Exploring the microfoundations of innovation capabilities. Evidence from a cross-border R&D partnership

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\textbf{A B S T R A C T}

In today's markets, innovation has been identified as a key driver of firms' competitive advantage and innovation capabilities and as a key explanatory variable for differences between firms in behavior and outcomes. Although the literature has explored innovation capabilities, typically from a firm-level perspective, little is known about how firms' innovation capabilities originate in lower-level entities and processes, namely in the microfoundations of innovation capabilities. To bridge this gap, the present research adopts a microfoundations perspective to propose a conceptual model that investigates whether and how individual characteristics for innovation (individual attention to detail, creativity, and openness) and individual-level knowledge sharing behaviors (individual motivation, control, ability, and engagement) affect firm-level strategic innovation capabilities. Drawing on data from 287 R&D employees and general managers operating within 11 firms/research centers belonging to a cross-border R&D partnership, the results of structural equation modeling (SEM) show the crucial role played by individual motivation in effective and frequent sharing of knowledge and by individual engagement in knowledge sharing activities. This research contributes to the existing body of knowledge on innovation capabilities and knowledge management and provides interesting insights for marketers.

\textbf{1. Introduction}

Over the last three decades, the nature of competition has changed dramatically. Numerous driving forces, such as the rise of the knowledge economy, globalization, digital transformation, the increasing speed of innovation, and accelerating product life cycles, have led to a fast-moving and even more global business environment characterized by diversification and dispersion in geographical and organizational sources of innovation and manufacturing (Schneckenberg et al., 2015; Teece, 2007). From the perspectives of both theory and practice, the combined effect of these driving forces has changed the ways in which firms create and combine knowledge, resources, and capabilities to develop new products/services and/or processes, adapt to customers' changing needs and preferences, and grasp new technological opportunities (Teece, 2007). In this new global scenario, firms try constantly to introduce innovations (new and potentially useful ideas, products, services, or processes that have commercial potential) as a crucial contribution to the enhancement of the firms' economic-financial performance and to the achievement of a significant competitive advantage (Zacher and Rosing, 2015). To introduce these innovations, firms now rely not only on their internal innovation capabilities but also on external relationships and networks in order to access knowledge located outside their boundaries. They foster their performance by adopting a collaborative approach through formal or informal linkages with external agents (e.g., suppliers, customers, competitors, universities, or institutions) (Ferreras-Méndez et al., 2015; Jordão and Novas, 2017; Scuotto et al., 2017a). In particular, cross-border R&D partnerships have become a strategic source of innovation and competitive advantage, since by sharing knowledge and pooling resources, partnering firms are able to develop cutting-edge technologies, products, and services across a range of fields and industries that could not be brought about by other means. By acquiring new strategic innovation capabilities and combining internal and external knowledge, cross-border R&D partnerships enable firms jointly to develop innovations that no firm could cover on its own, improve the quality and efficiency of the innovations developed, reduce time to market, and facilitate

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access to new international markets (Brattström, 2018; Carayannis et al., 2014; Martínez-Noya and Narula, 2018). Moreover, according to the resource-based view (Barney, 1991; Teece et al., 1997), firms that develop unique and difficult-to- replicate resources and capabilities generate better results and achieve a greater competitive advantage over their competitors. Therefore, innovation capabilities are particularly critical for the success of a firm that is endeavoring to develop a competitive advantage in the globalized market, since they represent one of the key explanatory variables of differences between firms in behavior and outcomes (Parida et al., 2015; Urbancova, 2013).

The management literature has paid attention mainly to formal and informal networks and collaboration in order to assess how firm-level strategic factors (Subramaniam and Youndt, 2005) enhance innovation capabilities and firm competitiveness (Santoro et al., 2018). However, few studies have tried to shed light on how individual characteristics and behaviors strengthen firm’s innovation capabilities in the context of collaborative modes for innovation, despite a growing interest in investigating firm innovativeness from an individual perspective (Lowik et al., 2017). Individuals are crucial for developing innovation, since they are responsible for combining internal and external knowledge, technical skills, and creativity to create innovation.

In addition, relatively limited efforts have been made to analyze empirically the potential determinants of innovation capabilities, taking into account lower-level entities. In fact, only a few studies have investigated this aspect from a microfoundations perspective and using a qualitative approach (Del Giudice et al., 2017; Lowik et al., 2016). Therefore, because of the role played by individuals in transforming innovative ideas into real innovations, more studies are needed, especially from a quantitative perspective, to understand how firms’ innovation capabilities originate in lower-level entities and processes (namely in the microfoundations of innovation capabilities) and to highlight the crucial role of individuals’ characteristics, interactions, and behaviors in generating firms’ routines and capabilities (Felin et al., 2012; Sok and O’Cass, 2015; West and Bogers, 2017).

To address this knowledge gap, the study empirically examines individual characteristics for innovation and individual-level knowledge sharing behaviors as possible determinants of strategic innovation capabilities. The study focuses on three individual characteristics (individual attention to detail, creativity, and openness) and four individual-level knowledge sharing behaviors (individual motivation, control, ability, and engagement), which function as microfoundations for strategic innovation capabilities. In this regard, the study proposes a conceptual model to evaluate whether and how the aforementioned seven microfoundations have a positive and direct effect on strategic innovation capabilities in the context of a cross-border R&D partnership. Empirically, this research analyzes a sample of 287 R&D employees and general managers operating within 11 firms/research centers belonging to the cross-border R&D partnership chosen as the study’s research setting.

