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International partnership as a tool to R&D achievements

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ABSTRACT: Global competition emerges with a greater need for faster innovations. R&D plays an essential role in the elaboration of new products and processes in an even shorter period. As the access to resources and knowledge inside the own country borders are restricted, firms start to go abroad looking for other options of R&D. This way, international R&D partnerships arise as an important theme for theory and practice. Through a systematic literature review of 31 papers published in management journals from 2002 to 2014, this study brings two streams of the literature. First, a description of the main concepts in international R&D partnerships. Second, the best practices for the theme proposed and the gaps in the area's knowledge. This paper contributes to both practitioners and literature by providing a research agenda with seven themes for future research, regarding in-depth studies, secondary data analysis, measure proposal and managerial implications.

Keywords: International cooperation; inter-firm collaboration; coopetition; innovation; R&D partnerships; R&D alliances; global operations; research agenda; R&D achievements.

1. INTRODUCTION

In a context of the global market with a great emphasis on knowledge-based activities and products, firms are struggling to make innovations at a faster pace. In this scenario, research and development (R&D) is placed as a centre activity to seek new products and perspectives for the market. Since the 1980's firms have increased their investments in this activity to speed up the pace of innovation and diversify their technological capabilities (Miotti and Sachwald, 2003).

Although R&D might be an internal activity, cooperative agreements in such area have been used to develop and integrate knowledge in the innovation process (Autant-Bernard et al., 2007). Cooperation is positively related to a firm's innovativeness, resulting in superior performance (Facó and Csillag, 2010). Network relationships with suppliers, customers and intermediaries such as professional and trade associations are relevant factors affecting innovation performance and productivity (Pittaway et al., 2004). Firms dealing with growing outsourcing and various types of technological partnerships have built complex networks. This is explained partially by the imperfection of knowledge transactions that leads organisations to build up several kinds of alliances (Miotti and Sachwald, 2003). Regarding these imperfections, Hagedoorn (2002) pointed up that firms would have restrictions in sharing R&D because of the risk of information spillover. Anyway, co-competition (collaborating with competing firms) could be risky or beneficial on the alliance design options firms take with respect to market rivalry and their common and specialised knowledge (Ritala, 2009). Relations of trust are essential in the decision of dealing with more complex activities, such as R&D (Schreiber and Pinheiro, 2009). This is probably one of the reasons R&D partnering has become more popular in academic and press publication in recent years.

Technological knowledge has become more dispersed in the world, so international partnerships play an important role as an additional channel to access the main flows of technology (Duysters and Lokshin, 2011). The benefits of going overseas lay on the fact that these partnerships are more likely to bring diverse resources and capabilities to the alliance, because of different technology bases presented by the participants. On the other hand, international alliances bring on higher technology transfer costs and may be less useful in the joint effort of co-

ordinating respective technologies (Kim and Song, 2007). A debate must be taken to understand the importance of international R&D partnerships and the reasons that lead firms to go forward this direction.

Despite the importance of the theme, there is little research on joint knowledge creation across partners (Bouncken and Teichert, 2013), and we have found no research agenda regarding international R&D partnerships. To fill this gap, we have three related objectives: describe the main concepts in international R&D partnerships, identify the best practices for international R&D partnerships, and propose a research agenda for international R&D partnerships. To achieve such objectives, we built a systematic literature review, according to the guidelines from Seuring and Gold (2012).

The literature reviewed has provided a better understanding of the international R&D partnerships and has also identified opportunities for future research. As a research agenda, we have identified opportunities for both empirical and conceptual work. We suggest in-depth studies on commitment, previous links, definition of objectives, trust and partners' reputation, stated as primary conditions for a successful R&D partnership. We also recommend practical developments for international R&D partnerships for small and medium enterprises and for managing a complex portfolio of partners. We also advocate that measures for supplier capacity and joint patents, and the update of studies about the trends on R&D partnerships (Bojanowski, Corten and Westbrook, 2012; Hagedoorn, 2002) would complement the extant literature. This way, the study contributes to the knowledge in the area and to practitioners as well.

Our paper has six sections, including this introduction. In the next section, we provide the methodological procedures conducted throughout the study. Section 3 presents the main contributions from conceptual papers in international R&D partnerships. Section 4 shows the findings from empirical papers on best practices for international R&D partnerships. Section 5 discusses the results of our systematic literature review, and section 6 brings some conclusion about the research.

