Internal and external technology sourcing impact on Innovation performance: a review and research agenda

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Summary

An important part of innovation performance concerns the way through firms can source technology. Internal versus external technology sourcing and the impact on innovation performance have gained considerable attention over decades. However, research articles have produced conflicting or mixed results and conclusions. Some scholars focus on internal development of technology, whereas others focus on external technology sourcing. We review the literature and develop a comprehensive framework, which groups the key links that have been examined in major papers published in key journals. Based on this framework, we synthesize the key findings giving a global view of the debates. Furthermore, we highlight unresolved questions after a critical assessment section. We also propose promising avenues for future research in the field.

Keywords: Innovation performance, Geographic dispersion of R&D, Organizational structure of R&D, Collaboration/Network, Acquisition.

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INTERNAL AND EXTERNAL TECHNOLOGY SOURCING IMPACT ON INNOVATION PERFORMANCE: A REVIEW AND RESEARCH AGENDA

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An important part of innovation performance concerns the way through firms can source technology. Internal versus external technology sourcing and the impact on innovation performance have gained considerable attention over decades. However, research articles have produced conflicting or mix results and conclusions. Some scholars focus on internal development of technology, whereas others focus on external technology sourcing. We review the literature and develop a comprehensive framework, which groups the key links that have been examined in major papers published in keys journals. Based on this framework, we synthetize the key findings giving a global view of the debates. Furthermore, we highlight unresolved questions after a critical assessment section. We also propose promising avenues for future research in the field.

Keywords: innovation performance; internal technology sourcing; external technology sourcing.

1. Introduction

Firms operate, today, in a highly competitive environment and under the pressure of fast technological changes. Evidence suggests that technological changes affect the environment in which firms survive (Tushman & Anderson, 1986; Teece et al. 1997). The onus is on them to come up with new and better ways of coping with their internal and external environment to maintain competitive advantage (Hill & Rothaermel, 2003; Roberts & Amit, 2003). There is growing recognition that to ensure firm’s competitiveness, one of the ways is to be innovative (Kessler & Chakrabarti, 1996; Brandenburger & Stuart, 1996; Filipescu et al., 2013). The concept of innovation

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performance is defined as achievement in the trajectory from conception of an idea up to the introduction of a technological invention into the market (Ernst, 2001; Hagedoorn & Cloodt, 2003). It enables firms to face technological changes. Regarding its strategic role for firms, it has attracted considerable interest among a large body of scholars over the past three decades. Literature research suggests two key strategies for firms to be innovative.

The first strategy is an internal development of technology, such as Research & Development (R&D) projects. Firms can receive a unique source of competitive advantage (Hymer, 1976) and of proprietary content (Anderson & Gatignon, 1986). However, evolutionary theory of firm by Nelson and Winter (1982) have suggested that accumulation of knowledge is not the unique matter, but continuous search and selection process to upgrade knowledge are also critical (Chang, 1996; Christensen, 2000). Therefore, some authors suggest a second strategy. In this strategy, firms can acquire the technology which exists outside the boundaries their firm through external technology sourcing (Chesbrough, 2006; Vanhaverbeke et al., 2002; Tsai & Wang, 2009). Hence, firms can keep up with up-to-date knowledge and/or reconfigure existing knowledge.

What is the right strategy to develop and maintain innovation performance? Should firm generate innovation performance internally or externally? Is there a relationship between innovation performance and corporate strategy of the firm? And how does it work? Those are central questions that have motivated diverse streams of research in this literature. Scholars have tried to answer these issues. However, as of yet, no satisfactory answer has been found. Our objective, in this review, is to facilitate a clear understanding of the issue and favor future research.

In doing so, our review makes several contributions. First, we update prior reviews. Indeed, our review concerns empirical research articles published in key management journals from 1970 to present. As recommended by Short (2009), a review started to be appropriate when a topic has received considerable attention, and when there is more than 5 years after the latest review. To the best of our knowledge, the latest article, reviewing technological innovation sourcing, dates back to 2005 (de Man & Duysters, 2005). Indeed, since 2001, the trend of publications on this topic has grown quickly. Second, limited articles on innovation performance in key management journals have focused on a multilevel approach (Rothaermel & Hess, 2007). As innovation performance required diverse and heterogeneous actors, and context at each stage of the process, we propose future research on the basis of a multilevel approach within the main streams that we will exhibit. Third, we point out the theoretical and empirical contradictions. Finally, we suggest several avenues of future research through presenting the unexplored questions emerging from the literature reviewed. By giving a synthesis and critical approach of the literature on technological innovation sourcing issues we hope to increase the understanding of the topic.