This study makes two important contributions to the literature. First, it responds to the call for a deeper investigation that breaks innovation capabilities down into their microfoundations and provides a better understanding of how firms’ routines and capabilities are influenced by individuals’ characteristics and behaviors in a cross-border R&D partnership context. Traditionally, studies on innovation capability as a firm-level outcome are typically focused on firm-level antecedents such as firms’ routines, capabilities, experiences, and absorptive capacity. However, to better understand firm-level outcome it is useful to analyze individual-level factors because this allows to understand how individuals, their interaction, the mechanisms, and the working environment contribute to enhance firm’s level outcomes (Felin et al., 2015). Furthermore, previous microfoundational research are mainly theoretical and qualitative and call for advancing the microfoundational field by carrying out quantitative studies (Felin et al., 2012). Unlike most previous research, this study does not adopt a firm-level perspective or employ a qualitative approach; instead, it analyzes survey data collected from employees of a cross-border R&D partnership to determine whether and how the seven micro-level antecedents of innovation capabilities affect the macro-level outcome, namely strategic innovation capabilities. Thus, the specific research setting, the microfoundational perspective, and the quantitative approach contribute significantly to the originality of this study.

Second, this research emphasizes the strategic importance of knowledge sharing as a crucial mechanism in exploring and acquiring external knowledge, integrating it with internal knowledge, sharing information and ideas, and, consequently, creating, developing, and managing firm-level innovation capabilities. Given the importance of knowledge sharing (Allameh, 2018; Zhang and Jiang, 2015), the study sheds light on how different individuals’ traits and behaviors affect the employee contribution to the development of firms’ strategic innovation capabilities. From this perspective, this study’s findings add to the theory showing that individual motivation and engagement are important for enhancing firms’ routines and capabilities within a cross-border R&D network.

The remainder of this study is structured as follows. The next section presents a review of previous literature on innovation capabilities in the cross-border R&D partnership context; on the basis of this review, seven hypotheses are developed. The methodology section provides details about the data sample, the data collection procedure, and the data analysis. Thereafter, the results are discussed, highlighting both theoretical contributions and managerial implications. Finally, the paper concludes by noting the limitations of the present research and suggesting directions for future research.

2. Theoretical background and study hypotheses

Innovation is a key driver for firms to develop sustainable competitive advantages (Jiménez-Jiménez et al., 2014; Petruzelli et al., 2010; Vrontis et al., 2017). In the past decades, innovation relied on a close, vertical integrated model where all innovation activities were developed internally to firms. Recently, this perspective has been replaced by the open innovation approach, where the contamination among firms, institutions, universities, and communities represents the milestone of this new paradigm (Bican et al., 2017; Romano et al., 2014). According to the open innovation literature (Lowik et al., 2017; Scotto et al., 2017), firms have to use knowledge efficiently since innovation relies more and more on the integration of different sources of knowledge. The combination of internal and external knowledge has been investigated as a mechanism that consists, on the one hand, of acquisition of external knowledge through collaboration with external actors and, on the other hand, of transferring firms’ internal knowledge to the external environment (Papa et al., 2018). Such a mechanism allows firms to foster their innovativeness since it blurs the existing boundaries between firms and their environment (Bican et al., 2017). In an open innovation perspective, sharing knowledge internally and externally through either informal or formal mechanisms helps firms to develop new ideas and capabilities that contribute to enhance innovation process and identify new markets where innovation can be used and sold (Díaz-Díaz and de Saá-Pérez, 2014; Galati and Bigliardi, 2019; Ritala et al., 2018). Given these circumstances, firms should combine internal and external knowledge especially through the adoption of knowledge management practices that support firms to obtain, manage, and employ knowledge as a mean to realize synergistic effects (Suh et al., 2004) and, in turn, develop significant innovations (Ferraris et al., 2017). Knowledge is a crucial antecedent of innovation and needs to be developed using all available resources (Bresciani et al., 2018; Schack, 2004; Soto-Acosta and Cegarra-Navarro, 2016), because it helps firms to create and improve capabilities that are useful for generating value (Wu and Chen, 2014). Internal knowledge is founded on people, skills, experience, and ability in interpreting, managing, and transforming existing knowledge into capabilities useful for developing innovation (Darroch, 2005; Guzman and Wilson, 2005; Petruzelli et al., 2010;
Roth, 2003). External knowledge relies either on external collaboration with other firms, universities, and research centers (in the form of R&D partnerships, mergers and acquisitions, alliances, and licensing) or on co-creation processes developed with customers (Galati and Bigliardi, 2019; Santoro et al., 2018; Scuotto et al., 2017a).

Although several studies have pointed out the relevance from a firm’s perspective of deploying both the internal and the external knowledge mechanisms, little research has investigated the role that individual characteristics and behaviors play in transforming knowledge into innovation capabilities. Since individual employees are still the main holders of knowledge (Andreeva and Kianto, 2012; Ordóñez de Pablos, 2004), this study adopts a microfoundational perspective to investigate their contribution to the innovativeness of firms.

2.1. Individual characteristics for innovation

Previous studies (Sok and O’Cass, 2015) have demonstrated that, in order to enhance firms’ ability to provide markets with innovative products or services and achieve superior financial performance, managers have to foster their employees to reach high levels of creativity and attention to detail. Given the critical role of individuals in innovation development (Andreeva and Kianto, 2012; Ordóñez de Pablos, 2004) and in enhancing creativity through networking activities (Santoro et al., 2018), employees’ capacity to engage in attention to detail and creativity appears to be crucial to the development of new and innovative products or services.

With regard to individual attention to particulars, O’Reilly et al. (1991) argued that employees’ attention to detail, in terms of precision and accuracy, is an organizational value, since the ability to focus on detail contributes significantly to leveraging product quality, minimizing inaccuracies, and reducing uncontrolled variations in quality (Naveh and Erez, 2004). Although an emphasis on individuals’ attention to detail lends itself to a culture of accuracy, precision, and compliance with procedures, in today’s market environment customers have even higher expectations about their purchases and place greater value on details. Therefore, firms aiming to innovate their offer need to stimulate their employees so that, by paying attention to details and to product quality, they contribute to significant improvements in processes and outcomes. Hence, this study proposes:

H1. Individual attention to detail directly and positively affects a firm’s strategic innovation capabilities.