2. METHODS

Seuring and Gold (2012) conducted a literature review based on a content analysis of 22 literature reviews of seven sub-fields of supply chain management (SCM). Concerned with reliability and validity,

the authors suggested a systematic procedure built on four milestones: material collection, descriptive analysis, patterns of analytic categories and material evolution and research quality. This way they could draw a consistent map of SCM and its development in recent years.

As we intend to deepen and develop a research agenda for international R&D partnerships with proper reliability and replicability, we have chosen to follow the procedures conducted by Seuring and Gold (2012): material collection, descriptive analysis, patterns of analytic categories, and refinement.

2.1. Material collection

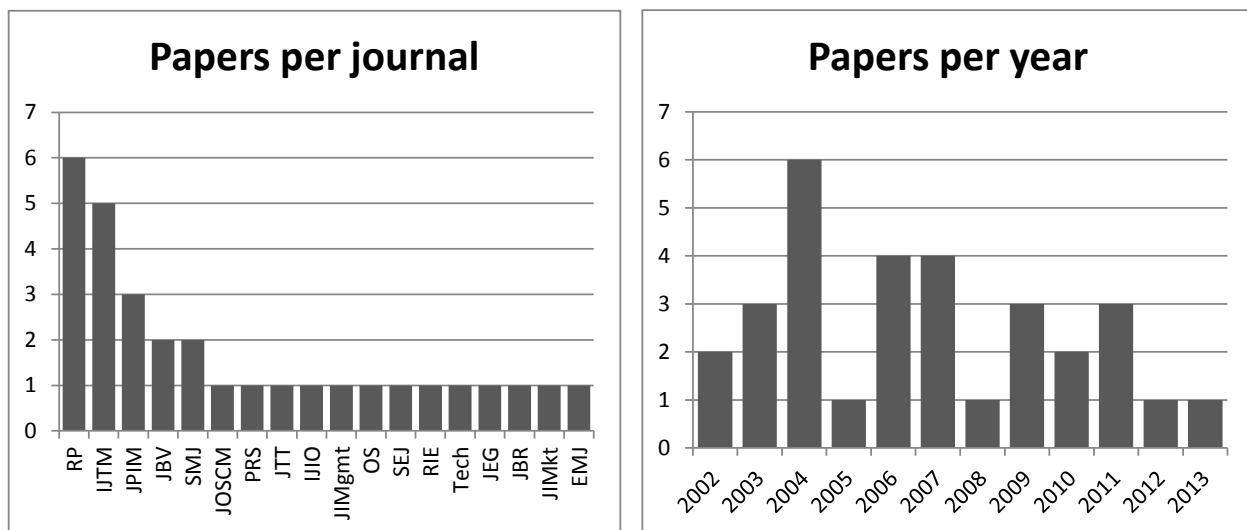
First of all, we have selected the unit of analysis as papers published in peer-reviewed journals, as they represent a primary mode of communication among researchers (Seuring and Gold, 2012). We delimited the material selected by the year of publication (from 2002 to 2014) reflecting the recent evolution of the theme. Besides, Hagedoorn (2002) has performed an extended overview through R&D partnerships since 1960, and a study assessing papers before 2002 could incur in redundancy.

The search was performed using the following keywords: international, global, R&D, research, cooperation, partnerships, networks and collaboration. We coded these keywords accordingly to the syntax of the search engines (for example, international AND R&D AND partnership*) and we searched in two on-line databases: ISI Web of Knowledge and EBSCO. We searched these keywords in the title, keywords and abstract. Additionally, the search was restricted to the “business economy” area. As a result, 50 papers were selected in the first place. After refining the search by reading the papers and reflecting over the appropriateness to the topic studied, the sample resulted in 31 papers.

2.2. Descriptive analysis

In this second step, information about the distribution of the papers across the years and journals was assessed (Figure 1). The evolution of the number of papers over the years shows a significant concentration of papers among the years 2004 and 2007, with a decrease of publications in the past three years. This sustains the argument of a need for a research agenda to keep growing the knowledge about the theme.

Figure 1. Description of the papers per year of publication and journal.