2. Evolution of Innovation Performance Strategic Role for Firms
Innovation output, innovation performance, innovation returns or innovativeness are diverse terms based on the same construct that have been presented in the literature as the ability for firms to succeed in introducing new products or new processes into markets (Freeman & Soete, 1997). Early studies have mostly presented innovation activities as exploitation of internal assets such as technological resources (R&D or patents), which give specific advantages helping to be competitive over rivals (Hymer, 1976; Rugman, 1981; Kuenmerle, 1999; Ambos & Schlegelmilch, 2007). In this literature, firms can use efficiently internal resources to develop, deploy and accumulate knowledge helping to produce new products and/or services (Eisenhardt & Martin, 2000; Grant, 1996; Helfat & Raubitschek, 2000).

Several studies have analyzed the role of R&D suggesting that it enhances technological research, creation, patents to be granted, and consequently new products or services production (Artz et al., 2010; Penner-Hahn & Shaver, 2005). However, development and exploitation of technological resources are costly and risky due the uncertainty of environment. Hence, some authors have suggested the need for firms to leverage these risks through external activities (Feinberg & Gupta, 2004). They have argued that when firms stay in an introspective view of the management of their know-how, they can bar their ability to get new ideas and knowledge from outside (Cantwell, 2003). Firms might source technology externally in order to gain economies of scope and scale (Cassiman & Veugelers, 2002), but also to get new knowledge that will be hard to develop internally (Tsai & Wang, 2008). The two main external sources that have been studied, at inter-organizational level, are collaboration, including inter-firm network and strategic alliances (Hagedoorn, 1993; Harrison et al. 2001; Ahuja 2000a; Owen-Smith & Powell, 2004), and acquisition (Chakrabarti et al., 1994; Ahuja & Katila, 2001). Authors have also examined intra-organizational network focusing on knowledge output and flow (Gupta & Govindarajan, 2000; Tsai, 2001; Rulke & Galaskiewicz, 2000). Finally, a recent but fast growing stream of literature started to study internal and external technology sourcing as complementary (Hagedoorn & Wang, 2012; Capron & Mitchell, 2004) and not substitute. Articles show that if firms want to really be innovative, they need to combine these two ways to obtain technological resources (Cassiman & Veugelers, 2006; Fleming, 2001; Tsai, 2009).

In the next sections, we will present the methodology used in this review, the links studied through an integrative and comprehensive framework and propose a discussion and an agenda for future research in the field.

3. Methodology of Review

In an effort to manage the scope of our review and ensure representative coverage of relevant studies, we followed the principle of systematic review methodology suggested by Transfield, Denyer & Smart (2003). Basically, this method suggests the use of rigorous, replicable and transparent process to synthesize and discuss best evidences (Cook et al., 1997). Recent literature reviews have used the logic of this method (Phelps et al., 2012; Provan, Fish & Sidow, 2007).
Five steps form the structure of our method. Firstly, we adopt a ‘keywords-search’ criterion with two sub-steps using five databases. These databases (ABI/inform, Scopus, Business source premier and PsycInfo) are largely used in reviews’ process within management field. Initially, we started by searching the keyword ‘Technology innovation’ in articles’ titles and abstracts in order to see what is the trends in this literature. Next, we associated ‘Technological innovation’ to a list of keywords such as ‘Acquisitions’, ‘Alliances’, ‘collaboration’, ‘networks’, ‘joint venture’. In order to be sure that we did not miss some important articles, we used the same process on the website of the above key management journals. This search yielded 1190 articles. Subsequently, we limited our review to empirical studies published in leading management and social sciences journals, starting from 1970 to the present. In doing so, we followed Phelps et al. (2012) arguments to facilitate comparisons between each article’s insights. Finally, we manually reviewed the abstracts of these articles for relevance. We reckoned an article as potentially relevant on the base of three conditions: (1) the article was an empirical study published from 1970 to present; (2) the dependent variable is technological innovation with explanatory variables that are internal or external modes of technological innovation sourcing; (3) the dependent variable is performance or characteristics of value creation with explanatory variables that is technological innovation. By using this process, we retrieved articles that do not meet our criteria, resulting in a final set of 163 articles. From the analysis of this set of articles, we coded and categorized the articles, identifying the primary variables and key findings.

