Are Global R&D Partnerships enough to increase company's innovation performance? The role of search and integrative capacities.

Are Global R&D Partnerships enough to increase a company's innovation performance? The role of search and integrative capacities

Abstract

The number of global R&D partnerships has grown in recent times thanks to the wealth of cross-cultural knowledge and skills they provide to businesses, allowing firms to significantly differentiate their innovation processes and upgrade their innovation performance, compared to other businesses. But, in order to integrate and capitalize on external knowledge drawn through these international partnerships, companies also need to more effectively develop key internal capabilities. While the literature shows that absorptive capacity is critical in this process, only few studies successfully break up this concept into sub-capacities and analyze their specific impacts on firm's innovation performance, in particular in the specific and underdeveloped context of Global R&D Partnerships (GPs). This study addresses this research gap by empirically analyzing the interrelation between Global R&D Partnerships, search and integrative capacities, and innovation performance. We tested our hypotheses on a sample of 112 medium-sized Italian firms with established GPs, leveraging a Partial Least Square (PLS) Structural Equation Model (SEM). Our results suggest knowledge drawn from GPs play a vital role in the innovation processes of the analyzed firms, but only when combined with the development of both of the internal sub-capacities we investigated (namely, search and integrative capacities), thus, demonstrating an indirect effect. Also, search capacity was found to have a stronger effect compared to integrative capacity, while also affecting the integrative capacity of the firm in question. The implications from a managerial perspective are also provided in order to stimulate debate on international collaborations. We also provide additional empirical studies on this topic.

Keywords: innovative partnerships; global partnerships, innovation performance, integrative capacity; search capacity

1. Introduction

Firms are gradually opening up their innovation boundaries, increasing the exchange of knowledge between businesses (Poot et al., 2009; West and Bogers, 2014; Natalicchio et al., 2017), and facilitating an increasing number of collaborations and partnerships with external actors on a more frequent basis. As a result, Global R&D Partnerships have shifted from bringing a peripheral competitive advantage to these businesses, to providing a key relational asset that affects a company's wider innovation strategy (Duysters et al., 1999; Islam et al., 2018) by acquiring and exploiting multiple technological competences and distinct sets of

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Global R&D partnerships are typically agreements that aim to contribute to an overall innovation strategy, and require close cooperation with foreign partners (Narula and Martínez-Noya, 2015). As noted above, firms that successfully develop collaborative innovations with foreign partners benefit in a range of ways. Nevertheless, firms that want to effectively and fully achieve the full range of benefits from external sources have to build a strong set of internal capabilities in order to integrate these external knowledge resources into their innovation processes (West and Bogers, 2014). This is because foreign knowledge is often separate from the knowledge possessed by the focal company. This can be evaluated as "cognitive distance" in terms of the differences in technological knowledge between firms' employees and the external sources of knowledge (Nooteboom et al., 2007). A greater separation between the sender and the receiver of knowledge can foster innovation and create synergies and new opportunities but, at the same time, this may be a problem because firms need a different set of managerial capabilities to effectively codify this knowledge when attempting to successfully engage in GPs (Nooteboom et al., 2007; Del Giudice et al., 2012a; Del Giudice et al., 2012b). This means that firms that are active in the establishment of GPs also need to develop, extend and maintain "absorptive capacity" (Cohen and Levinthal, 1990; Nooteboom et al., 2007), which is the ability to scan the external environment and to integrate new external knowledge into their innovation processes (Santoro et al., 2018).

Similarly, Lin et al. (2012) proposed and empirically validated three indicators related to absorptive capacity, namely the proportion of R&D alliances within an alliance portfolio; technological distance and R&D intensity; and finding significant positive and moderating effects on the relationships between alliances on innovation performance.

Within the well-known and accepted concept of absorptive capacity, Ahn et al. (2016) distinguished between two sub-capacities that play an important but different role in this process, specifically the search and integrative sub-capacities. Search capacity refers to the ability to find potential external valuable sources of knowledge (Arbussa and Coenders 2007), allowing firms to better individuate suitable knowledge from broad external sources. In addition, companies require internal competencies that can identify the need for external collaboration, define references for GPs, accompany/complement GPs, and incorporate the results accordingly to their needs. These competencies are frequently considered to be systemic/holistic competencies, which require the ongoing revision of the company's own knowledge base. Due to the specific peculiarities of GPs and the different and heterogeneous domains they cover, the importance of these competencies is further compounded (Luo and Deng, 2009).

In contrast, integrative capacity refers to the ability to successfully integrate the relevant external knowledge identified previously into the innovation process, which aids the analysis of any external knowledge and transforms it into new knowledge (Chesbrough et al. 2006). This is an important issue because firms that establish relationships with foreign partners need to convert different and distinct knowledge sets into ideas

that are valuable to their own business. Furthermore, when it comes to GPs, firms need to possess a high level of integrative capacity to better incorporate and transform potentially valuable knowledge from external sources to integrate this into codified knowledge, new ideas or innovations.

Overall, following Fishbein and Ajzen (1975) and their general "theory of reasoned action", a firm that has already set up a positive mindset towards open innovation and external knowledge sourcing is more likely to develop superior search and integrative capacities. As a result, we postulate this second, two-part, hypothesis:

Hypothesis 2a: The propensity in engaging in Global R&D Partnerships is positively associated with search capacity.

Hypothesis 2b: The propensity in engaging in Global R&D Partnerships is positively associated with integrative capacity.

According to West and Bogers (2014), firms that want to innovate with help from external sources proceed using two steps: 1) finding external sources of innovation; 2) acquiring and properly leveraging external knowledge in their innovation processes.

Search and integrative capacities help companies incrementally increase their knowledge base and better exploit external resources through GPs, consequently improving their innovative outcomes (Berchicci 2013; Ahn et al., 2015). The enlargement of these capabilities increases these firms' ability to access, absorb, and assimilate the innovation-relevant knowledge contained in external organizations (Ferraris et al., 2017a). Thus, a company improves its ability in recombining external knowledge resources with its internal resources (Messeni Petruzzelli and Savino, 2014) and it is more capable in sourcing external knowledge, resulting in better innovation outcomes (Vrontis et al., 2017). We then propose the following, two-part hypothesis:

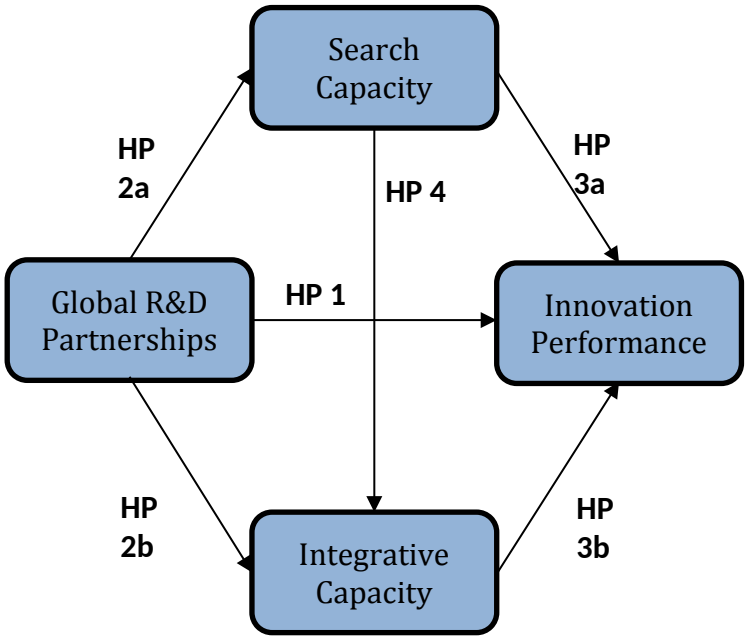
Hypothesis 3a: Search capacity positively contributes to a firm's innovation performance.

Hypothesis 3b: Integrative capacity positively contributes to a firm's innovation performance.

In the process of acquiring external knowledge from GPs, firms' capacities can be interrelated (West and Bogers, 2014; Ahn et al., 2016). The firms, after identifying (or searching for) the required external knowledge, have to match and recombine (integrate) this external knowledge with their internal knowledge base to produce a new shared knowledge repository that can be used for internal innovation. The effectiveness in this search for external ideas in the GPs may affect the firm's subsequent ability in integrating this external knowledge. Thus, we propose that search capacity influences the integrative capacity in our final hypothesis:

Hypothesis 4: Search capacity is positively associated with integrative capacity.

Figure 1 – The hypothesized model



In conclusion, our hypotheses are interrelated (Figure 1). Starting with the direct impact of GPs on innovation performance (HP1), we argue that there is an additional indirect impact via two channels. First, GPs correlate with companies' search capacities (HP2a) and, second, with their integrative capacity (HP2b). Integrative capacity also depends on search capacity (HP4). Finally, search capacity is closely related to innovation performance (HP3a) and, in a similar manner, to integrative capacity (HP3b).

3. Methodology

During our research, data was gathered from CEOs of medium-sized firms, all of which are based in Italy. Italy has been used previously as a valuable source for other innovation studies as well as for various fields of research for SMEs (e.g. Campanella et al., 2013; Vrontis et al., 2017). We decided to focus only on medium-sized firms because smaller companies in Italy have few resources to devote to these complex, risky, heterogeneous and unfamiliar partnerships. First, a total of 1,000 medium-sized firms were randomly selected from the Amadeus database, which is a European database that has been commonly used for similar studies (e.g. Bresciani and Ferraris, 2016; Ferraris et al., 2016b). In line with the European Commission's definitions (2009), we selected medium-sized firms with 50 to 250 employees. Second, an email with an

invitation to participate in the survey (along with an explanation of the study's purpose) was sent to all of the firms. In total, 289 firms expressed interest in taking part in the study (a response rate of 29%). Third, a questionnaire of 16 open and closed questions was sent to each firm. Consequently, 112 firms successfully answered and they represent the final sample for this study. They operate in several sectors, including the Food and Beverage, Handcraft, Engineering, Furniture and Construction industries.

Using a seven-point Likert scale, we asked the respondents to evaluate the propensity of the firm in making R&D partnerships outside of their home countries (Ahn et al., 2016 and similar studies). The questions posed included: a) the firm has a culture that encourages collaboration with external individuals or organizations outside its home country (GP1); b) the firm is willing to share its experiences through collaboration with stakeholders outside its home country (GP2); c) managers in the firm behave proactively to encourage collaboration with external individuals or organizations in foreign countries (GP3); d) the firm shows trustful behavior with external partners in foreign countries (GP4).

Search capacity was codified as the intensity of the firm's search for knowledge from many different external sources, which implies that the firm has to develop a high-level of search capacity (Laursen and Salter, 2006; Ahn et al., 2016). Based on Arbussa and Coenders (2007), respondents were asked to evaluate on a seven-point Likert scale to what extent information sources have been used over the last three years (the higher score, the higher importance) for: a) universities or higher education institutes (SC1); b) marketing channels, such as clients, customers and suppliers (SC2); c) specialized channels, such as technical standards and regulations (SC3); d) human networks, such as informal meetings between CEOs and CTOs (SC4); e) expert level information, such as patent or journal databases (SC5); f) general information media, such as trade fairs, conferences, the internet (SC6); g) other institutional channels, such as other organizations, public/private research institutes (SC7).

Based on Ahn et al. (2016), we measured *integrative capacity* by assessing to what extent respondents agreed with the following statements (the higher score, the higher agreement) on a seven-point Likert scale: a) over the last three years, the information/technology adapted from external sources has played an important role in developing products or improving processes (IC1); b) over the last three years, the information/technology adapted from external partners has been widely used for product development or process improvements (IC2).

We built the *innovation performance* construct on two previous and relevant studies (Berchicci, 2013; Aloini et al., 2015), asking respondents to evaluate to what extent they agreed with the following statements on a seven-point Likert scale (where the higher score, the higher agreement). For three years, compared to the average competitor in the same industry, the firm has successfully achieved a rise in: a) new products introduced to the market (IP1); b) new services introduced (IP2); c) marketing innovations (IP3); d) organizational innovations (IP4).

In line with Ahn et al. (2016), we tested our hypotheses using the Partial Least Square (PLS) Structural Equation Model (SEM), which allows the description of unobservable latent variables. This approach has high flexibility when confronting the conceptual model with the data (Shah and Goldstein, 2006), it also enables the valuation of direct and indirect effects among variables. This technique is usually adopted when evaluating relationships among several latent factors (Zeng et al., 2010). More specifically, we adopted a PLS method, preferring it over the maximum likelihood (ML) approach (Sohn and Moon 2003) since ML exhibits weaknesses that PLS does not, including assumptions based on large sample sizes, interval scaling, and multivariate normality (Sohn and Moon 2003).

4. Results

Initial descriptive analysis of the questionnaire responses and correlations among the constructs are shown in Table 1 and Table 2.