In order to leverage their innovation capabilities, firms not only have to focus on attention to detail but must also rely on their employees’ creativity as a means to improve and innovate their products and services (Naveh and Erez, 2004). Creativity, as individual-level construct, is the first stage of the innovation process (Oldham and Cummings, 1996) and can be seen as individuals’ inspiration, abilities, and talents that are useful for creating innovative ideas, products, or solutions (Manfredi Latilla et al., 2018). Creativity is a complex, multi-level, and continuously changing phenomenon that needs to be managed properly in order to maximize the benefits (Anderson et al., 2014). Achieving significant individual creativity levels within a firm can be difficult, and firms struggle to stimulate and harness their employees’ creativity. As employee creativity can substantially influence innovation and effectiveness (Nonaka, 1994; Shalley et al., 2004) and represents an important source of competitive advantage (Oldham and Cummings, 1996; Zhou and George, 2003), firms are willing to stimulate and leverage their employees’ creative behaviors. In fact, by stimulating individuals’ creativity, firms encourage and support their employees to develop innovative ideas and solutions, to define original ways of solving problems, and to perform creatively in general, making them collaborate to enhance the firm’s innovation capabilities. Therefore, this study posits:

H2. Individual creativity directly and positively affects a firm’s strategic innovation capabilities.

Previous studies suggest that firms’ innovation capabilities depend not only on their existing knowledge but also on their external relationships and networks. More specifically, innovation capabilities depend on a firm’s capacity to discover new sources of knowledge and to acquire knowledge from the external environment that may contribute to the creation of innovative products or services (Ferreras-Méndez et al., 2015). The willingness to invest in and search for external knowledge, often defined as open innovation, requires the establishment of relationships with several external actors and the management of information and resources that foster innovation processes (Chesbrough, 2012). However, such external knowledge is just one key resource that enables firms to achieve a competitive advantage. Since no firm has all the required technological resources internally (Teece, 1996), firms have to combine several resources and capabilities in order to obtain a sustainable competitive advantage (Teece et al., 1997). However, being connected with the external environment and activating different external collaborations to exchange information and support is not sufficient to improve firms’ performance. In order to leverage innovation capabilities and exploit external knowledge at its best, firms’ employees have to adopt open behaviors in searching for innovation (Lane et al., 2006).

Employee openness plays a crucial role in acquiring external knowledge and integrating it with a firm’s own competences in order to enhance the innovation process and, consequently, the firm’s competitiveness (Papa et al., 2018). In other words, firms have to encourage their employees to scan the external environment actively to identify new ideas, technologies, and valuable knowledge that can help to satisfy customers’ wishes and requirements. Collaboration is not a natural individual behavior, but, if managed appropriately, it can contribute to better results (Carayannis et al., 2014); therefore, employees have to be encouraged to organize and take part in regular meetings (Stenius et al., 2015) and to cooperate with foreign colleagues, partners, and institutions. By these means, individuals obtain new knowledge that, in combination with knowledge they already owned, can help firms to cope with the dynamic environment, exploit commercial opportunities (Scuotto et al., 2017a), and, ultimately, increase their strategic innovation capabilities. Therefore, this study proposes:

H3. Individual openness directly and positively affects a firm’s strategic innovation capabilities.

2.2. Individual-level knowledge sharing behaviors

In the current environment, knowledge is the primary way to improve firm competitiveness and, consequently, a key resource for firms that compete globally (Del Giudice and Maggioni, 2014). However, only a part of the knowledge in a firm is controlled by the firm; the other part is internalized by the employees (Bhatt, 2002). Thus, sharing knowledge within a firm, especially among employees, appears to be a key element in competitiveness. The crucial role that knowledge sharing plays in supporting individuals to perceive market changes rapidly, recombine existing knowledge into new applications, and better understand evolving scenarios arises from research in cognitive psychology. Hence, knowledge sharing is acknowledged as a significant help for individuals in retaining information and creating new linkages and combinations with other information they already have in their minds, since these results can be better achieved if individuals are engaged in some processes of cognitive re-elaboration and re-formulation of information themselves (Slavin, 1996). Knowledge sharing at individual level is a voluntary behavior that relies mainly on personal motivation to share knowledge, individual’s opportunity to control over the process of sharing knowledge, individual’s ability to share knowledge and individual’s engagement in knowledge sharing activities (Radaelli et al., 2014). Previous studies have tried to better explain the
key elements underlying this personal behavior and their effects on individuals’ willingness to spread knowledge (Reinholt et al., 2011; Siemsen et al., 2008). In particular, to overcome the several issues related to the acquisition, the elaboration, and the dissemination of knowledge, individuals need to be strongly motivated. At the same time, the knowledge dissemination process requires much effort and, consequently, individuals have to own personal skills and to be employed in a context that stimulates and rewards their attitude to share knowledge with others. Finally, knowledge sharing behavior also requires the engagement of employees that have to be spurred to share their personal knowledge and experiences useful to improve their innovation capabilities.