4. Overview of Empirical Findings

4.1. Internal Source of Technology as Antecedent of Innovation Performance

R&D is the main factor examined by researchers as driving innovation performance. Two major aspects of R&D have been examined: geographic dispersion and organization structure.

4.1.1. Geographic dispersion of R&D

Some findings have suggested that the geographical dispersion of R&D impact the generation of innovation performance (Gassman et al., 2010; Castellani & Zanfei, 2006). The main objective of firms in this context is to gain access to knowledge spillovers from peers (Feinberg & Gupta, 2004; Kuemmerle, 1999). On one hand, authors have shown a positive effect of geographic dispersion of R&D on innovative performance (Lahiri, 2010; Chen et al., 2012; Enkel et al., 2009; Laursen & Salter, 2005). On the other hand, scholars have suggested a negative impact arguing that “nature of local expertise” and difficulty to easily tap into non-local knowledge sources will preclude the expected benefits (Singh, 2008). This shows that the relationship is not that evident. In a context of uncertainty due to the rapid changes in the economic environment of organizations, it is interesting to capture diverse technology where it is available (Garcia-Vega, 2006; Miller, 2004). However, a too diversified technology could imply a difficulty to deeply
exploit the benefits of its geographical distribution and negatively impact innovation performance. Empirically attesting this case, Lahiri (2010) has found that a very wide geographical distribution of R&D reduces the quality of innovation. This shows that the relationship between geographic distribution of R&D and quality of innovation is not linear but an inverted U-shape with a moderating role of technological diversification. Another element that has gotten considerable attention are the ways the organizations integrate effectively their intra-organizational linkages across each of their locations. In the same line with authors such as Almeida and Kogut (1999), Lahiri (2010) have found that high integration of firm’s intra-organizational linkages increase the positive impact of geographic distribution of R&D on quality of innovation. As the question of this integration remains important for organizations, the timing with which and the way they manage it is also critical (Singh, 2008). Authors have also shown that geographical dispersion of R&D is embedded in different stages presented as decentralization and recentralization (Gerybadze & Reger, 1999; Song, Asakawa & Chu, 2011), but also the organizational slack (transition stage). Asakawa (2001) describes organizational slack as the time where organizations shift from decentralization to recentralization. Following this author, Chen et al. (2012) have provided evidence of a horizontal S-shape link between geographical dispersion of R&D and innovation performance moderated by organizational slack with a positive effect in decentralization time followed by a negative effect in transition time and finally positive effect in recentralization time.

4.1.2. Organization Structure of R&D

Here two major characteristics are being debated, centralization versus decentralization of R&D organizational structure. Decentralization has first been presented by Damanpour (1991) as a hierarchy and decision-making moving down, for example from headquarter to organizational divisions. Therefore, the question is what is the impact of the choice between these organizational characteristics on innovation performance? Following Damanpour (1991) description of R&D organizational structure, Cardinal (2001) have suggested that decentralization increases channels enabling divisions to interact and be coordinated with each other, but also increases the quantity and quality of knowledge and ideas. Going in the same direction, Gupta and Govindarajan (2000) have suggested that decentralization increase the perception of autonomy among units and motivation to augment the stock of knowledge and share it within the organization. Thus, decentralization is supposed to enable more research efforts and consequently innovation performance (Sheremata, 2000). Conversely, decentralization of R&D structure should induce internal transaction costs associated with interdivisional coordination. For this reason, Argyres and Silverman (2004) have concluded that fully centralized R&D activities will tend to increase level and breadth of innovation more than fully decentralized R&D activities. The result remained contradictory and other authors have extended the analysis using an exploration-exploitation framework. Indeed, Jansen et al. (2005) went beyond the above view and found that centralization reduces the level of explorative innovation performance but not increases exploitative innovation as could be
expected regarding the fact that it diminishes non-routine problem solving (Atuahene-Gima, 2003). Therefore, they partially contradict Cardinal (2001) findings.

