's business flexibility is the "link capability" that provides the responsiveness to connect exploration and exploitation activities.

Third, our study also contributes to a better understanding of the connection between several types of organizational capabilities (IT, dynamic, and operational capabilities) and the firm's capabilities for opportunity exploration and exploitation. The results of our study imply that IT infrastructure is a foundational capability from which organizational capabilities are developed on a dynamic base (business experimentation and business flexibility), which in turn facilitates the design of a portfolio of operational capabilities that directly increase firm performance. Business experimentation and business flexibility are the (dynamic) opportunity exploration capabilities, and operational competence is the (operational) opportunity exploitation capability.

Finally, business value of IT literature has studied the impact of IT investments and IT capabilities on firm performance (Mithas & Rust, 2016; Benitez et al., 2018a; Benitez et al., 2018c). A vast number of business value of IT studies found that IT investments and IT capabilities affect firm performance through the development of organizational capabilities such as new product development capability (Pavlou & El Sawy, 2006), information management capability (Mithas et al., 2011), proactive environmental strategy (Benitez & Walczuch, 2012), or corporate entrepreneurship (Chen et al., 2015). This is the so-called IT-enabled organizational capabilities perspective. Similarly, our study contributes to the literatures on business value of IT and IT-enabled organizational capabilities by studying how IT infrastructure capability affects opportunity exploration and exploitation firm's capabilities through the lens of business experimentation**,** business flexibility, and operational competence.

Limitations and suggestions for future research

This study has three limitations. First, following previous studies (Durcikova et al., 2011), we used the conceptual framework of opportunity exploration and exploitation to contextualize the proposed model. We did not measure opportunity exploration and exploitation firm's capabilities directly, however. Second, as this study focuses on a sample of large firms in Spain, the results can be only generalized to large firms in Spain. Considering that prior research has primarily investigated how U.S. firms leverage IT to create business value (Benitez et al., 2018a), future IS research could examine the effect of IT on exploration and exploitation of business opportunities in other countries in the Spanish business community (e.g., Mexico, Chile). We really need to extend/shift our understanding of the business value of IT to a more diverse entrepreneurial context beyond the U.S. companies. Third, some of our variables (IT infrastructure capability, business experimentation, and business flexibility) were measured using cross-sectional data, which preclude showing causality between these variables. As collecting a panel of survey data is a critical

challenge in our field, future research could examine the role of IT in exploration and exploitation of business opportunities using a panel of secondary data proceeding, for example, from a content analysis of firms' annual reports (Braojos et al., 2015). We believe that this methodology will provide many future opportunities to conduct panel data analysis at the firm level. Analyzing whether and how IT-enabled opportunity exploration and exploitation provide the base for accumulating process capabilities in the long term seems a very important approach to a problem that we should solve in future research.

Implications for IT managers

Firms must sense, explore, and exploit business opportunities better and faster than their competitors do to survive in the long term. This study also provides some interesting and useful lessons on sensing and seizing business opportunities for (IT and business) managers. Our study suggests to managers that firms that invest more in IT infrastructure identify better and faster and exploit business opportunities. IT infrastructure enables business experimentation and provides business flexibility to explore business opportunities. IT-enabled business flexibility facilitates the operational proficiency to exploit the identified business opportunities. Sensing an opportunity in advance of competitors gives the firm more time and experience to explore and develop carefully the most appropriate/profitable operational proficiency in terms of operational excellence and product margin control. The study also illustrates that exploration and exploitation of business opportunities are a sequence of competitive actions. Exploration precedes exploitation of business opportunities. Exploration and exploitation are connected through business flexibility.

About 78% of the best ideas implemented by the most innovative companies in the world in 2016 came from their organization's members (Boston Consulting Group, 2017). This illustrates

how critical it is for firms to develop the appropriate digital platforms to facilitate collaboration and creativity. Our study develops the concept of business experimentation in the context of business value of IT investments for finding and developing business opportunities. Finally, this research also shows the potential of firm's IT investments to increase business benefits. Managers can also learn that IT provides openness, responsiveness, and control. IT enables business experimentation, which provides the openness to develop new products and business models to identify internal opportunities. IT facilitates business flexibility, which provides the responsiveness to identify external business opportunities. In addition, IT-enabled flexibility facilitates operational competence, which provides the control to increase firm performance. IT does matter.