Table 1 – Descriptive statistics

	Global R&D partnerships				Integrative capactity		Search capactity							Innovation performance			
DS/variables	GP1	GP2	GP3	GP4	IC1	IC2	SC1	SC2	SC3	SC4	SC5	SC6	SC7	IP1	IP2	IP3	IP4
min	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	2,00	1,00
max	6,00	7,00	7,00	6,00	7,00	6,00	7,00	7,00	7,00	7,00	6,00	7,00	6,00	7,00	7,00	7,00	7,00
mean	3,10	3,25	3,18	3,28	3,18	3,27	2,29	3,96	3,32	3,38	2,49	3,38	4,21	3,35	4,24	4,56	3,45
SD	1,29	1,41	1,62	1,98	1,42	1,25	1,32	1,58	1,41	1,53	1,24	1,34	1,83	1,33	1,39	1,41	1,26

Note: scale used: 1 – strongly disagree, 2 – disagree, 3 – somewhat disagree, 4 – neither agree or disagree, 5 – somewhat agree, 6 – agree, 7 – strongly agree.

Table 2 – Correlations among constructs

		GP	SC	IC	IP
GP	Pearson Correlation	1	,451**	,048	,368**
	Sign. (2 tails)		,000	,530	,000
	N	112	112	112	112
SC	Pearson Correlation	,451**	1	,088	,413**
	Sign. (2 tails)	,000		,493	,000
	N	112	112	112	112
IC	Pearson Correlation	,048	,088	1	,271*
	Sign. (2 tails)	,530	,493		,002
	N	112	112	112	112
IP	Pearson Correlation	,368**	,413**	,271*	1
	Sign. (2 tails)	,000	,000	,002	
	N	112	112	112	112

* Significant at 0,05 (two tails).

** Significant at 0,01 (two tails).

In order to test the relationships between each measurement variable and the respective latent factor, we conducted a Confirmatory Factor Analysis (CFA). In Appendix 1, Cronbach's alpha values for all latent factors are presented providing sufficient reliability for each construct. Applying the chosen statistical techniques (PLS structural equation model) to our data, we estimated the path coefficients for this research (Ahn et al., 2016), which can be seen in Table 3.

Table 3 – SEM results (direct and indirect effects)

Factor		**Factor**	**Direct**	**Indirect**	**Total**
Global R&D Partnerships	→	Innovation Performance	-	0,263	0,263
Global R&D Partnerships	→	Search Capacity	-	-	-
Global R&D Partnerships	→	Integrative Capacity	0,349	-	0,349
Search Capacity	→	Innovation Performance	0,866	0,462	1,328
Integrative Capacity	→	Innovation Performance	0,754	-	0,754
Search Capacity	→	Integrative Capacity	0,613	-	0,613

Note 1: The direct effect is the path coefficient, while the indirect effect is calculated by multiplying each path coefficient from one latent factor to a target factor. A total effect is the sum of the direct and indirect effect of each factor.

Note 2: Model fit statistics: χ^2=922.95, df=539, χ^2/df=1.712, TLI=0.906, CFI=0.914, RMSEA=0.049 (LO90=0.043; HI90=0.054), SRMR=0.548

Path coefficients are significant at a 1% level, except the path between search capacity and innovation performance is significant at 5%. However, there are two paths (between Global R&D Partnerships and innovation performance and search capacity, respectively) that are not significant. But Global R&D Partnerships positively affected integrative capacities directly and influenced innovation performance indirectly (via integrative capacity). Search and integrative capacities have direct effects on a firm's innovation performance and search capacity, which also has an indirect effect via the integrative capacity. This validates hypotheses three and four, and partially supports hypotheses one and two. Taking into account the effects of the different factors, we may individuate which factors have the stronger effect on a firm's innovation performance. GPs only had a direct effect on integrative capacity and an indirect effect on innovation performance. At the same time, integrative capacity had a direct influence on innovation performance but a weaker effect if compared with the direct effect of search capacity on the same construct, which also represents the strongest total effect on the innovation performance.

5. Discussing conclusion

Discussion

Despite the late development of firms' global R&D partnerships as a vehicle to acquire and leverage cross-border technological capabilities (Kim and Park 2010), available practical evidence suggests that they usually

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Appendix 1 – The Confirmatory Factor Analysis (CFA) results[1]

		First estimation		Second estimation	
Latent factors	**Measurement variables**	**Loading value**	**Alpha**	**Loading value**	**Alpha**
Global R&D partnerships	a) propensity of the firm in collaborations with external individuals or organisations	0,8750	0,792	0,754	0,870
	b) propensity of the firm in sharing experiences through collaborations	0,6954		0,7801	
	c) proactive behavior of managers for collaborations with externals individuals or organizations	0,6558		0,6213	
	d) trustful behavior of managers with regard to external partners	0,8145		0,8067	
Search capacity	a) importance of universities or higher education institutes	0,6975	0,823	0,5512	0,8452
	b) importance of marketing channels	0,7500		0,7965	
	c) importance of specialized channels	0,3456			
	d) importance of human networks	0,7511		0,7568	
	e) importance of expert level information or patent/journal data	0,5897		0,6103	
	f) importance of trade fairs, conferences and the internet	0,7239		0,7353	
	g) importance of other institutional channels, other organizations, public/private research institutes.	0,3991			
Integrative capacity	a) embedding knowledge from partnerships has a key role in the innovation process	0,9123	0,893	0,9234	0,911
	b) knowledge from partnerships has widely used for product development or process improvement.	0,9014		0,9074	
Innovation performance	a) increase in new products introduced in to the market	0,7238	0,815	0,7349	0,821
	b) increase in new services introduced	0,7213		0,7197	
	c) increase in marketing innovations	0,6851		0,6798	
	d) increase in organizational/ workplace innovations	0,7521		0,7753	

[1] Note: we performed the second estimation because some variables with low value (less than 0,5) were removed in order to increase the convergent validity.

Highlights

- Global R&D partnerships have grown recently thanks to the benefits of cross-cultural knowledge they provide to businesses;
- Search and integrative capacities improve the effectiveness of Global R&D partnerships in medium sized firms;
- In acquiring external knowledge from GPs, firms' capacities are interrelated and show different effects on innovation.

Are Global R&D Partnerships enough to increase a company's innovation performance? The role of search and integrative capacities

Abstract

The number of global R&D partnerships has grown in recent times thanks to the wealth of cross-cultural knowledge and skills they provide to businesses, allowing firms to significantly differentiate their innovation processes and upgrade their innovation performance, compared to other businesses. But, in order to integrate and capitalize on external knowledge drawn through these international partnerships, companies also need to more effectively develop key internal capabilities. While the literature shows that absorptive capacity is critical in this process, only few studies successfully break up this concept into sub-capacities and analyze their specific impacts on firm's innovation performance, in particular in the specific and underdeveloped context of Global R&D Partnerships (GPs). This study addresses this research gap by empirically analyzing the interrelation between Global R&D Partnerships, search and integrative capacities, and innovation performance. We tested our hypotheses on a sample of 112 medium-sized Italian firms with established GPs, leveraging a Partial Least Square (PLS) Structural Equation Model (SEM). Our results suggest knowledge drawn from GPs play a vital role in the innovation processes of the analyzed firms, but only when combined with the development of both of the internal sub-capacities we investigated (namely, search and integrative capacities), thus, demonstrating an indirect effect. Also, search capacity was found to have a stronger effect compared to integrative capacity, while also affecting the integrative capacity of the firm in question. The implications from a managerial perspective are also provided in order to stimulate debate on international collaborations. We also provide additional empirical studies on this topic.