### 4.2. External Technology Sourcing as Antecedent of Innovation Performance

Most of articles on external sourcing of technological innovation have studied collaboration/network (Phelps, 2010; Tsai & Wang, 2008; Vanhaverbeke et al., 2009; Hagedoorn & Duysters, 2002) and acquisition (Ranft & Lord, 2002; Vanhaverbeke et al., 2002, Ahuja & Katila, 2001; Katila & Ahuja, 2004), as key modes that impact firm-level technological innovation.

#### 4.2.1. Collaboration/Network

Authors have considered intra-organizational (Hansen, 2002; Tsai, 2001; Hansen, Mors & Levás, 2005) as well as inter-organizational networks (Ahuja, 2000; Stuart, 2000; Soh et al., 2004; Sampson, 2007; Schilling & Phelps, 2007) as critical for innovation performance. Regarding structure of network, a great number of direct ties positively impacts innovation performance (Ahuja, 2000; Owen-Smith et al., 2004; Tsai & Ghoshal, 1998; Tsai, 2001). Maintaining these ties can be more costly than the benefits of knowledge creation, implying a negative effect (Wadhwa & Kotha, 2006; Hansen, 2002). These conflicting results have conducted scholars to investigate on network composition focusing on the depth (Stuart, 2000), partner resources or the technology diversity (Baum et al., 2000). At inter-organizational level, as firms partners could be connected with each other, researchers have introduced a third part of the “ego-network” that is their degree of connectivity or non-connectivity, which should impact, in their point of view, innovation performance. Still, they have found conflicting results. Indeed, for some scholars, connectivity (structural holes) increases knowledge creation and diffusion, and ultimately innovation performance (Ahuja, 2000; Schilling & Phelps, 2007; Faems, Van Looy & Debackere, 2005). On the contrary, non-connectivity creates and intensifies trust, common identity and reduces opportunism behaviors (McEvily & Zaheer, 1999; Hargadon and Sutton, 1997). Intending to find possible response to these conflicting results, recent scholars such as Phelps article (2010) called for a more deep analysis of “network composition”. Finally, firm capacity to get benefits of network and increase innovation performance depends also on it centrality in the network compared to other members. The more a firm is central to the network, the more it will benefit from external technological knowledge (Argyres and Silverman, 2004).

Authors have also examined the real nature of the ties (its strength), geographic and competitive proximity within the network. Strengthen ties refer to closeness of relationships within the network which is developed through long duration, frequency, intensive or repeated partnering overtime (Bouty, 2000; Lane, Salk & Lyles, 2001; Simonin, 1999). Strong ties have positive impacts on innovation performance through innovation adoption, knowledge creation and knowledge transfer (Capaldo, 2007; Tiwana, 2008; Lavie, Lechner & Singh, 2007). It is due to trust, reciprocity and common identity resulting from intrinsic characteristics of strengthen ties (Lane et al.; 2001).
These social interactions favor interfirm learning but also knowledge flows (Tiwana, 2008). On the contrary these closed links will generate inverted U-shaped relationship at best (Molina-Morales and Martinez-Fernandez, 2009) which would otherwise have negative impact on the ability to acquire new ideas (Yli-Penko et al., 2001). Furthermore, they will imply a collective blindness precisely because partners are highly trustful of each other (Lane et al., 2001). For some scholars, proximity could imply a tendency of knowledge to become more similar and complementary increasing their ability to learn more from each other, and increase their innovation performance regarding (Lane & Lubatkin, 1998, Simonin, 1999; Rothaermel & Alexandre, 2009; Rothaermel & Hess, 2007). Conversely, as partners are in many cases in competition with each other, the similarity tendency could lead them to be more protective of their knowledge thereby reducing transfer and knowledge creation (Baum et al., 2000).