Concluding remarks

How IT influences exploration and exploitation of business opportunities is a cutting-edge research question/problem that has not received sufficient attention in IS research. We combine theory on dynamic and operational capabilities, the IT-enabled organizational capabilities perspective, and the prior literature on exploration and exploitation to take a first step toward filling this gap. Using a unique research design that combines a survey and secondary dataset for a sample of 203 large firms in Spain, we find that IT infrastructure capability influences opportunity exploration capability through business experimentation and business flexibility. We also find that IT-enabled business flexibility influences opportunity exploitation capability by rapidly developing a valuable portfolio of operational capabilities, thus facilitating the firm's long-term survival.

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APPENDIX

Table A1: Sequential process of exploration and exploitation of business opportunities.

Process	Motivation	Steps description	Examples
From IT infrastructure capability to exploration of business opportunities	Firm's ability in leveraging its IT resources enables business experimentation and provides business flexibility to sense and explore new business opportunities	- Firms can use IT infrastructure to quickly detect and react to new business opportunities (i.e., become flexible) - Firms can use IT infrastructure to support creative thinking and innovation activities (openness to experiment) - Encouraging experimentation helps firms to quickly respond to challenging business opportunities	- Zara's IT infrastructure provides flexibility to explore new opportunities - Siemens makes use of a digital platform to encourage employees to share their creativity about new sustainability practices - Toyota's support in employees' creativity enables solution to problems in an agile way
From IT-enabled exploration of business opportunities to exploitation of business opportunities	Once firms have detected and experimented with new business opportunities (exploration), they are able to seize, refine, and take advantage of this new business opportunities (exploitation)	- Flexibility in detecting and reacting to new business opportunities gives the time, experience, and chance to agilely manufacture and supply products and to properly manage margins (operational competence) - Excellence in manufacturing products and managing margins helps firms to improve their financial performance, thus exploiting business opportunities	General Motors' ability in exploring/sensing new opportunities for the production process design lead to the integration and refinement of this opportunity, taking advantage of it to improve its firm performance. As being the heart of the firm, operational capabilities are critical to convert the sensed business opportunities in money

Table A2: Detailed information on survey items.

Construct/indicator: Except where otherwise indicated below, the possible range for measures was from 1 to 7 (1: Strongly disagree, 7: Strongly agree)	**Mean**	**S.D.**	**VIF**	**Weight**	**Loading**
Technological IT infrastructure	0.101	0.149	1.468	0.450***	0.810***
Annual IT investment per employee	0.101	0.149	1.000	1.000	1.000
Managerial IT infrastructure	3.828	1.663	1.973	0.568***	0.921***
IT managers identify and support IT-enabled business activities	3.527	1.630	1.882	0.275**	0.798***
IT managers provide adequate funding to execute IT innovation projects	3.611	1.589	1.881	0.281**	0.787***
IT managers redesign IT processes to sense and respond to business opportunities	4.335	1.585	1.613	0.491***	0.864***
IT managers work closely with business managers to execute the firm's business strategies	3.837	1.737	1.944	0.174*	0.777***
Technical IT infrastructure	4.414	1.444	1.435	0.188†	0.601***
Skills of our IT personnel in designing databases are excellent	4.626	1.367	2.052	0.295***	0.825***
Skills of our IT personnel in developing new IT applications are excellent	4.645	1.394	2.463	0.286***	0.867***
Skills of our IT personnel in improving the efficiency of the IT services are excellent	4.532	1.336	1.789	0.322***	0.818***
IT personnel use different programming languages	3.852	1.531	1.542	0.316***	0.776***
Business experimentation	4.292	1.618	NA	NA	NA
Our firm encourages organizational members to suggest new ways of doing things	4.123	1.620	2.181	0.164***	0.788***
Our firm encourages organizational members to suggest productivity and quality improvements	4.187	1.590	2.363	0.144***	0.775***
Our firm encourages organizational members to suggest the elimination of wasteful/inefficient work practices	4.059	1.556	1.895	0.158***	0.740***
Our firm encourages organizational members to suggest new product ideas	4.325	1.627	2.977	0.162***	0.860***
Our firm encourages organizational members to suggest product quality	4.369	1.702	2.579	0.141***	0.797***
Our firm encourages organizational members to suggest new ways to save money	4.414	1.553	2.121	0.144***	0.776***
Our firm encourages organizational members to suggest new procedures	4.350	1.695	2.208	0.173***	0.782***
Our firm encourages organizational members to suggest new marketing ideas	4.507	1.568	2.101	0.181***	0.794***
Operational flexibility	4.367	1.798	1.691	0.214†	0.756***
Our firm works with a high number of suppliers	4.414	1.782	1.876	0.146	0.753***
Our firm shares key resources with its suppliers	4.429	1.845	2.139	0.442***	0.895***
Our organization outsources non-core activities to other firms	4.488	1.814	1.906	0.393***	0.866***
Our organization uses temporary personnel to develop firm activities	4.138	1.744	1.590	0.212*	0.728***
Structural flexibility	4.624	1.801	1.754	0.530***	0.900***
In our firm, we apply horizontal extension of responsibilities (job enlargement), that is, the ability to perform a broader repertoire of activities	4.631	1.866	1.683	0.142†	0.682***
Our firm has an empowerment (more decision-making authority for employees) culture	4.571	1.848	1.853	0.602***	0.932***
In our firm we create multifunctional teams	4.606	1.727	2.876	0.123	0.811***
Our firm easily changes the managerial roles	4.690	1.771	2.767	0.287**	0.843***