Keywords: innovative partnerships; global partnerships, innovation performance, integrative capacity; search capacity

1. Introduction

Firms are gradually opening up their innovation boundaries, increasing the exchange of knowledge between businesses (Poot et al., 2009; West and Bogers, 2014; Natalicchio et al., 2017), and facilitating an increasing number of collaborations and partnerships with external actors on a more frequent basis. As a result, Global R&D Partnerships have shifted from bringing a peripheral competitive advantage to these businesses, to providing a key relational asset that affects a company's wider innovation strategy (Duysters et al., 1999; Islam et al., 2018) by acquiring and exploiting multiple technological competences and distinct sets of

knowledge (Carayannis et al., 2017; Papa et al., 2018). In fact, in the last few decades, a wider range of international cooperative agreements have been used for innovation activities, where knowledge and intangible assets increasingly form the basis of such deals (Narula and Martínez-Noya, 2015; Della Peruta et al., 2014). For example, in the pharmaceutical industry, Pfizer has established a novel range of R&D international partnerships to help the company enter the emerging markets and establish a strong position in these territories. Two famous examples include the joint venture with Zhejiang Hisun (a leading Chinese pharmaceutical company), which aims at providing high-quality and affordable branded generic medicines to patients in China, and the global alliance with American multinational pharmaceutical company Merck in Type 2 diabetes and immuno-oncology treatments.

Globalization has facilitated the adoption of external knowledge resources for companies to both improve their innovation performance and to reduce the associated costs and risks of carrying out such intensive knowledge-based activities (Hagedoorn, 1993; GIacosa et al., 2017). Narula (2004) proposed that large companies increasingly try to partner with SMEs to leverage the flexibility and innovative nature of these smaller businesses, and that the wider use of R&D partnerships also brings benefits to SMEs. In effect, practice and research revealed that global competition and technological change have motivated companies to look for external knowledge partners in order to develop different forms of inter-organizational alliances (Hagedoorn and Osborn, 2002; Lefebvre et al., 2015; Ferraris et al., 2017a).

In line with the Knowledge-Based View (KBV) of a firm, innovation and related knowledge creation activities involve a recombination process, which complements a company's internal knowledge base and where firms search for novel and distinct knowledge components (Grant, 1996; Mansell, 2002; Bos et al., 2017). The formation of partnerships can facilitate this recombination process, where global R&D partnerships (GPs) provide a novel and strategic tool for SMEs to scan, access and integrate knowledge that is external to the home country of said firm (Eng and Ozdemir, 2014; Rodríguez et al., 2018; Santoro et al., 2018).

The main research motivation of this paper arises from the fact that firms are facing an increasingly interdisciplinary approach to innovation, which makes it more difficult, risky and unpredictable to innovate. Moreover, many cross border partnerships failed because partners were poorly selected; the coordination and governance of alliances were badly managed; and due to the occurrence of unresolved cultural problems and differences (Lunnan and Haugland, 2008; Robson et al., 2012; Sandulli et al., 2017). These issues are compounded when we analyze SMEs and foreign partners under the constraints of limited financial, managerial and technological capabilities (Van de Vrande et al., 2009; Santoro et al., 2018). These issues force smaller companies to focus inwards and develop strong internal capabilities to access and integrate complementary resources and knowledge to better satisfy the needs of their customers. This, in turn, reduces costs, product innovation requirements and time-to-market (Martínez-Noya, García-Canal and Guillén, 2012; Ferraris et al., 2017b; Ferraris et al., 2018b).

According to mainstream studies, firms that want to successfully exploit external knowledge need to possess superior organizational capabilities (Freeze and Kulkarni, 2007; Pandey and Dutta, 2013), such as high level of absorptive capacity (Cohen and Levinthal, 1990), which can later be unbundled in search and integrative capacities (Ahn et al., 2016). As a result, a firm can scan the external environment for suitable knowledge sources and suitable partners, according to its innovation strategy (search capacity) and to assimilate external heterogeneous knowledge within its internal innovation process (integrative capacity).

Within the literature, while international collaborations have been studied in depth, more studies on global R&D partnerships, absorptive capacity and their effects on innovation are required (Herstad et al., 2014). In this context, there is still no consensus on the positive (see, for example, Ahuja and Katila, 2001) or the non-significant (see, for example, Weck and Blomquist, 2008) impacts of R&D partnerships on innovation performance, and this is probably due to the effect of a company's absorptive capacity (Lin et al., 2012). Moreover, only a few studies have broken this concept down into sub-capacities and analyzed the specific impacts on a firm's innovation performance, in particular in the specific and underdeveloped context of Global R&D Partnerships (GPs). This work addresses this research gap, performing one of the first quantitative studies on SMEs in this field of research.

Our work covers three major research streams. First, we suggest some implications that arise from the existing literature into global partnerships (Narula and Martínez-Noya, 2015), highlighting the links between the development of international R&D partnerships and outcomes for innovation. Second, we contribute to the literature on R&D alliances (e.g. Capaldo and Messeni Petruzzelli, 2011), with new empirical evidence covering the role of two sub-capacities, namely the search and integrative capacities, in the underdeveloped context of international R&D partnerships. Third, we contribute to the literature on internationalization and innovation in SMEs (e.g. Van de Vrande, 2009), where limited studies have been proposed to explain how, and thanks to which internal capabilities, SMEs may be able to internationalize their knowledge and innovation-related activities.

The article is organized as follows: the first section covers the existing literature along with the development of four hypotheses. The second section explains the methodology used for this research and the third section covers the results of the analysis. Finally, the latter sections highlight the implications of this study.

2. Literature background and hypotheses

2.1 Global R&D partnerships

Over the last few decades, multiple pieces of research have analyzed the different facets of actual international collaborations in different countries (e.g. Pandza, Wilkins, and Alfoldi 2011; Ahammad et al., 2016) including the innovation teamwork activities via traditional and virtual tools in several geographical

contexts (e.g. Schultze and Orlikowski 2010; O'Leary and Mortensen 2010; Huan et al., 2017), highlighting the academic interest in this prominent field of research (Rodríguez et al., 2018).