4.2.2. Acquisition

Researchers have argued that firms will better face increasing costs and complexity of technology development by acquiring technology from outside (Vanhaeverbeke et al., 2002; Fey & Birkinshaw, 2005; Vermeulen & Barkema, 2001). In such a context, they could access new ideas that they would have not gotten internally and develop innovation performance. In many scholars, different characteristics of technological knowledge acquired, such as size and relatedness of knowledge, are examined. Studying firm’s size, authors have found that absolute size of acquired firm compared to acquiring firm increases innovation performance, while large knowledge base of acquiring firm relative to acquired firm reduces it (Ahuja & Katila, 2001; Cloo dt et al., 2006). Regarding relatedness, researchers have found that when the acquirer and the target firm are technologically related, this relatedness will induce a positive effect of acquisition on innovation performance (Cassiman et al.; 2005, Desyllas & Hugues, 2010, Bena & Li, 2012). Nuancing the above conclusion, other authors have determined an inverted U-shape effect, arguing that technology relatedness will lead to positive effect in a first time due to economy of scale and scope and also to facility to integrate similar knowledge from a learning point of view (Ahuja & Katila, 2001; Cloo dt et al., 2006). However, due to the redundancy of technology, they have concluded that the effects on innovation performance will be reduced. The way firms integrate acquired firm (in terms of knowledge and employees) is also a critical to maintain innovation continuity (Ranft & Lord, 2002). First, key inventors in the acquired firm are human resource that are at the beginning of all and are the essence of knowledge creation and of innovation. They can decide to quite the target firm before the completion of the acquisition. This fact can reduce the potential knowledge to be acquired and negatively impact innovation performance (Ernst & Vitt, 2002). Thus, acquiring firm has to keep them inside through incentives to stay (Kapoor & Lim, 2007). Second, researchers have examined how structural integration impact innovation outcomes in technology acquisition (Puranam, Singh & Zollo, 2006). They have found
that loss of autonomy will conduct to negative effect on initial innovation from acquired firms that have not sold new products, but also on first innovation post-acquisition.

4.3. Review of Moderators

There are various factors that influence the link between innovation performance, antecedents and outcomes in the literature. These factors can be synthetized into organizational characteristics, environment, resources characteristics and other moderators.

4.3.1. Organizational characteristics as moderators

The extent of knowledge sharing impacts innovation performance by increasing *intra-organizational linkages*, in the sense that units can rapidly localize knowledge needed to solve problems due to information provided by previous intra-organizational linkages (Lahiri, 2010; Hansen & Løvås, 2004). Lahiri (2010) argues that positive effect of geographic dispersion of R&D on innovation performance will be reinforced with strong intra-organizational linkages. Furthermore, she suggests that these linkages considerably undermine the negative impact of a too wide geographical dispersion on innovation performance. A second influential element that has been discussed in literature is *organizational slack*, particularly with a direct effect according to the learning literature (Tan & Peng, 2003; George, 2005). Recent authors suggest an analysis of organizational slack as a moderator (Chen et al., 2012). They follow Lawson (2001), who has defined organizational slack as a contextual factor enabling firms to adjust successfully internal pressures with external pressures for changes. In their paper, they show that organizational slack will negatively moderate the link between R&D internationalization and innovation performance.

4.3.2. Environmental factors as moderators

Geographical location of R&D can be in an international or domestic environment. Doing business in an international context implies interaction with different national systems. Therefore, cultural distance between home country and host country’s national systems has long been discussed in the international business and strategic management research (Tihanyi et al. 2005; Brouthers & Brouthers, 2001; Gomez-Mejia et al., 1997). Prior research has discussed cultural distance regarding its direct effect on international strategies finding conflicting results (Luo & Peng, 1999; Erramilli et al. 1997; Morosini et al., 1998). Recently, regarding the literature on antecedents of innovation performance, authors have discussed cultural distance as moderator and have found that it increases the impact of post-acquisition innovation performance of acquiring firm, forcing firm to rethink innovation strategy in a more international environment (Cloodt et al., 2006).
4.3.3. Technology characteristics as moderators

Firstly, technology diversification is a way to differentiate over rivals and get competitive advantages (Hitt et al., 1997; Miller, Fern & Cardinal, 2007). It leads firms to conduct their search widely and increase their ability to recombine new knowledge with existing one, as it increases the likelihood to possess related knowledge inside (Rosenkopf & Nerkar, 2001; Lahiri, 2010; Phelps, 2010; Ahuja & Katila, 2004). However, authors such as Lahiri (2010) have pointed that it negatively moderates the link between geographical dispersion of R&D and innovation, as it increases the costs of duplication of elements of diverse technological resources in all locations.