2.3. Patterns of analytic categories

In content analysis, categories must be defined to assess the data and classify the reviewed material. The options for defining categories derive from deductive paradigm – set before the analysis of the data – and inductive paradigm – categories emerge from the material assessed itself - (Eisenhardt, 1989). In our definition of categories, we accepted the suggestion of Seuring and Gold (2012) and develop two steps for categorization. First we have deductively pre-defined that papers should reflect the central concepts of international R&D partnerships and the best practices of international R&D partnerships. With this frame at hands, we intended to cover the literature on conceptual and empirical papers. Then, while analysing the material, new aspects emerged from conceptual papers and three categories were defined: benefits, eventual problems and capabilities required.

2.4. Material evolution and research quality

As we have conducted an inductive coding, it was necessary to establish a cycle of category refinement. Therefore, every time a new category emerged from the analysis, a discussion between the authors was steered, we would include this new category after reaching an agreement. Once the category was accepted, all the other papers were once again assessed.

To assure the analysis reliability, right after the assessment of the papers, the authors would meet and find a proper agreement over the interpretation of data. These procedures guarantee the reproducibility and reliability of the research.

3. THE MAIN CONCEPTS IN INTERNATIONAL R&D PARTNERSHIPS

In our literature review, we identified three main themes in the conceptual papers: benefits from international R&D partnerships, eventual problems in international R&D partnerships, and capabilities required for building and maintaining international R&D partnerships. We discuss them in the following sections.

3.1. Benefits

Strategic alliances play a significant role in developing global innovation (Zhang et al., 2010). Alliances enable firms to access capabilities and assets that are

required to create, store and commercialize knowledge to generate new products (Rothaermel, Hitt and Jobe, 2006). Organisations establish relationships to access resources that they do not have themselves (Balland, Vaan and Boshma, 2013). This opportunity for combining capabilities from multiple sources is more relevant in international partnerships, because they are more likely to bring diverse resources and capabilities, which are not easy to access inside the firm's country (Kim and Song, 2007). Firms from all over the world are deliberately seeking partners with unique centres of excellence to advance their technological knowledge (Subramaniam, 2006). This way, international R&D partnerships form an additional channel to access the main flows of technology. International R&D partnerships are also seen as an alternative to access the local technology expertise (Duysters and Lokshin, 2011).

At the macro level, the international partnerships result in globe-spanning networks. Such networks can be a valuable source of international knowledge spillovers, or knowledge flows (Bojanowski, Corten and Westbrook, 2012), playing an important role in innovative R&D partnerships (Belderbos, Carree and Lokshin, 2004). Additionally, adaptation to local needs, lower costs of R&D personnel (Duysters and Lokshin, 2011) cost and risk sharing of the activity (Autant-Bernard et al., 2007) are also motivations for international R&D partnerships.

The motivations for international R&D partnerships vary among countries. American firms, for example, seek partnerships to be on the technological frontier; on the other hand, European firms pursue partnerships primarily to share R&D costs and resources (Miotti and Sachwald, 2003).

Besides proposing the motivations for international R&D partnerships, another stream of research defines a successful partnership in R&D. Kim and Song (2007), for example, suggested to measure an alliance in R&D by the number of joint patents, that is, the number of patents registered by both partners. While not all R&D efforts lead to patented intellectual property, that variable seems to be a reasonable proxy for the outcomes of the international R&D partnerships, as long as the patent registration occurs with partners from different countries.

3.2. Eventual problems

Despite all the advantages of international R&D partnerships, there are also points that require atten-

tion. Most partnerships occur among competitors in the product market. Therefore, the technology transfer cost is substantially higher as the firm develops its agreements (Kim and Song, 2007). When cooperative R&D is more successful, the higher the quality and quantity of external resources available, and the lower the transaction and coordination cost required for such arrangements (Okamuro, 2007).

Besides, the positive relationship between competition and knowledge acquisition cannot prevent, and in some cases even stimulates, opportunistic behaviour (Zhang, 2010). Opportunistic is seen as behaviour that, instead of maximizing the returns for the alliance partners, maximizes only the partner's own benefit, which is not necessarily the best interest of the partnership (Dickson, Weaver and Hoy, 2006). When the activities performed in the alliance are more extensive, interdependent, complex, and uncertain, the potential risk of opportunism is higher (Oxley and Sampson, 2004).