Global R&D partnerships usually avoid the replication of previous research investments, which enables firms, at the same time, to still exploit the countries' distinct knowledge sets, resulting in positive gains both for firms and societies (Bojanowski et al., 2012). Moreover, GPs allow the creation of R&D networks that are themselves a source of knowledge production (Fritz and Schiefer, 2009; Del Giudice and Maggioni, 2014; Bresciani, 2017) that facilitate multi-stakeholder innovation (Bresciani et al., 2018; Ferraris et al., 2018a; Shams et al., 2019). Through GPs, thus, companies not only achieve increased efficiency and flexibility in their operations, but also gain access to a unique set of capabilities and insights into specialized public and private organizations located in foreign countries (Graf and Mudambi, 2005; Narula and Martínez-Noya, 2015). This increased diversity of foreign partners opens up even greater opportunities for cross-fertilization and the non-overlapping knowledge when compared to domestic alliances (Colombo et al. 2009). This is because foreign organizations are rooted in innovative "milieu" that highlight important differences compared to the company's home country context (Colombo et al. 2009; Bresciani and Ferraris, 2016; Dezi et al., 2018). Moreover, Gulati (2007) argued that global R&D partnerships are an effective means to draw the resources and knowledge that reside in their foreign partners, and also enable the successful exploitation of their existing business networks (Colombo et al., 2009). This relevance and complexity of knowledge drawn from GPs highlighted also the attention of firms on "how" this knowledge is dynamically sourced, managed and exploited (Paarup Nielsen, 2006; Jøranli, 2018) and "through which" knowledge infrastructure and knowledge management capabilities (Freeze and Kulkarni, 2007; Pandey and Dutta, 2013) that affect performance (Lee et al., 2012). As a consequence, this diverse knowledge set and capabilities could be utilized to generate synergistic advances by recombining this information and experience with the host partners' internal knowledge base. Global R&D partnerships can thus provide complementary capabilities and enhance different knowledge bases and learning (Rodríguez et al., 2018). This may help SMEs with their new product developments (Eng and Ozdemir, 2014) and in improving their R&D partnership networks, which give firms access to an improved supply of knowledge and interconnected innovation outcome, while allowing them to overcome concerns about their nascent nature and smaller scale (Baum et al., 2000; Lavie, 2007).

We propose therefore to test the following first hypothesis:

Hypothesis 1: The propensity in engaging in Global R&D Partnerships is positively associated with innovation performance.

2.2 Internal capabilities related to Global R&D Partnerships

Global R&D partnerships are typically agreements that aim to contribute to an overall innovation strategy, and require close cooperation with foreign partners (Narula and Martínez-Noya, 2015). As noted above, firms that successfully develop collaborative innovations with foreign partners benefit in a range of ways. Nevertheless, firms that want to effectively and fully achieve the full range of benefits from external sources have to build a strong set of internal capabilities in order to integrate these external knowledge resources into their innovation processes (West and Bogers, 2014). This is because foreign knowledge is often separate from the knowledge possessed by the focal company. This can be evaluated as "cognitive distance" in terms of the differences in technological knowledge between firms' employees and the external sources of knowledge (Nooteboom et al., 2007). A greater separation between the sender and the receiver of knowledge can foster innovation and create synergies and new opportunities but, at the same time, this may be a problem because firms need a different set of managerial capabilities to effectively codify this knowledge when attempting to successfully engage in GPs (Nooteboom et al., 2007; Del Giudice et al., 2012a; Del Giudice et al., 2012b). This means that firms that are active in the establishment of GPs also need to develop, extend and maintain "absorptive capacity" (Cohen and Levinthal, 1990; Nooteboom et al., 2007), which is the ability to scan the external environment and to integrate new external knowledge into their innovation processes (Santoro et al., 2018).

Similarly, Lin et al. (2012) proposed and empirically validated three indicators related to absorptive capacity, namely the proportion of R&D alliances within an alliance portfolio; technological distance and R&D intensity; and finding significant positive and moderating effects on the relationships between alliances on innovation performance.

Within the well-known and accepted concept of absorptive capacity, Ahn et al. (2016) distinguished between two sub-capacities that play an important but different role in this process, specifically the search and integrative sub-capacities. Search capacity refers to the ability to find potential external valuable sources of knowledge (Arbussa and Coenders 2007), allowing firms to better individuate suitable knowledge from broad external sources. In addition, companies require internal competencies that can identify the need for external collaboration, define references for GPs, accompany/complement GPs, and incorporate the results accordingly to their needs. These competencies are frequently considered to be systemic/holistic competencies, which require the ongoing revision of the company's own knowledge base. Due to the specific peculiarities of GPs and the different and heterogeneous domains they cover, the importance of these competencies is further compounded (Luo and Deng, 2009).

In contrast, integrative capacity refers to the ability to successfully integrate the relevant external knowledge identified previously into the innovation process, which aids the analysis of any external knowledge and transforms it into new knowledge (Chesbrough et al. 2006). This is an important issue because firms that establish relationships with foreign partners need to convert different and distinct knowledge sets into ideas

that are valuable to their own business. Furthermore, when it comes to GPs, firms need to possess a high level of integrative capacity to better incorporate and transform potentially valuable knowledge from external sources to integrate this into codified knowledge, new ideas or innovations.

Overall, following Fishbein and Ajzen (1975) and their general "theory of reasoned action", a firm that has already set up a positive mindset towards open innovation and external knowledge sourcing is more likely to develop superior search and integrative capacities. As a result, we postulate this second, two-part, hypothesis:

Hypothesis 2a: The propensity in engaging in Global R&D Partnerships is positively associated with search capacity.

Hypothesis 2b: The propensity in engaging in Global R&D Partnerships is positively associated with integrative capacity.

According to West and Bogers (2014), firms that want to innovate with help from external sources proceed using two steps: 1) finding external sources of innovation; 2) acquiring and properly leveraging external knowledge in their innovation processes.