Secondly, technology relatedness matters. As explain in the beginning of this review, one motivation of firms to make acquisition is to gain specific knowledge from others. However, literature has pointed out that capacity to integrate post-acquisition knowledge remains critical (Ahuja & Katila, 2001). This is in the same line with prior studies that have argued that relatedness in technology increases the potential for future synergies (Piscitello, 2004). Hence, based on prior argument of Cassiman et al. (2005) have suggested that technology relatedness; in contrast to other studies which discussed a direct effect (Ahuja & Katila, 2001), will positively moderate the link between acquisition and innovation performance. Their results are consistent with those with Rodriguez-Duarte et al. (2007).

Thirdly, market relatedness also matters. When firms are rivals in a related market, their products can be substitutable. This market relatedness can influence the choice to acquire rivals when expecting to get target’s specific knowledge in order to increase potential of innovation performance and more market power. However, recent scholars discussing market relatedness, as moderator, have found that rivals receive little technology benefits from mergers, as they dampen redundant technology and thus potential innovation (Cassiman et al., 2005, Atuahene-Gima, 2005).

Finally, network factors also matters. Trying to find the reasons for the conflicting results highlighted in prior scholars about the effect of network on innovation performance, Phelps (2010) suggests another perspective. He argues that an important aspect of network that has not been taken into account is network density. This density increases trust and common identity and reciprocity between partners, which facilitate knowledge sharing (Gulati & Sytch, 2008). Therefore, Phelps (2010) suggests that network density moderates the curvilinear effect of network (or alliances) on explorative innovation.

5. Critical assessment and avenues for future research

Our review pinpoints several gaps in the literature leading to interesting avenues of future research for scholars investigating innovation performance. Overall, new theoretical approaches developed recently can help to enhance understanding of this phenomenon. For instance, Dynamic Capabilities perspective, since it addresses the question of how firms can anticipate changes in its environment, it can help to make further in-depth study of capabilities necessary to reconfigure internal assets after external knowledge
acquisition (Lavie, 2006; Karim, 2006). Furthermore, it addresses critical managerial issues such as “capability monitoring”, which help scanning environmental changes (Teece, 2007; Schreyögg and Kliesch-Eberl, 2007). Moreover, detailed investigation of the phenomenon using multiple levels of analysis, refined measures and the role of time in relationships are potentially interesting directions for future research.

5.1. Internal Technology Development

5.1.1. Geographic Dispersion of R&D

As our review shows, research has produced conflicting results on the link between geographic dispersion of R&D and innovation performance. For some authors, (Schulz, 2001; Lam, 2003) positive effects were observed, whereas others experienced negative effects (Singh, 2008). Other suggestions included an inverted U-shape () or S-Shape links (Lahiri, 2010, Chen et al., 2012). A variety of gaps is highlighted under this review and such conflicting results can be explained. Firstly, there is a common feature among these studies. They have mostly investigated the above links assuming that all firm’s portfolio of R&D will homogeneously produce innovation performance, which is not the case in the real world. Secondly, these scholars have treated formal interactions in an almost exclusive way, yet informal aspects are just as central since they can enhance innovation performance (Reagans & Zuckerman, 2001; Nickerson and Zenger, 2002). Finally, creation, transfer and diffusion of knowledge abroad or to simply locate R&D activities outside is embedded in the cultural (informal) or institutional (formal) distances existing between home and host country (Tihanyi, Griffith & Russel, 2005). Therefore, the behavior of economic actors depends on the institutional context. This perspective has gained a great deal of interest in recent management and international business research. Yet, as our review indicates, innovation performance is under contextualized. Moreover, many scholars have suggested that competitive and institutional pressures influence a firm’s likelihood to conduct activities abroad (Tihanyi et al., 2005; Hennart & Larimo, 1998). Furthermore, both host country and home country environment influence the likelihood to integrate new ideas or knowledge (Almeida & Phene, 2004; Mu et al., 2007).