However, employees are more likely to spread knowledge with their colleagues when motivated and, in this perspective, incentives have been found to be crucial in leading individuals to take part to an act that is somehow unnatural (Carayannis et al., 2014; Del Giudice and Maggioni, 2014). Being aware about the contribution of knowledge sharing to firms' innovativeness (Allameh, 2018), this research considers that firms are more likely to develop strategic innovation capabilities if they encourage knowledge sharing at all levels (de Almeida et al., 2016; Howell and Anansingh, 2013) and conveys that firms that are more inclined to share knowledge are also more innovation-prone (Lu et al., 2012). Several studies have attempted to demonstrate how individual motivation, control and individual ability to share information contribute to increase individuals’ knowledge sharing (Kiango et al., 2014; Reinholt et al., 2011; Siemsen et al., 2008). In particular, individual motivation has been identified as the most important knowledge sharing antecedent, since employees who have the opportunity to directly experience and evaluate the benefits descended from the sharing of the working experiences and knowledge with their colleagues are more likely to collaborate with other and, consequently, contribute to enhance their firms’ innovation capabilities. Therefore, this study states:

**H4.** Individual motivation directly and positively affects strategic innovation capabilities.

With regard to individual control, previous studies suggest that employees are more motivated in sharing their knowledge with their colleagues if they work in an open climate, where the management supports and encourages extra-role initiatives and proactive mentality (Chow and Chan, 2008; Siemsen et al., 2008) and has a positive approach towards those employees who come up with new ideas and solutions. Furthermore, also workload plays a significant role in regulating the contribution employees provide to firm strategic innovation capabilities (Taylor and Greve, 2006). Individuals operating in working environments with a fair workload pressure have fewer difficulties in sharing and transferring their knowledge effectively, are more likely to consider the knowledge they handle, and have time to develop new ideas and manage their implementation. Lower workload environments allow employees to engage with their colleagues in order to share and elaborate their ideas, reflect on external stimuli and opportunities, and cooperate to devise original and innovative solutions. Therefore, this study posits:

**H5.** Individual control directly and positively affects a firm’s strategic innovation capabilities.

Individual ability to share knowledge is another crucial aspect in understanding individual knowledge sharing behaviors. Employees who have more opportunities to exchange information and experiences with their colleagues can share their knowledge with each other and are more likely to elaborate new ideas and solutions. Employees who are inclined to disclose their knowledge to colleagues and partners activate a process of cognitive restructuring of their retained knowledge (Radaelli et al., 2014) that contributes to better exploitation of that knowledge and supports its mobilization for purposes of innovation. Furthermore, by sharing their knowledge, employees do not simply allow their colleagues to access these information, but they also activate a process that allows to combine and translate them into a form that is clear to the recipients (Hansen et al., 2005). By disclosing their knowledge, employees could also transfer tacit knowledge that, even if it cannot be easily spread to peers due to its own nature, it contributes to leverage the overall knowledge internalized by the firm (Bhatt, 2002) and it has an effective impact on firms' performance (Manfredi Latilla et al., 2018). Through knowledge sharing employees have the opportunity to gain new information and acquire competences that could be useful to explore the external environment and develop new ideas (Carayannis et al., 2017). Previous studies (Mura et al., 2013) highlight a positive effect of knowledge sharing behaviors in affecting employees' innovativeness, both in terms of propensity and capacity to promote new ideas and of application of these ideas to create new products or services. Therefore, this study proposes:

**H6.** Individual ability directly and positively affects a firm’s strategic innovation capabilities.

Finally, individual engagement is assumed to contribute to the development of strategic innovation capabilities. In order to support a firm in developing these capabilities, it is crucial that employees regard their contribution as worth the effort and perceive that some new value will be created thanks to their willingness to share their knowledge with colleagues (Nahapiet and Ghoshal, 1998). Previous studies (Wasko and Faraj, 2005) suggest that knowledge sharing within a firm is facilitated when employees are motivated to engage in its exchange, especially if they have the perception that contributing to knowledge sharing could leverage their reputation and status among colleagues and the management. When employees are engaged in disclosing their knowledge, they tend to engage in informal meetings with their colleagues in order to share their experiences and opinions. Additionally, when individuals have instruments that enable easy communication, they are more inclined to spread their knowledge (Razmerita et al., 2016) and are motivated to respond quickly to colleagues’ requests to share knowledge and ideas (Wasko and Faraj, 2005). By sharing and collaborating with other members of the firm, engaged employees contribute actively to the enhancement of the knowledge owned by the firm and play a crucial role in fostering its innovation capabilities (Papa et al., 2018). Drawing from these arguments, this study hypothesizes:

**H7.** Individual engagement directly and positively affects a firm’s strategic innovation capabilities.

3. Methodology

From the literature review, seven constructs were identified and analyzed in relation to strategic innovation capabilities: three constructs referring to individual characteristics for innovation and four constructs referring to individual-level knowledge sharing behaviors. Fig. 1 portrays the relationship of each of these microfoundations to strategic innovation capabilities.

The hypothesized relationships were tested by means of structural equation modeling (SEM), a combination of multiple regression and factor analysis that allows the estimation of the net influence of each independent variable on the dependent variable (Woodsides, 2013). The aim was to assess whether and how the seven microfoundations – individual attention to detail, creativity, openness, motivation, control, ability, and engagement – have a positive effect on firm-level strategic innovation capabilities.

3.1. Research setting

In today's markets, with increasing level of global competition and shorter product life cycles (Sok and O' Cass, 2015), cross-border R&D partnerships (agreements through which firms pool specific skills, capabilities, and resources in order to develop innovations) seem to
represent the key to success, competitive advantage, enhanced profit, and survival (Del Giudice et al., 2018; Santoro et al., 2018; Vrontis et al., 2017). For this reason and to successfully address the research aim, the study investigates a cross-border R&D partnership. Two features make the selected partnership particularly appropriate for the purposes of this study. First, the partnership was created in 2014 by the most important independent energy producer operating in Italy; it currently includes 11 firms/research centers with a total of 1100 R&D employees, researchers, and experts, and acts as a global hub for energy and technology innovation. Second, the partnership represents a milestone in innovation development, since it develops and fosters its strategic innovation capabilities continuously in order to enhance its economic-financial performance and sustain its competitive position. Therefore, this-border R&D partnership provides a suitable research setting, since it represents a unique and rich case for analyzing the microfoundations of firm-level strategic innovation capabilities.