Search and integrative capacities help companies incrementally increase their knowledge base and better exploit external resources through GPs, consequently improving their innovative outcomes (Berchicci 2013; Ahn et al., 2015). The enlargement of these capabilities increases these firms' ability to access, absorb, and assimilate the innovation-relevant knowledge contained in external organizations (Ferraris et al., 2017a). Thus, a company improves its ability in recombining external knowledge resources with its internal resources (Messeni Petruzzelli and Savino, 2014) and it is more capable in sourcing external knowledge, resulting in better innovation outcomes (Vrontis et al., 2017). We then propose the following, two-part hypothesis:

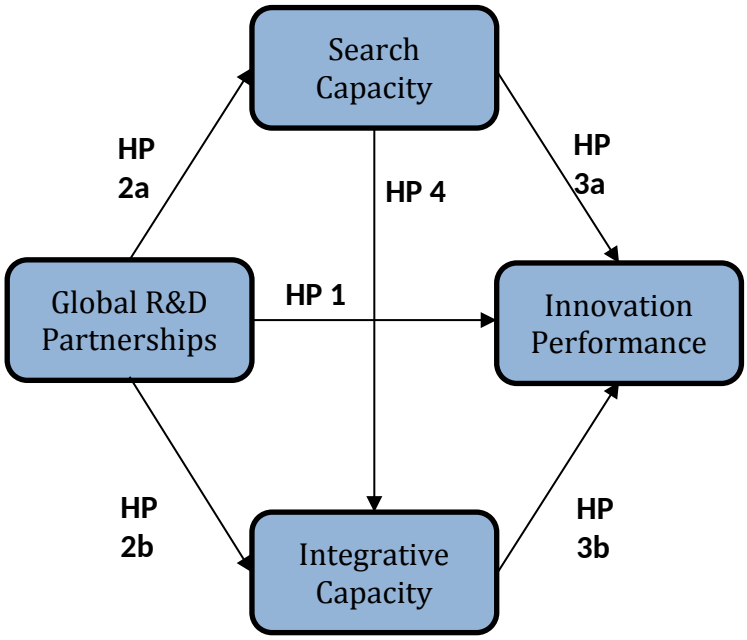
Hypothesis 3a: Search capacity positively contributes to a firm's innovation performance.

Hypothesis 3b: Integrative capacity positively contributes to a firm's innovation performance.

In the process of acquiring external knowledge from GPs, firms' capacities can be interrelated (West and Bogers, 2014; Ahn et al., 2016). The firms, after identifying (or searching for) the required external knowledge, have to match and recombine (integrate) this external knowledge with their internal knowledge base to produce a new shared knowledge repository that can be used for internal innovation. The effectiveness in this search for external ideas in the GPs may affect the firm's subsequent ability in integrating this external knowledge. Thus, we propose that search capacity influences the integrative capacity in our final hypothesis:

Hypothesis 4: Search capacity is positively associated with integrative capacity.

Figure 1 – The hypothesized model



In conclusion, our hypotheses are interrelated (Figure 1). Starting with the direct impact of GPs on innovation performance (HP1), we argue that there is an additional indirect impact via two channels. First, GPs correlate with companies' search capacities (HP2a) and, second, with their integrative capacity (HP2b). Integrative capacity also depends on search capacity (HP4). Finally, search capacity is closely related to innovation performance (HP3a) and, in a similar manner, to integrative capacity (HP3b).

3. Methodology

During our research, data was gathered from CEOs of medium-sized firms, all of which are based in Italy. Italy has been used previously as a valuable source for other innovation studies as well as for various fields of research for SMEs (e.g. Campanella et al., 2013; Vrontis et al., 2017). We decided to focus only on medium-sized firms because smaller companies in Italy have few resources to devote to these complex, risky, heterogeneous and unfamiliar partnerships. First, a total of 1,000 medium-sized firms were randomly selected from the Amadeus database, which is a European database that has been commonly used for similar studies (e.g. Bresciani and Ferraris, 2016; Ferraris et al., 2016b). In line with the European Commission's definitions (2009), we selected medium-sized firms with 50 to 250 employees. Second, an email with an

invitation to participate in the survey (along with an explanation of the study's purpose) was sent to all of the firms. In total, 289 firms expressed interest in taking part in the study (a response rate of 29%). Third, a questionnaire of 16 open and closed questions was sent to each firm. Consequently, 112 firms successfully answered and they represent the final sample for this study. They operate in several sectors, including the Food and Beverage, Handcraft, Engineering, Furniture and Construction industries.

Using a seven-point Likert scale, we asked the respondents to evaluate the propensity of the firm in making R&D partnerships outside of their home countries (Ahn et al., 2016 and similar studies). The questions posed included: a) the firm has a culture that encourages collaboration with external individuals or organizations outside its home country (GP1); b) the firm is willing to share its experiences through collaboration with stakeholders outside its home country (GP2); c) managers in the firm behave proactively to encourage collaboration with external individuals or organizations in foreign countries (GP3); d) the firm shows trustful behavior with external partners in foreign countries (GP4).

Search capacity was codified as the intensity of the firm's search for knowledge from many different external sources, which implies that the firm has to develop a high-level of search capacity (Laursen and Salter, 2006; Ahn et al., 2016). Based on Arbussa and Coenders (2007), respondents were asked to evaluate on a seven-point Likert scale to what extent information sources have been used over the last three years (the higher score, the higher importance) for: a) universities or higher education institutes (SC1); b) marketing channels, such as clients, customers and suppliers (SC2); c) specialized channels, such as technical standards and regulations (SC3); d) human networks, such as informal meetings between CEOs and CTOs (SC4); e) expert level information, such as patent or journal databases (SC5); f) general information media, such as trade fairs, conferences, the internet (SC6); g) other institutional channels, such as other organizations, public/private research institutes (SC7).

Based on Ahn et al. (2016), we measured *integrative capacity* by assessing to what extent respondents agreed with the following statements (the higher score, the higher agreement) on a seven-point Likert scale: a) over the last three years, the information/technology adapted from external sources has played an important role in developing products or improving processes (IC1); b) over the last three years, the information/technology adapted from external partners has been widely used for product development or process improvements (IC2).

We built the *innovation performance* construct on two previous and relevant studies (Berchicci, 2013; Aloini et al., 2015), asking respondents to evaluate to what extent they agreed with the following statements on a seven-point Likert scale (where the higher score, the higher agreement). For three years, compared to the average competitor in the same industry, the firm has successfully achieved a rise in: a) new products introduced to the market (IP1); b) new services introduced (IP2); c) marketing innovations (IP3); d) organizational innovations (IP4).

In line with Ahn et al. (2016), we tested our hypotheses using the Partial Least Square (PLS) Structural Equation Model (SEM), which allows the description of unobservable latent variables. This approach has high flexibility when confronting the conceptual model with the data (Shah and Goldstein, 2006), it also enables the valuation of direct and indirect effects among variables. This technique is usually adopted when evaluating relationships among several latent factors (Zeng et al., 2010). More specifically, we adopted a PLS method, preferring it over the maximum likelihood (ML) approach (Sohn and Moon 2003) since ML exhibits weaknesses that PLS does not, including assumptions based on large sample sizes, interval scaling, and multivariate normality (Sohn and Moon 2003).

4. Results

Initial descriptive analysis of the questionnaire responses and correlations among the constructs are shown in Table 1 and Table 2.