Strategic flexibility	4.541	1.924	1.725	0.424***	0.854***
Our firm changes current strategies quickly with low costs	4.567	2.000	2.822	0.190†	0.857***
Our firm can easily increase the variety of products for delivery	4.690	1.847	2.290	0.259*	0.844***
Our firm can enter in new markets for delivery	4.429	2.019	1.623	0.321**	0.795***
Our firm periodically adopts new technologies	4.478	1.825	2.860	0.400**	0.908***
Operational competence	2.418	62.127	NA	NA	NA
Operational excellence	0.621	0.284	1.006	0.840***	0.877***
Gross margin	4.530	91.62	1.006	0.482**	0.547***
Quality management: How would you evaluate your firm's (degree of) implementation of the following quality management practices? 1: Not considering it, 2: Planning to consider it, 3: Currently considering it, 4: Implementation will begin in the short term, 5: Currently initiating implementation, 6. Intermediate implementation phase, 7: Implementing successfully	4.187	1.776	NA	NA	NA
ISO 9000 certifications	4.640	1.701	1.188	0.331*	0.658***
Total quality management type programs	3.734	1.737	1.188	0.821***	0.953***

Note: NA: Not applicable

Table A3: Test of robustness.

Beta coefficient	Base model	Base model with direct effects	First alternative model	Second alternative model	Third alternative model	Third alternative model with direct effects
IT infrastructure capability → Business experimentation (H1a)	0.538***	0.537***	0.502***	0.537***	0.502***	0.501***
IT infrastructure capability → Business flexibility (H1b)	0.327***	0.328***	0.414***	0.417***	0.414***	0.415***
Business experimentation → Business flexibility (H1c)	0.158*	0.157*				
Business flexibility → Operational competence (H2a)	0.287***	0.315***	0.286***	0.290***	0.295***	0.314***
Operational competence → Firm performance (H2b)	0.499***	0.515***	0.499***	0.489***	0.488***	0.516***
IT infrastructure capability → Operational competence		-0.057				-0.056
IT infrastructure capability → Firm performance		-0.040				-0.039
Business experimentation → Operational competence		0.017		-0.009	-0.011	0.017
Business experimentation → Firm performance		-0.100				-0.100
Business flexibility → Firm performance		-0.049				-0.052
Business flexibility → Business experimentation			0.092†		0.092†	0.092†
Control variables						
Quality management → Business experimentation (control variable)	0.162***	0.162***	0.140**	0.162**	0.140**	0.140**
Quality management → Operational competence (control variable)	-0.038	-0.036	-0.038	-0.035	-0.034	-0.036
Quality management → Firm performance (control variable)	0.069	0.107*	0.069	0.068	0.068	0.107*
Firm size → Operational competence (control variable)	0.450***	0.440***	0.450***	0.450***	0.448***	0.441***
Firm size → Firm performance (control variable)	-0.137*	-0.151*	-0.137*	-0.133*	-0.132*	-0.150*
Industry → Operational competence (control variable)	-0.202***	-0.196***	-0.202***	-0.202***	-0.202***	-0.196***
Industry → Firm performance (control variable)	-0.095*	-0.101*	-0.095†	-0.098*	-0.098*	-0.101*
R^2						
Business experimentation	0.334	0.333	0.340	0.334	0.340	0.339
Business flexibility	0.189	0.190	0.171	0.174	0.172	0.172
Operational competence	0.384	0.392	0.384	0.386	0.388	0.392
Firm performance	0.234	0.241	0.234	0.227	0.226	0.241
SRMR value	0.082	0.080	0.083	0.085	0.083	0.081
SRMR HI_{95}	0.247	0.201	0.245	0.203	0.200	0.200
d_{ULS} value	2.205	2.065	2.243	2.321	2.233	2.120
d_{ULS} HI_{95}	19.906	13.127	19.533	13.379	13.015	13.057
d_G value	0.464	0.465	0.468	0.474	0.470	0.468
d_G HI_{95}	7.092	6.602	7.004	7.047	7.154	6.562
Effect size analysis (f^2)						