### 3.2. Sample and data collection

The 1100 R&D employees, researchers, and experts involved in the study were identified thanks to the collaboration of senior management at the R&D partnership, who provided a list of the e-mail contacts of managers and employees involved in the partnership. Data were collected from July 2018 to September 2018 through two online questionnaire-based surveys, one administered to a sample of employees working in cross-border R&D partnership innovation projects (1021 out of 1100) and the other to managers who were in charge of at least one innovation project within one firm/research center in the international R&D network (79 out of 1100). The choice of these sample pools is consistent with the aim of the research and confirms the appropriateness of the research setting, since both the innovation employees and the general managers were well placed to answer questions about individual-level characteristics and behaviors, and strategic innovation capabilities, respectively. In particular, the dependent variable, strategic innovation capabilities, was defined on the basis of responses from the innovation project general manager; the independent variables, namely the microfoundations of innovation capabilities identified in this study, were operationalized on the basis of responses from employees working on the cross-border R&D partnership innovation projects.

In order to enhance the validity of the empirical research, for each respective firm/research center, the business director acted as the main contact person and as the person who identified potential respondents (people with the knowledge and experience necessary to answer questions related to the study). Both questionnaires were in English. At the end of the data collection period, 287 valid responses had been collected, resulting in an adequate response rate of 26.1% (Ilieva et al., 2002).

As shown in Table 1, the largest group of participants (35.2%) had worked in firms/research centers belonging to the cross-border R&D partnership for about three to four years, followed by those who had worked there for one to two years (23.3%), five to seven years (19.9%), > 7 years (15.0%), and less than a year (6.6%). The majority of respondents (60.3%) operated within R&D teams that consisted of up to ten people. Most respondents (62.9%) were male and aged between 30 and 50 (68.6%).

### 3.3. Measures

The constructs of interest of this study were individual attention to detail, individual creativity, and individual openness (for individual characteristics for innovation) and individual motivation, individual control, individual ability, and individual engagement (for individual-level knowledge sharing behaviors); the outcome was strategic innovation capabilities. In order to ensure the validity of the study’s constructs, scale items were taken from validated measures used in previous studies and adapted to suit the research context (see Appendix 1 for all items and for the relevant literature on which each scale was based). Each item was measured on a seven-point Likert scale (1 – Strongly disagree and 7 – Strongly agree).

The measurements for the individual attention to detail and individual creativity constructs were adopted from Sok and O’Cass (2015) and Miron et al. (2004). These two scales consist of three items each. The measurement scale for individual openness was borrowed from the studies of Ferreras-Méndez et al. (2015), Arbussà and Coenders (2007), and Jansen et al. (2005) and was measured using five items. The measurements for individual motivation, control, ability, and engagement were adapted from Radaelli et al. (2014), Bock et al. (2005), Armitage and Conner (1999), and Wasko and Faraj (2005). Each of these measurement scales consists of four items. Finally, the strategic innovation capabilities construct was measured using five items drawn

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<th>Table 1: Sample characteristics.</th>
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<td><strong>Percentage</strong></td>
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<td>Work experience within the R&amp;D partnership innovation projects</td>
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[Fig. 1. Conceptual model.]
from the studies of Camisón and Villar-López (2014) and Donate et al. (2016).

4. Results

4.1. Measurement model

The measurement model was assessed using SPSS and LISREL 8.80. Items for each construct were evaluated using Cronbach’s alpha values and confirmatory factor analysis (CFA) to test the reliability, convergent validity, and discriminant validity of each construct (Anderson and Gerbing, 1988; Jöreskog and Sörbom, 2005). As shown in Table 2, all the constructs had Cronbach’s alpha values > 0.70, indicating a high degree of reliability for each construct (Bagozzi and Yi, 1988; Nunnally and Bernstein, 1994). Moreover, all item loadings surpassed the recommended threshold of 0.50 (Hair et al., 2013), and the composite reliability (CR) for all seven latent constructs was > 0.70 (Bagozzi and Yi, 1988; Nunnally and Bernstein, 1994). All the average variance extracted (AVE) values were > 0.50 (except for one variable, individual motivation, which had an AVE of 0.444), which suggests an acceptable degree of convergent validity (Fornell and Larcker, 1981). Finally, since the AVE values for each construct exceeded the square of the correlations between pairwise matched factors, the requirements of discriminant validity are fulfilled. Therefore, the measures for each construct satisfied the requirements of construct reliability and validity, both convergent and discriminant. Table 2 shows the reliability and CFA results, and Table 3 gives the correlation matrix of the constructs.

4.2. Structural model

The research model was tested using the SEM method and LISREL 8.80 statistical software. According to well-established fit criteria, the structural model fit indices provide indications of the goodness of fit of the estimated model: $\chi^2 / df = 2.128$; root mean square error of approximation 0.063; comparative fit index 0.975; and standardized RMR (SRMR) 0.056. All items loaded significantly onto their assigned latent constructs. The results of the SEM analysis are shown in Table 4.