The literature suggests some ways to prevent opportunistic behaviours and reduce transaction and coordination costs. Commitment, previous links, the definition of objectives, trust and the partners' reputation are crucial to reduce these damages (Mora-Valentin, Montoro-Sanchez and Guerras-Martin, 2004). Opportunism is not seen as an imminent threat in industries with an institutional framework that decrease the possibility of a partner to make use of a dominant position, (Kastelli, Caloghirou and Ioannides, 2004). The experience of the firm also plays an important role, so experienced firms are more likely to be able to identify trustful collaborations and attract potential collaborators (Balland, Vaan and Boshma, 2013).

Teng (2007) propose some mechanisms to protect intellectual property. Equity arrangements, such as joint ventures or minority equity investments, are widely used to align partners' interests. Non-disclosure and non-compete agreements are contractual measures in which the partners agree to keep the intellectual property under confidentiality. Also important, monitoring and auditing are ways to avoid the opportunistic behaviour.

On the contrary of what most managers think, the geographic distance is not so important to prevent opportunism. Autant-Bernard et al. (2007) suggest in their study that social distance (the number of links between each pair of firms) matters more than the geographic distance for a successful partnership.

Then, the higher the social distance, in other words, the lower the number of links between two firms, the higher will be the chance for an opportunistic behaviour.

3.3. Required capabilities

With the purpose of taking advantage of partnerships, there are some capabilities that must be reinforced and developed inside the firm. Rothaermel and Deeds (2006) suggested that the firms are pushed to establish multiple partnerships so that they have better access to resources and capabilities. On the other hand, because of the complexity of this venture, firms have to develop an alliance management capability, or the ability to manage multiple partnerships effectively. The success of a firm is directly related to this capability.

Another important ability to achieve success through international R&D partnerships is the absorptive capability (Autant-Bernard et al., 2007). Through this ability, a firm can identify the new information, assimilate it and apply it to its own process. This way, the creation of new technology can be facilitated by ensuring the positive side of the absorptive capability (Kim and Song, 2007).

The literature suggests that in order to maintain and develop successful international R&D partnerships it is necessary to have sufficiently open knowledge exchange (Bojanowski, Corten and Westbrook, 2012; Zhang et al., 2010; Kim and Song, 2007). On the other hand, it is a concern that this openness may cause opportunistic behaviour in the partnership (Dickson, Weaver and Hoy, 2006; Zhang, 2010). The trade-off between maintaining knowledge exchange between partners while controlling for unintended knowledge leakages brings an important challenge for participants in R&D partnerships. A response for that dilemma would be reducing the scope of the partnership. This way partners choose to limit the scope of alliance activities to those that can be successfully completed with limited (and carefully regulated) knowledge sharing. (Oxley and Sampson, 2004).

These main concepts bring the motivations, problems and capabilities that sustain the international R&D alliances. Table 1 summarizes the findings regarding the first objective of this paper. The next step is to show how to improve the capabilities though the best practices found in the literature.

Table 1. Main concepts from literature reviewed

Author	Year	Main concepts about international partnership for R&D
Zedtwitz and Gassmann	2002	The alliances are driven by two principal location rationales: access to market and access to science.
Miotti and Sachwald	2003	The main reasons to cooperate internationally depend on each country: Access to the technological frontier (USA), access to complementary R&D resources (France), share R&D costs (EU).
Belderbos, Carree and Lokshin	2004	The spillovers play an important role on innovative R&D partnerships.
Kastelli, I. Caloghirou, Y. Ioannides, S.	2004	In industries with a clear institutional framework with monitoring rules that reduce the possibility of a partner to make use of dominant position, opportunism does not seem to influence the benefits from cooperative R&D.
Oxley and Rachele	2004	The more extensive, interdependent, complex, and uncertain are the activities performed in the alliance, the greater is the potential risk of opportunism.
Veugelers and Cassiman	2005	Cooperating with universities is complementary to other innovation activities such as performing own R&D, sourcing public information and cooperating with other partners.
Dickson, Weaver and Hoy	2006	Opportunistic behaviour is seen as behaviour that while designed to maximize the resources derived from an alliance by a participant to the alliance is not necessarily in the best interest of the alliance.
Subramaniam	2006	Firms are increasingly deliberately seeking partnerships with unique centres of excellence in order to advance their technological knowledge.
Rothaermel and Deeds	2006	The success of an international alliance for R&D depends on the alliance management capability
Kim and Song	2007	International alliances can create unique learning opportunities not typically available from the same country. On the other hand, there are higher technology transfer costs.
Autant-Bernard et. al.	2007	Geographic distance is not the main restriction to R&D partnership. Social distance is much restrictive in these matters.
Teng, B.	2007	As an output for R&D alliances, Intellectual property needs to be carefully selected and protected through mechanisms such as equity arrangement (joint ventures or minority equity investments), non-disclosure and non-compete agreements (keep intellectual property confidential), and monitoring and auditing.
Fink, M. Harms, R. Kraus, S.	2008	Self-commitment (the willingness of individuals to commit to cooperation with a partner without the safety net of controls or sanction mechanisms) is particularly important in international cooperation.
Colombo	2009	Alliance partners create an indirect link with the knowledge sources, making them more accessible to companies.