Table 1 – Descriptive statistics

	Global R&D partnerships				Integrative capactity		Search capactity							Innovation performance			
DS/variables	GP1	GP2	GP3	GP4	IC1	IC2	SC1	SC2	SC3	SC4	SC5	SC6	SC7	IP1	IP2	IP3	IP4
min	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	2,00	1,00
max	6,00	7,00	7,00	6,00	7,00	6,00	7,00	7,00	7,00	7,00	6,00	7,00	6,00	7,00	7,00	7,00	7,00
mean	3,10	3,25	3,18	3,28	3,18	3,27	2,29	3,96	3,32	3,38	2,49	3,38	4,21	3,35	4,24	4,56	3,45
SD	1,29	1,41	1,62	1,98	1,42	1,25	1,32	1,58	1,41	1,53	1,24	1,34	1,83	1,33	1,39	1,41	1,26

Note: scale used: 1 – strongly disagree, 2 – disagree, 3 – somewhat disagree, 4 – neither agree or disagree, 5 – somewhat agree, 6 – agree, 7 – strongly agree.

Table 2 – Correlations among constructs

		GP	SC	IC	IP
GP	Pearson Correlation	1	,451**	,048	,368**
	Sign. (2 tails)		,000	,530	,000
	N	112	112	112	112
SC	Pearson Correlation	,451**	1	,088	,413**
	Sign. (2 tails)	,000		,493	,000
	N	112	112	112	112
IC	Pearson Correlation	,048	,088	1	,271*
	Sign. (2 tails)	,530	,493		,002
	N	112	112	112	112
IP	Pearson Correlation	,368**	,413**	,271*	1
	Sign. (2 tails)	,000	,000	,002	
	N	112	112	112	112

* Significant at 0,05 (two tails).

** Significant at 0,01 (two tails).

In order to test the relationships between each measurement variable and the respective latent factor, we conducted a Confirmatory Factor Analysis (CFA). In Appendix 1, Cronbach's alpha values for all latent factors are presented providing sufficient reliability for each construct. Applying the chosen statistical techniques (PLS structural equation model) to our data, we estimated the path coefficients for this research (Ahn et al., 2016), which can be seen in Table 3.

Table 3 – SEM results (direct and indirect effects)

Factor		**Factor**	**Direct**	**Indirect**	**Total**
Global R&D Partnerships	→	Innovation Performance	-	0,263	0,263
Global R&D Partnerships	→	Search Capacity	-	-	-
Global R&D Partnerships	→	Integrative Capacity	0,349	-	0,349
Search Capacity	→	Innovation Performance	0,866	0,462	1,328
Integrative Capacity	→	Innovation Performance	0,754	-	0,754
Search Capacity	→	Integrative Capacity	0,613	-	0,613

Note 1: The direct effect is the path coefficient, while the indirect effect is calculated by multiplying each path coefficient from one latent factor to a target factor. A total effect is the sum of the direct and indirect effect of each factor.

Note 2: Model fit statistics: χ^2=922.95, df=539, χ^2/df=1.712, TLI=0.906, CFI=0.914, RMSEA=0.049 (LO90=0.043; HI90=0.054), SRMR=0.548

Path coefficients are significant at a 1% level, except the path between search capacity and innovation performance is significant at 5%. However, there are two paths (between Global R&D Partnerships and innovation performance and search capacity, respectively) that are not significant. But Global R&D Partnerships positively affected integrative capacities directly and influenced innovation performance indirectly (via integrative capacity). Search and integrative capacities have direct effects on a firm's innovation performance and search capacity, which also has an indirect effect via the integrative capacity. This validates hypotheses three and four, and partially supports hypotheses one and two. Taking into account the effects of the different factors, we may individuate which factors have the stronger effect on a firm's innovation performance. GPs only had a direct effect on integrative capacity and an indirect effect on innovation performance. At the same time, integrative capacity had a direct influence on innovation performance but a weaker effect if compared with the direct effect of search capacity on the same construct, which also represents the strongest total effect on the innovation performance.

5. Discussing conclusion

Discussion

Despite the late development of firms' global R&D partnerships as a vehicle to acquire and leverage cross-border technological capabilities (Kim and Park 2010), available practical evidence suggests that they usually

are not an effective solution for international R&D success (Robson et al., 2012). This research thoroughly analyzed Global R&D Partnerships within the innovation process of medium-sized firms by testing the relationships between a firm's propensity to use GPs, search and integrative capacities and a company's innovation performance. Our results show that a firm's propensity to engage in Global R&D Partnerships can affect its innovation performance indirectly via the development of absorptive capacity (in particular, integrative sub-capacity) (Cohen and Levinthal, 1990; Ahn et al., 2016).

This means that a firm can thus augment its engagement in GPs, opening its innovation boundaries to key knowledge from different foreign external partners. This leads the firm to achieve better innovation performance when it possesses superior capacities to integrate external sources within the internal innovation process (Lin et al., 2012). In this analysis, both search and integrative capacities affect innovation performance. This further suggests that internal capabilities are critical in the innovation process of these firms, in particular when knowledge comes from outside of foreign contexts and when said knowledge is unfamiliar compared to the knowledge base of the firm (Nooteboom et al., 2007). Companies may thus overcome classical difficulties extracting value from the combination of internal and external knowledge and, hence, introduce new products based upon new technological solutions (Rathi et al., 2014; Ardito et al., 2015). Moreover, search and integrative capacities may be critical since knowledge coming from outside the company could encounter the not-invented-here (NIH) constraint for its effective integration (Lichtenthaler and Ernst, 2006). This reflects the aversion of firms' employees towards external knowledge, hence complicating its acquisition despite its usefulness to the company.

The positive impact of the development of these specific, internal sub-capacities confirms that the establishment of external partnerships is only half of the battle in the innovation arena (Bogers and West, 2014). Indeed, firms that want to successfully benefit from external sources need to search, scan, access, integrate and absorb ideas in an effective manner (Chesbrough et al., 2006). The context of the analysis in our study of medium-sized businesses also enriches the debate on global R&D partnerships, which have mainly been studied in multinational firms that possess a completely different set of resources and competencies. While there is still not a full consensus about the effect of GPs on innovation outcomes (Lin et al., 2012), we advanced knowledge on the topic by analyzing in detail the sub-capacities needed to allow firms to exploit knowledge from their external foreign partners.