The estimations of the structural relationships support five out of the seven hypothesized relationships. The results indicate that individual attention to detail and individual creativity significantly and positively affect strategic innovation capabilities (respectively, $\gamma = 0.147$, $t = 2.370$, $p < 0.05$; $\gamma = 0.184$, $t = 2.745$, $p < 0.01$), supporting H1 and H2. Further, there is a significant and positive relationship between individual motivation and strategic innovation capabilities ($\gamma = 0.272$, $t = 4.185$, $p < 0.01$), supporting H4. The results also provide support for both H6 and H7, showing a positive and significant effect of individual ability and individual engagement on strategic innovation capabilities (respectively, $\gamma = 0.145$, $t = 1.978$, $p < 0.05$; $\gamma = 0.210$, $t = 3.228$, $p < 0.01$). The findings suggest that individual openness and individual control do not directly affect strategic innovation capabilities (respectively, $\gamma = 0.057$, $t = 1.223$; $\gamma = 0.075$, $t = 1.270$), and thus H3 and H5 are rejected. Finally, the structural model explains 65.9% of the variance in strategic innovation capabilities ($R^2 = 0.659$) (Fig. 2).

5. Discussion of the results

Global competition and the increasingly dynamic business environment have transformed the ways in which firms develop and introduce innovations. Firms have progressively adopted collaborative and open approaches, building efficient and durable relationships within their ecosystem, especially through R&D partnerships, to co-create and develop new and potentially useful products/services or processes, thereby enhancing their performance and growth (Scuotto et al., 2017a; Zacher and Rosing, 2015). In this context, innovation has been identified as one of the key drivers of competitive advantage and innovation capabilities, and as one of the key explanatory variables for differences between firms in behavior and outcomes (Parida et al., 2015; Urbancova, 2013).

Today, firms tend to rely on the combination of internal and external sources of knowledge (such as other firms, universities, research centers) to enhance their innovation capabilities and foster their competitiveness on the market. More in detail, R&D partnerships are gaining a central role in the innovation development process because they allow partnering firms to share knowledge internally generated and, at the same time, acquire information and experiences from the external environment (Bican et al., 2017; Romano et al., 2014).

From a microfoundational perspective, it becomes crucial to investigate how individuals contribute to the new knowledge creation paradigm and, in turn, foster firms’ innovation capabilities. Employees are those actors that are strictly involved in the generation, promotion, and application of innovative ideas (Radaelli et al., 2014).

The present study extends the strategic management literature by empirically investigating seven microfoundations of firm-level strategic innovation capabilities and by adopting a cross-border R&D partnership as the research setting. Thus, this study addresses a research gap by examining innovation capabilities from the microfoundational perspective that has been underestimated in previous studies (Felin et al., 2012; Sok and O’Cass, 2015; West and Bogers, 2017).

A conceptual model that integrates two individual-level categories of conditions and behavior (the individual characteristics for innovation and the individual-level knowledge sharing behaviors) has been proposed and tested empirically by investigating 287 R&D employees

### Table 2
Reliability and CFA results.

<table>
<thead>
<tr>
<th>Construct</th>
<th>CR</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual attention to detail</td>
<td>0.893</td>
<td>0.748</td>
</tr>
<tr>
<td>Individual creativity</td>
<td>0.875</td>
<td>0.713</td>
</tr>
<tr>
<td>Individual openness</td>
<td>0.975</td>
<td>0.886</td>
</tr>
<tr>
<td>Individual motivation</td>
<td>0.729</td>
<td>0.444</td>
</tr>
<tr>
<td>Individual control</td>
<td>0.908</td>
<td>0.716</td>
</tr>
<tr>
<td>Individual ability</td>
<td>0.852</td>
<td>0.602</td>
</tr>
<tr>
<td>Individual engagement</td>
<td>0.824</td>
<td>0.569</td>
</tr>
<tr>
<td>Strategic innovation capabilities</td>
<td>0.888</td>
<td>0.675</td>
</tr>
</tbody>
</table>

### Table 3
Correlation matrix.

<table>
<thead>
<tr>
<th>Construct</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual attention to detail</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual creativity</td>
<td>0.510</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual openness</td>
<td>0.299</td>
<td>0.228</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual motivation</td>
<td>0.359</td>
<td>0.509</td>
<td>0.193</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual control</td>
<td>0.416</td>
<td>0.545</td>
<td>0.234</td>
<td>0.449</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual ability</td>
<td>0.620</td>
<td>0.609</td>
<td>0.350</td>
<td>0.409</td>
<td>0.528</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual engagement</td>
<td>0.543</td>
<td>0.510</td>
<td>0.361</td>
<td>0.426</td>
<td>0.489</td>
<td>0.552</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Strategic innovation capabilities</td>
<td>0.591</td>
<td>0.647</td>
<td>0.339</td>
<td>0.612</td>
<td>0.551</td>
<td>0.635</td>
<td>0.637</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Table 4
Structural relationships and hypothesis testing.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Path</th>
<th>Completely std. $\gamma$</th>
<th>t value</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 (+)</td>
<td>Individual attention to detail $\rightarrow$ Strategic innovation capabilities</td>
<td>0.147</td>
<td>2.370</td>
<td>Supported</td>
</tr>
<tr>
<td>H2 (+)</td>
<td>Individual creativity $\rightarrow$ Strategic innovation capabilities</td>
<td>0.184</td>
<td>2.745*</td>
<td>Supported</td>
</tr>
<tr>
<td>H3 (+)</td>
<td>Individual openness $\rightarrow$ Strategic innovation capabilities</td>
<td>0.057</td>
<td>1.223</td>
<td>Not supported</td>
</tr>
<tr>
<td>H4 (+)</td>
<td>Individual motivation $\rightarrow$ Strategic innovation capabilities</td>
<td>0.272</td>
<td>4.185**</td>
<td>Supported</td>
</tr>
<tr>
<td>H5 (+)</td>
<td>Individual control $\rightarrow$ Strategic innovation capabilities</td>
<td>0.075</td>
<td>1.270</td>
<td>Not supported</td>
</tr>
<tr>
<td>H6 (+)</td>
<td>Individual ability $\rightarrow$ Strategic innovation capabilities</td>
<td>0.145</td>
<td>1.978</td>
<td>Supported</td>
</tr>
<tr>
<td>H7 (+)</td>
<td>Individual engagement $\rightarrow$ Strategic innovation capabilities</td>
<td>0.210</td>
<td>3.228**</td>
<td>Supported</td>
</tr>
</tbody>
</table>

*$p < 0.05$.