Zhang et. al.	2010	Firms can overcome resource constrains and achieve superior innovative performance not only by using internal resources but also by acquiring knowledge based capabilities from alliance partners.
Duysters and Lokshin	2011	Access to qualified R&D personnel at foreign locations, adaptation to local needs, lower costs of R&D personnel, and improved access to external knowledge at scientific competence centers located are the main motives for international alliances for R&D.
Bojanowski, Corten and Westbrock	2012	International partnerships for R&D result in a globe-spanning network that can be a valuable source of international knowledge spillovers.
Balland, Vaan and Boshma	2013	Experienced firms are more likely to be able to identify fruitful partnerships and attract potential partners.

4. BEST PRACTICES FOR INTERNATIONAL R&D PARTNERSHIPS

Literature shows the best practices for developing successful international R&D partnerships. Our review identified five of these best practices: development over previous experiences, relationship capabilities, international strategy, partner choice and governance mode. Past experience seems to be an important factor for a successful international R&D partnership. The alliance management capability is increased by recurrent experiences, making the firm more able to deal with multiple agreements (Rothaermel and Deeds, 2006). Besides, joint patents are more numerous when the partners have had previous ties (Kim and Song, 2007).

Relationship capabilities are recommended during the establishment and development stages. Managerial and organisational mechanisms must be promoted to facilitate a high degree of commitment, trust, dependence, good communication, and reduced level of conflict (Mora-Valentin, Montoro-Sanchez and Guerras-Martin, 2004). The tighter involvement of partners is determinant for sharing information and technology, but trust is the elementary variable for approaching (Petersen, Handfield and Ragartz, 2003). However, the degree of relation may vary according to the strategy, size and spread of actuation of each firm.

The international strategy adopted by multinationals suggests a local responsiveness through the development of international units of R&D. This way, the firms are able to interact with the local market and increase the knowledge exchange (Zedtwitz,

Gassmann and Boutellier, 2004). There is also a process with three stages identified by Liu, Wang and Zhang (2010) where the multinational increases the level of partnership. The first stage is called ethnocentric centralized R&D (with a dominant R&D centre serving far away markets), then evolves for a geocentric centralized R&D (where the R&D centre engages in cooperative projects with customers and other research institutes), and the last one is an R&D hub model (with the R&D centre serving as the central information and decision-making platform for all global R&D units).

International R&D partnerships are not only exclusive to multinationals and greatest firms. High-tech start-ups also take advantage of this strategy when observing two important factors: a) the partnership must involve firms located in a variety of countries, and b) these countries must be closer to the best world knowledge sources (Colombo et al. 2009). Furthermore, small and medium enterprises must pay particular attention to opportunistic behaviour in R&D partnerships, so the analysis of a potential partner should be even more exhaustive (Dickson, Weaver and Hoy, 2006).

In terms of choice of the partner, there seems to be a variety of factors that may influence this decision, but the objective of the partnership is the starting point. Once the firm has established its goal, the partner's country and the partner itself can be chosen simultaneously. This way, if a firm looks for high technology, it will choose an American or East Asian firm as a partner, especially in sectors in which these countries exhibit comparative advantage, because

this way the firm is able to access complementary R&D resources close to the technological frontier (Miotti and Sachwald, 2003). Data from 40 years of international R&D partnerships shows that 99% of R&D partnerships involved at least one firm from North America, Europe or East of Asia (Hagedoorn, 2002). In a study of Chinese multinationals, Liu, Wang and Zheng (2010) identified that strategic R&D partnerships always involve at least one firm from developed or in developing countries. Therefore, it is clear that the centre of knowledge for R&D resides on developed countries and companies from less developed regions seek to begin and maintain agreements to access this core of knowledge.