IT infrastructure capability → Business experimentation (H1a)	0.430	0.428	0.316	0.429	0.316	0.315
IT infrastructure capability → Business flexibility (H1b)	0.091	0.092	0.207	0.211	0.207	0.208
Business experimentation → Business flexibility (H1c)	0.021	0.021				
Business flexibility → Operational competence (H2a)	0.115	0.110	0.115	0.105	0.108	0.110
Operational competence → Firm performance (H2b)	0.223	0.212	0.223	0.212	0.211	0.213
Business flexibility → Business experimentation			0.010		0.010	0.010
Business experimentation → Operational competence				0.000	0.000	0.000
Quality management → Business experimentation (control variable)	0.039	0.039	0.028	0.039	0.027	0.027
Quality management → Operational competence (control variable)	0.002	0.002	0.002	0.002	0.002	0.002
Quality management → Firm performance (control variable)	0.006	0.013	0.006	0.006	0.006	0.013
Firm size → Operational competence (control variable)	0.287	0.259	0.287	0.277	0.275	0.259
Firm size → Firm performance (control variable)	0.017	0.019	0.017	0.016	0.015	0.019
Industry → Operational competence (control variable)	0.066	0.062	0.066	0.065	0.065	0.062
Industry → Firm performance (control variable)	0.011	0.012	0.011	0.012	0.012	0.012

Table A4: Correlation matrix.

Construct	1	1.1	1.2	1.3	2	3	3.1	3.2	3.3	4	5	6	7	8
1. IT infrastructure capability	1.000													
1.1 Technological IT infrastructure	0.810***	1.000												
1.2 Managerial IT infrastructure	0.922***	0.562***	1.000											
1.3 Technical IT infrastructure	0.601***	0.232***	0.543***	1.000										
2. Business experimentation	0.555***	0.495***	0.494***	0.276***	1.000									
3. Business flexibility	0.415***	0.279***	0.401***	0.323***	0.236***	1.000								
3.1 Operational flexibility	0.356***	0.259***	0.329***	0.280***	0.236***	0.757***	1.000							
3.2 Structural flexibility	0.326***	0.208***	0.304***	0.312***	0.320***	0.576***	0.576***	1.000						
3.3 Strategic flexibility	0.393***	0.271***	0.400***	0.228***	0.285***	0.566***	0.566***	0.585***	1.000					
4. Operational competence	-0.035	-0.191**	0.033	0.171**	0.047	0.352***	0.234***	0.345***	0.277***	1.000				
5. Firm performance	-0.077	-0.112*	-0.056	0.029	-0.054	0.093†	0.094†	0.079	0.075	0.512***	1.000			
6. Quality management	0.104†	0.083	0.093†	0.071	0.218***	0.280***	0.309***	0.246***	0.199**	0.129*	0.115*	1.000		
7. Firm size	-0.090†	-0.252***	-0.100	0.150*	-0.045	0.302***	0.242***	0.291***	0.227***	0.494***	0.142*	0.264***	1.000	
8. Industry	0.033	0.041	0.036	-0.034	-0.104†	0.040	0.005	0.021	0.065	-0.200**	-0.190**	-0.001	0.006	1.000