**$p < 0.01$.

and managers operating within a cross-border R&D partnership. The SEM evidence of this paper provides support for five of the seven hypothesized causal relationships and reveals two key results.

With regard to the individual characteristics for innovation, and in line with the extant literature (Manfredi Latilla et al., 2018; Miron et al., 2004; Sok and O'Cass, 2015), the findings reveal that individual attention to detail and individual creativity exert significant positive effects on strategic innovation capabilities. These two individual characteristics are crucial in the initial stages of the innovation process, since individuals' accuracy, abilities, and talents play a significant role in the generation of new ideas and, thus, in the enhancement of firms' innovativeness. Thus, since individuals' attention to detail and creativity foster employees' predisposition to solve problems, perform tasks precisely, do their jobs in an original way, high level of these two individual characteristics improve firms' strategic innovation capabilities. Perhaps surprisingly, individual openness appears not to be significant, suggesting that this individual characteristic might be a prerequisite of the individual skillset and ability rather than something that adds to the enhancement of strategic innovation capabilities (Salter et al., 2015).

With regard to individual-level knowledge sharing behaviors, the results emphasize and confirm the important roles played by individual motivation, engagement, and the ability to integrate internal and external knowledge and share it within the network in the development of strategic innovation capabilities. The results show the significant positive effects of these microfoundations on the outcome of strategic innovation capabilities. The microfoundational lens adopted by this study highlights the contribution made by employees' skills, experience, ability, and capacity to use and share knowledge to the development of strategic capabilities and, consequently, to the enhancement of firms' innovativeness (Darroch, 2005; Guzman and Wilson, 2005; Petruzzelli et al., 2010; Roth, 2003). Findings suggest that individual motivation and engagement are the most important antecedents of strategic innovation capabilities, suggesting that motivated and engaged employees are more likely to actively share knowledge, overcome issues and, in turn, contribute to firm performance (Radaelli et al., 2014).

However, the individual's control over knowledge sharing appears not to have any effect on strategic innovation capabilities. This result is probably due to the fact that the individual control construct, being a function of organizational climate and workload, might differ from firm/research center to firm/research center (and from country to country), even within the same cross-border R&D partnership. Knowledge sharing behavior is a complex process that becomes even more challenging within cross-border partnerships because of the geographical and cultural distances involved (Jiménez-Jiménez et al., 2014); thus, the individual's control might suffer, especially when there is a requirement to collaborate with several R&D teams.

6. Conclusions

This study sheds new light on the relationship between individual characteristics and knowledge sharing behavior on strategic innovation capabilities by adopting a microfoundational perspective. The study surveyed R&D employees and managers within the peculiar R&D partnership context and results provide useful insights, both theoretically and practically.

6.1. Theoretical contributions

This study's findings contribute to the growing interest of both academics and marketers in the lower-level origins and creation, development, and management of firm-level capabilities. By adopting a microfoundations perspective and investigating firms' resource and capabilities empirically from an individual-level perspective, this study enriches the body of knowledge in the strategic management field.

The results of this research generate two major theoretical contributions. First, the study extends current knowledge about firms' routines and capabilities by empirically assessing the direct effects of seven microfoundations of strategic innovation capabilities (from the two individual-level categories of personal conditions and knowledge sharing behaviors) within a cross-border R&D partnership. Specifically, the present research answers the call for individual-level investigation by breaking down firms' strategic innovation capabilities into their microfoundations (Felin et al., 2012; Lowik et al., 2017; Sok and O'Cass, 2015; West and Bogers, 2017). By conceptualizing individual attention to detail, creativity, and openness as individuals' characteristics for innovation, and individual motivation, control, ability, and engagement.
as individual-level knowledge sharing behaviors, the study demonstrates that these microfoundations, especially individual motivation, engagement and creativity, are strategic sources for firms aiming to foster their ability to project and develop innovations that could have commercial potential in the contemporary marketplace. Unlike most previous research, which adopts a firm-level perspective and uses a qualitative approach (Del Giudice et al., 2017; Felin et al., 2012; Lowik et al., 2016), this study offers a quantitative analysis of whether and how the seven micro-level antecedents of innovation capabilities affect the macro-level outcome.

Second, the study’s results extend current knowledge in the management field by highlighting the importance of individual-level knowledge sharing behaviors and by reinforcing the line of research that argues that knowledge sharing is positively associated with innovation capabilities (Paruchuri and Eisenman, 2012; Radaelli et al., 2014; Schneckenberg et al., 2015; Scuotto et al., 2017a). Empirical evidence reveals the crucial role played by individual motivation in the effective and frequent sharing of knowledge within a cross-border R&D network, and the importance of individual engagement in knowledge sharing activities in positively influencing firm-level strategic innovation capabilities. At the individual level, knowledge sharing behaviors can contribute effectively to the enhancement of strategic innovation capabilities, since knowledge sharing allows individuals to transform and exploit internal and external knowledge within the R&D networks they belong to and, consequently, to foster innovation generation and development (Darroch, 2005; Guzman and Wilson, 2005; Petruzzelli et al., 2010; Roth, 2003). Within a cross-border R&D partnership, motivation and engagement in acquiring, integrating, and disseminating knowledge can be understood as crucial enablers and as key microfoundations of firm-level strategic innovation capabilities, and this suggests that individuals and their knowledge sharing behaviors are crucial for innovation (Andreeva and Kianto, 2012; Ordóñez de Pablos, 2004). Thus, this study’s findings contribute to a better understanding of knowledge management by emphasizing the strategic importance of knowledge sharing as a crucial mechanism for acquiring and exploring external knowledge, integrating internal knowledge with external knowledge, sharing information and ideas, and, consequently, allowing the creation, development, and management of firm-level innovation capabilities (Bresciani et al., 2018; Schack, 2004; Soto-Acosta and Cegarra-Navarro, 2016).