In addition, the similarity of the firms, in terms of both technological and market profiles, and the familiarity through past interactions are usually regarded in the partners' choice (Vonortas and Okamura, 2009). This decision considers also R&D specific factors such as the quality of input (local talent, engaging in local scientific cooperation, etc.), the quality of expected output (cooperation with local customers and local development, market proximity, etc.), and R&D-external factors (tax optimization, reliability and stability of the local political and social system, and image enhancement) (Zedtwitz and Gassmann, 2002).

Besides partners' country, there are multiple options of partner types to be allied to, and a broad portfolio in terms of options of alliances helps innovations in R&D (Duysters and Lokshin, 2011). Competitors, suppliers, consumers, universities and research institutes are some options to build a partnership (Belderbos, Carree and Lokshin, 2004). Customers and universities are important knowledge sources for radical innovations. Further, the spillovers are more frequent when the firm is allied to universities or research institutes (Belderbos, Carree and Lokshin, 2004). The establishment of partnerships with universities is not very common in international alliances, albeit it is also sustained by the subsidized cost-sharing in public-private partnerships (Veugelers and Cassiman, 2005). Partnerships with suppliers help in development processes. This form of R&D partnership is studied mainly for its use by Japanese firms. Through cooperation, suppliers may increase their knowledge about product and processes. Moreover, sharing information and supplier involvement in internal teams result in better outcomes and technology uncertainty mitigation. Anyway, only trusted suppliers with a long experience

and proven track record are approached (Petersen, Handfield and Ragartz, 2003).

In terms of how to establish the partnership, the literature suggests mergers, acquisitions, joint ventures, or contractual agreements as strategic alternatives for joint R&D activities (Duysters and Lokshin, 2011). In the 1980's there was a trend for joint ventures, but in the 1990's on, the new trend seems to be the contractual agreements. Contractual R&D partnerships enable firms to increase their strategic flexibility through short-term joint R&D projects with a variety of partners. Another benefit from this flexibility is the cost sharing of R&D budget. (Hagedoorn, 2002). Anyway, in highly dynamic and knowledge-oriented industries (where the costs of R&D are higher), there is a substantially greater propensity for longer-term contracts than in other industries (Sytch, Tatarynowicz and Gulati, 2011). Joint ventures are the most likely governance mode when alliance objectives require partners to share complex and/or tacit knowledge, especially on innovative technology projects. When firms adopt an equity joint venture structure, the opportunistic behaviour can be mitigated due to the shared ownership (Oxley and Sampson, 2004). Zu et al. (2011) suggested another type of partnership by a research joint venture (RJV). In this partnership, the firms cooperate in R&D but compete in product markets. Also called horizontal alliances, these partnerships with competitors make a significant contribution to productivity gains in R&D (Oum et al., 2004). What is important in these ventures is a pairwise stable R&D, where both firms have the same strength in this activity. This way, opportunistic behaviour can be diminished (Zu et al., 2011). Zhang et al. (2010) added that inter-firm cooperation and competition coexist in strategic alliances and both factors increase knowledge acquisition, although from different motivational bases. A particular form of R&D partnership is studied by Geisler (2003) as an independent organisation formed by industry, government and university. The infrastructure of this cooperative organisation will affect the sustained performance of each member, by impacting the decisions to join, remain or terminate the membership.

These were the best practices identified in the literature reviewed. The partner choice depends on each objective and size of the firm. This way, a firm should first determine its goals with the partnership to be built and take self-awareness of its size to then, analyse the available options of partnering. Table 2 summarizes the main finding from the best practices.