Main contributions

This study provides multiple contributions to the existing literature and research. First, we contribute to the global partnerships literature (e.g. Capaldo and Messeni Petruzzelli, 2014), highlighting the positive associations between the development of GPs and innovation performance, while explaining the role of search and integrative capacities to increase the effectiveness of GPs. Second, we provide new insights into

R&D alliances (e.g. Ahn et al., 2016), unbundling the concept of absorptive capacity and finding evidence of different effects of the two sub-capacities (search and integrative) in a specific underdeveloped context, i.e. the Global R&D Partnerships. Third, we contribute to the literature on internationalization and innovation in SMEs (e.g. Santoro et al., 2018), where only a limited set of studies have been proposed to explain how, and thanks to which internal capabilities, SMEs may be able to internationalize their knowledge and innovation activities. Fourth, we contribute to the literature on Knowledge Management (KM) (e.g. Paarup Nielsen, 2006) by highlighting how cross cultural knowledge from GPs is becoming a hot topic both for theory and practice due to the fact that companies will be called even more than today to develop (or to adapt) KM competencies, tools and infrastructure to effectively take advantage from distant and heterogeneous knowledge.

From a practitioners' viewpoint, we suggest SME managers open up their boundaries to international partners that possess a distinct set of knowledge and technologies, which is more readily available through external collaborations rather than internal investments, in particular for high value-added activities such as product design or problem solving. Yet, we show that this can be practically achieved if SMEs invest greatly in internal competencies and R&D staff, which are crucial to further source external innovation. Here, we first suggest that a high level of search capacity augments the likelihood to find the best external technologies and partners in relation to the needs of the firm. SMEs, therefore, need to encourage their R&D staff to proactively scan the external environment, both inside and outside of their home country. We also suggest that the sole establishment of these partnerships with international partners is not enough. SME managers need to develop internal capacities and competencies in order to reduce the cognitive distance with foreign partners and to easily integrate external knowledge into their internal innovation processes. Cognitive distance is reduced if SMEs possess a high level of search capability. Yet this is, again, not enough to take full advantage of international partnerships. However, an open question remains where managers (according to the firm's overall innovation strategy) need to understand if they should develop multiple loose relationships with global partners (focusing on "external search breadth") or focus on a few key relationships (favoring more "external search depth"). The insights that we bring here provide strong guidelines for practitioners who seriously want to engage their organization with global R&D partnerships, and consider these latter as a key dimension of their innovation policy. This has become all the more important as an increasing number of industries today face a truly global and fast pace competition, and therefore must consider global R&D partnerships to sustain their competitive advantage. This has been recently exemplified to some extent with US pharmaceutical Pfizer acquiring Array BioPharma for $11.4bn in order to boost their innovation in cancer treatment. This raises some interesting questions, such as "Will the US giant successfully integrate the new capabilities and reap the promised benefits of the deal…?" As a conclusion here, we believe that our results can pave the way for further investigation by offering deep insights for scholars, practitioners and policy makers.

Limitations and future lines of research

Some limitations in our research need highlighting. First, we did not take into account the cultural differences in the GPs, which is usually one of the most important factors influencing high termination rates for alliances. In fact, large cultural differences between partners may cause internal tensions in cross-cultural alliances, resulting in instability before sustained commitments can lead to knowledge creation (Robson et al., 2012). Future studies may try to more deeply understand this complex phenomenon, by including cross-cultural integration variables and verifying the impact on the model proposed here. Second, we did not consider the intensity of the partnerships. In this respect, future lines of research should also investigate the differences related to the quality of relationships with foreign partners. This is an important factor as the intensity and strength of the collaboration may influence the innovation performance and the related firm's capacities (Bresciani and Ferraris, 2016). Third, we did not investigate the potential differences between industries. In fact, it would be interesting to analyze the behavior of firms depending on their sectors, looking for different effects that may be observed, in manufacturing vs services, or high-tech vs traditional industry, for example. Some industries may indeed benefit more than others from sourcing ideas from foreign partners and the mechanisms to which search and integrate capacities add to a firm's external knowledge may differ. Finally, this study investigates firms in only one country (Italy) which is characterized by its specific features (in terms of legal, the financial environment, its market and industrial structures) such as a poor capital market orientation, a scarcely efficient market for corporate control, the fact that control is usually preserved through a high concentration of ownership, and a high presence of family-owned firms. These characteristics may have an influence on how the propensity in engaging in GPs impacts the innovation performance and which firms' capacities are relevant. Further studies should, therefore, include a cross-country analysis in order to verify if our findings are generalizable to diverse national contexts. Finally, it could be insightful to analyze and include in this framework the further dimensions suggested in the literature on R&D alliances, which could affect the model (Crossan and Apaydin, 2010). For example, it may be relevant to look at the number of countries in which foreign partners are located and their closeness to worldwide knowledge clusters (Colombo et al., 2009), or to take into account whether the foreign partners are other SMEs or large MNEs (Narula and Martínez-Noya, 2015), or to consider governance modes of the alliances (Robson et al., 2012).

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Appendix 1 – The Confirmatory Factor Analysis (CFA) results[1]

		First estimation		Second estimation	
Latent factors	**Measurement variables**	**Loading value**	**Alpha**	**Loading value**	**Alpha**
Global R&D partnerships	a) propensity of the firm in collaborations with external individuals or organisations	0,8750	0,792	0,754	0,870
	b) propensity of the firm in sharing experiences through collaborations	0,6954		0,7801	
	c) proactive behavior of managers for collaborations with externals individuals or organizations	0,6558		0,6213	
	d) trustful behavior of managers with regard to external partners	0,8145		0,8067	
Search capacity	a) importance of universities or higher education institutes	0,6975	0,823	0,5512	0,8452
	b) importance of marketing channels	0,7500		0,7965	
	c) importance of specialized channels	0,3456			
	d) importance of human networks	0,7511		0,7568	
	e) importance of expert level information or patent/journal data	0,5897		0,6103	
	f) importance of trade fairs, conferences and the internet	0,7239		0,7353	
	g) importance of other institutional channels, other organizations, public/private research institutes.	0,3991			
Integrative capacity	a) embedding knowledge from partnerships has a key role in the innovation process	0,9123	0,893	0,9234	0,911
	b) knowledge from partnerships has widely used for product development or process improvement.	0,9014		0,9074	
Innovation performance	a) increase in new products introduced in to the market	0,7238	0,815	0,7349	0,821
	b) increase in new services introduced	0,7213		0,7197	
	c) increase in marketing innovations	0,6851		0,6798	
	d) increase in organizational/ workplace innovations	0,7521		0,7753	

[1] Note: we performed the second estimation because some variables with low value (less than 0,5) were removed in order to increase the convergent validity.

ARE GLOBAL R&D PARTNERSHIPS ENOUGH TO IMPROVE FIRM'S INNOVATION PERFORMANCE? THE ROLE OF SEARCH AND INTEGRATIVE CAPACITIES.

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