6.2. Managerial implications

From a practical perspective, the study has interesting managerial implications. Its results are useful for understanding the key explanatory variables that contribute to improve strategic innovation capabilities in the context of a cross-border R&D partnership. The microfoundational approach makes marketers aware that not all individual traits and behaviors affect a firm’s innovativeness in the same way. In fact, to foster a firm’s innovation capabilities, managers should pay greater attention to employee training and rewards by adopting new programs that encourage the development and improvement of attention to detail and creativity. By adopting human resources policies that make use of performance-related rewards, training, and learning, managers have the opportunity to enhance knowledge management practices effectively and, consequently, to improve innovation performance. Furthermore, managers should take steps to hire and retain employees who are interested in producing high-quality products and who have skills for enhancing product functionality, as well as employees who are able to scan the external environment for new ideas and opportunities for collaboration.

In light of the study’s results, firms should motivate and engage employees strictly involved in innovation projects oriented to the elaboration, integration, and dissemination of knowledge within the R&D network in order to enhance their innovation capabilities and, consequently, increase the overall performance of the R&D partnership. Since individual motivation and engagement play a key role in fostering knowledge sharing and firms’ strategic innovation capabilities, managers should adopt new approaches for promoting collaboration among employees and improving their working experiences. From this perspective, managers should support employees to take part in formal and informal meetings with their colleagues.

Finally, managers should stimulate knowledge sharing, especially through clear and structured knowledge sharing processes and information and communication technologies (ICT), and they should design initiatives to engage their employees and make them aware of the importance of knowledge sharing behaviors as a primary enabler of strategic innovation capabilities.

6.3. Limitations and future research directions

The present study has some limitations that suggest directions for future research. First, although the employees and managers who participated in this study belong to different firms/research centers, they were all operating within the same R&D partnership; consequently, the single research setting might reduce and limit the generalizability of the results. Future research might explore different cross-border R&D partnerships involving firms operating in sectors of activity other than energy production.

Second, the study is limited by its focus on a cross-border R&D partnership, as the collaborative form adopted by the firms/research centers under investigation may suffer from specific and systemic conditions. Future research should involve different forms of open innovation collaboration, such as mergers and acquisitions, alliances, or licensing.

Third, the use of SEM may constrain the study’s results, because this methodology highlights only the net effect of each variable on the investigated outcome and does not show their synergistic effects. This limitation could be overcome in future research by adopting different methodologies, both quantitative and qualitative.

The final limitation is that firms’ strategic innovation capabilities depend on a set of factors broader than those examined in this research, including factors that are external to firms and unrelated to employee characteristics. Future research should take into account a firm’s interactions with the external environment and with stakeholders other than employees in order to investigate whether and how these interactions contribute to the firm’s strategic innovation capabilities.

Appendix 1. Scale items

Individual attention to detail (adapted from Sok and O’Cass, 2015; Miron et al., 2004)
In general, I
am thorough when solving problems.
perform the tasks precisely over a long time.
am good in tasks that require dealing with details.

Individual creativity (adapted from Sok and O’Cass, 2015; Miron et al., 2004)
In general, I
have a lot of creative ideas.
prefer tasks that enable me to think creatively.
like to do things in an original way.
Individual openness (adapted from Ferreras-Méndez et al., 2015; Arbuss and Coenders, 2007; Jansen et al., 2005)

I frequently scan the environment for new technologies.
I thoroughly observe technological trends.
I observe in detail external sources of new technologies.
I periodically organize special meetings with external partners to acquire new technologies.
I regularly approach external institutions to acquire knowledge.

Individual motivation (adapted from Radelli et al., 2014; Bock et al., 2005)

I intend to frequently share my knowledge with my colleagues.
I will always give my knowledge to those who ask for it.
I will always try to give my knowledge to others in the most efficient way possible.
I intend to frequently share my working experiences with my colleagues.

Individual control (adapted from Radelli et al., 2014)

I can devote enough time to sharing my knowledge.
Due to my workload, I have difficulties in effectively sharing my knowledge. (R)
The climate in my organization allows me to share my knowledge easily.
The climate in my organization facilitates informal meetings where knowledge is shared.

Individual ability (adapted from Radelli et al., 2014; Armitage and Conner, 1999)

I am fully capable of sharing my knowledge with others.
If it depended only on me, I would exhaustively share my knowledge. (R)
I am fully capable of articulating my knowledge in written or spoken form.
I believe I am fully capable of sharing my knowledge at any time.

Individual engagement (adapted from Radelli et al., 2014; Wasko and Faraj, 2005)

I usually spend a lot of time sharing my knowledge with my colleagues.
During meetings, I am usually very active in sharing my knowledge with my colleagues.
I customarily engage in informal meetings with my colleagues in which I share my working experiences.
I am usually quick in responding to my colleagues’ requests to share my knowledge.

Strategic innovation capabilities (adapted from Camisón and Villar-López, 2014; Donate et al., 2016)

My firm/research center has developed new products in the last three years.
My firm/research center has developed innovations in manufacturing process in the last three years.
My firm/research center has developed products improvements in the last three years.
My firm/research center has developed innovations in marketing and methods in the last three years.

Respondents evaluated all the measurement items on seven-point scales ranging from 1 = Strongly disagree to 7 = Strongly agree.
R indicates reverse-scored items

References


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