Table 2. Best practices from literature reviewed

Author	Year	Best practices for international partnership for R&D
Hagedoorn	2002	In the 1980's there was a trend for joint ventures, but in the 1990's on the new trend are contractual agreements. Contractual R&D partnerships enable companies to increase their strategic flexibility through short-term joint R&D projects with a variety of partners. Another benefit from this flexibility is the cost sharing of R&D budget.
Miotti and Sachwald	2003	Companies must define their objectives with the international partnership. Once this is done, the partner and the country it comes from are simultaneously chosen.
Geisler, E.	2003	Industry, government and universities may form an independent organisation to coordinate joint R&D efforts. The infrastructure of cooperative organisations affects their sustained performance, by impacting the decisions to join, remain or terminate membership.
Belderbos, Carree and Lokshin	2004	Spillovers are more frequent and more powerful when the company is allied to a university or research institute.
Oxley and Rachele	2004	By adopting an equity joint venture structure, the hazards of opportunism can be mitigated because incentives are more closely aligned when ownership of the venture is shared.
Mora-Valentin, Montoro-Sanchez and Guerras-Martin	2004	Companies have to design managerial and organisational mechanisms that facilitate a high degree of commitment, trust, dependence, good communication, and reduced level of conflict.
Zedtwitz, Gassmann and Boutellier	2004	Development of units of R&D in foreign countries is a best practice for multinationals.
Oum et. al.	2004	Horizontal alliances make a significant contribution to productivity gains.
Veugelers and Cassiman	2005	This practice of allying to universities is also sustained by the subsidized cost-sharing in public-private partnerships.
Rothaermel and Deeds	2006	The alliance management capability is developed through recurrent experiences.
Colombo	2009	The greater the number of countries in which industrial partners are located and the closer these countries are to worldwide knowledge sources, the more positive the effect of the R&D alliances on firm performance.
Vonortas, N. Okamura, K.	2009	Firms are more likely to collaborate the closer they are in terms of both technological and market profiles, the higher the expected knowledge spillovers among them, the more familiar they are with each other through past interaction, and the more centrally located they are in knowledge networks
Zhang et. al.	2010	Inter-firm cooperation and competition coexist in strategic alliances and both factors increase knowledge acquisition, though from different motivational bases.

Liu, Wang and Zheng	2010	Seeking for international R&D, multinationals presented three stages: ethnocentric centralized R&D, geocentric centralized R&D and R&D hub model.
Duysters and Lokshin	2011	In international ventures, firms tend to prefer alliances to merges and acquisitions because of risk sharing. Innovators, different from imitators, tend to develop more alliances abroad.
Zu et al.	2011	Research joint ventures (RJV) where firms cooperate in R&D but compete in product markets, is an alternative type of partnership
Sytch, Tatarynowicz and Gulati	2011	In highly dynamic and knowledge-oriented industries (where the costs of R&D are higher) there is a substantially greater propensity for extended contract than in other industries.

5. DISCUSSION AND RESEARCH AGENDA

The concepts reviewed were necessary to build a summarized knowledge on the international R&D partnerships theme. Besides, the best practices presented are mainly directed to managers who intend to go abroad into a search for potential R&D partners.

Access to and lower costs of qualified R&D personnel, adaptation to local needs and improved access to external knowledge at scientific competence centres located abroad are some of the reasons to build an international R&D partnership (Duysters and Lokshin, 2011). In some cases, the access to technological frontier (Miotti and Sachwald, 2008) and to unique opportunities of learning are only developed with partners abroad (Kim and Song, 2007). Anyway, building an international partnership incurs in risks and costs that are not usually found in partnerships within the own country frontiers. Local taxes, reliability and stability of local political and social system (Zedtwitz and Gassmann, 2002), control, communication and hierarchy (Zedtwitz, Gassmann and Bouteller, 2004) affect the decision on international R&D partnerships. This means that the decision process of going abroad in a R&D partnership must be different from developing a R&D partnership with local companies, because they comprise different levels of complexity, risk and uncertainty.

The literature is extensive in demonstrating the main concepts about the international R&D partnership, but still, there are some gaps that were not found in the papers reviewed. Partnering with suppliers, for example, could be very positive for development, but not every supplier can be approached to the process (Petersen, Handfield and Ragartz, 2003).

Anyway, the literature does not display scientific measures to evaluate the capacity of suppliers to be allied to.

Joint patents are an important measure of R&D partnership achievements and have been increasing in recent years. Most research using joint patents as a variable had focused the pharmaceutical industry (Kim and Song, 2007). Anyway, due to the possibility to quantify the outcome of the R&D partnership, there is an excellent opportunity for further research on the theme, especially by proposing scales and applying them to a great diversity of industries.

Another gap identified regards the broadness of a portfolio of partners. It is known that a wide number of partners is beneficial to innovation ventures (Duysters and Lokshin, 2011), but this broadness, especially to firms who have partners from all over the globe, brings complexity to the management of the portfolio. The ways to deal with this complexity are not clear and need future research.

The primary conditions for success in R&D partnerships were established, but research has only started to exploit the theme. Commitment, previous links, the definition of objectives, trust and the partners' reputation are identified as main determinants of success (Mora-Valentin, Montoro-Sanchez and Guerras-Martin, 2004). Anyway, we have not identified an in-depth study on each of these factors, making this an opportunity to test what was proposed in the literature.

Furthermore, there are some longitudinal studies that show the trends of partnerships up to the beginning of the 2000's decade (Bojanowski, Corten and

Westbrock, 2012; Hagedoorn, 2002). Since then, the theme evolved substantially, and the number of partnerships has increased considerably (Kim and Song, 2007). As we have discussed here, firms are expanding their field of research to outside their country borders in a search for knowledge creation and competitiveness. Therefore, there is a good opportunity to update these studies and identify the new trends and data from international alliances of R&D.

The study over small and medium enterprises (SMEs) as international R&D partners has a long way to evolve. Research on SMEs mainly focus on strategies to avoid opportunism (Dickson, Weaver and Hoy, 2006) and transaction and coordination costs (Okamuro, 2007). It is known that high-technology start-ups are in the spotlight of R&D for small and medium enterprises (Colombo, 2009), but we have found very little literature regarding international R&D partnerships for this kind of firms. Broader studies, with an emphasis on understanding the dynamics of international R&D partnerships for SME, would contribute to the literature on international R&D partnerships.

The absorptive capability (Kim and Song, 2007; Autant-Bernard et al., 2007), or the inter-firm learning (Zhang et al., 2010) are shown as essential abilities a firm should have to take the benefits of international R&D partnerships. Nevertheless, the literature is not so clear about the best practices for developing these capabilities, making it into a gap for future studies.

To sum up, the international alliances of R&D make a fertile field for research. They are an increasingly relevant theme as the firms are in the race for innovation on a global scale. Besides, with a particular attention to the gaps in the literature, the knowledge about the field can evolve, making newer contributions to the theory and to the practitioners.

6. CONCLUSION

International R&D partnerships have become even more relevant in academic and press publication in recent years, but still we have found no research agenda in the literature. Firms can no longer treat knowledge creation only inside their borders, so by cooperation the opportunity of accessing external resources is open. An extensive literature has focused on understanding this phenomenon, but there are still gaps for future research. This way, our research has set three objectives: describe the main concepts in international R&D partnerships, identify the best

practices for international R&D partnerships, and propose a research agenda for international R&D partnerships.

As our first objective, we have described the main concepts in international R&D partnerships into three categories: benefits, eventual problems and capabilities required. The benefits stand the importance of going abroad in a search for complementary knowledge. Some of the benefits we identified are: access to state-of-the-art technology, cost sharing (Miotti and Sachwald, 2003), risk sharing (Autant-Bernard et al., 2007) and access to local technological expertise (Duysters and Lokshin, 2011). Despite those benefits, firms may face some issues in this venture, especially related to opportunism (Zhang, 2010). Capabilities to avoid opportunism and to take advantage of partnerships are relevant with a particular regard to absorptive capability (Autant-Bernard et al., 2007) and alliance management capability (Rothaermel and Deeds, 2006).

Identifying the best practices for international R&D partnerships was the second proposed objective. The exploitation of relational capabilities and experience (Rothaermel and Deeds, 2006; Mora-Valentin, Montoro-Sanchez and Guerras-Martin, 2004) were placed as some of the best practices for success in these ventures. Strategy, the choice of a partner and a country and formation of partnerships were also treated in the best practices section.

As gaps in the literature, we have found at least seven opportunities for complementary research. Although the literature suggests suppliers as a good opportunity to build R&D partnerships (Petersen, Handfield and Ragartz, 2003), no specific measures for evaluating the capacity of each supplier to contribute was proposed. Joint patents are another opportunity for scales development which little literature has covered yet. There are also some practical issues that were not fully developed in literature. For example: the ways to deal with a complex portfolio of partners, the dynamics of international R&D partnerships for SMEs and the development of absorptive capability and intra-firm learning. Also, the primary conditions for successful R&D partnerships need in-depth studies (Mora-Valentin, Montoro-Sanchez and Guerras-Martin, 2004). As a last opportunity identified, secondary data studies have shown the trend of international R&D partnerships up to the 2000's decade and must be updated.

Through these three objectives, we bring our contributions to the theory and practitioners. By defining

a research agenda, we believe that future researchers have the opportunity to identify a path for complementary contributions to literature in such an important theme. Besides, practitioners may select a suitable strategic alternative among the best practices to take advantage of international R&D partnerships.

7. REFERENCES

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