Future research could explore how, when, and why institutional context enables and constrains link between innovation performance, it antecedents and outcomes. Similarly, as institutions are heterogeneous depending on their location, research could study how institutional heterogeneity influence knowledge creation and sharing. Institutional context in host-markets in which firms have activities and adaptation to this context could influence the way they operate under home-markets. Therefore, future research should examine the questions of (1) what could be the institutional implications of having technological international activities on home-markets technology development? (2) How are norms exported or imported by firms and their stakeholders? (3) Do institutions in different nations converge or diverge with increased international exchange?
5.1.2. Organization Structure of R&D

The issue relative to the optimal form of organization structure impacting innovation performance is important. Therefore the question is, should it be a fully decentralized R&D activities as proposed by Cardinal (2001) to gain more knowledge and ideas and perception of autonomy (Gupta & Govindarajan, 2000), or a fully centralized R&D activities as suggested by Argyres & Silverman (2004), to avoid interdivisional coordination costs? Argyres and Silverman (2004) also suggested considering a hybrid form. This R&D organization structure is anchored both in the location of the corporate headquarter (for the central responsible of R&D activities) and the business division level (that can be near or far from the corporate headquarter). They have not found significant results, perhaps due to a lack of theoretical basis, as suggested themselves. Scholars can develop new theory to examine this hybrid form. However, we suggest that the major point is the way which managers at each level of the organization are implicated in R&D projects irrespective of the organizational structure. In fact, it is important that managers’ interests differ from shareholders. For instance, incentives could be a motivation for managers to develop only technological projects that are perceived as creative. Therefore an issue could be, (1) what is the role of management incentives on the impact of organizational structure on innovation performance? (2) What is its long-term impact?

5.2. External Technology Sourcing

5.2.1. Collaboration/Network

Different gaps could be pointed out, stemming from basic assumptions. Firstly, most of authors assume that firm can access to diverse information and that the innovation benefits stemming from the network closure are mutually exclusive. Secondly, authors also assume that network density will conduct to access to information from same partner overtime (Phelps, 2010; Ahuja, 2000). This implicitly means that partners will become homogeneous overtime and then reduce diversity of knowledge and information shared. This gap calls for further research. (1) How does homogeneity between partners can harm innovation performance? (2) Do specialized and diverse partners in a dense network increase the positive effect on innovation performance? (3) How do inter-organizational and interpersonal networks interact to produce social capital and how this social capital influences knowledge transfer and innovation?

5.2.2. Acquisition

Link between acquisition of technological knowledge and innovation performance have largely been studied. Currently, one of the factors of the linkage, technological knowledge, remains over-explored. There is a consensus between authors suggesting that technology relatedness is the most important thing to take into account for post-acquisition innovation performance (Prabhu, Chandy & Ellis, 2005; Ahuja & Katila, 2001; Cassimian et al., 2005). They consider that this relationship increases the ability to
integrate external knowledge and easily recombine assets. The importance of this relationship is undisputed. However, acquiring unrelated technological knowledge can be interesting as this encourages a more broader view of the variety of technological domains and to graft new technology opportunities (Leiponen & Helfat, 2010; Ahuja & Katila, 2004). Therefore, it is surprising that only a few scholars have explored the role of unrelated technology.

Another important gap is that, apart from Duarte et al. (2007) or (Zhao X., 2009), very little studies have treated reciprocal relationships. Indeed, firms need to respond to rivals’ innovativeness and to provide counterattack to stay competitive (McGahan & Silverman, 2006). When rivals innovate disequilibrium is created in firms’ corporate portfolio and scope, leading to a necessary reconfiguration of resources (Kaul, 2012). It could also conduct firms to search for an entry in new business areas to obtain new proven resources (Helfat & Eisenhardt, 2004; Helfat and Libermann, 2002) or acquiring competitors (Capron & Chatain, 2008). In such context, acquisition becomes an outcome of innovation performance, implying a reciprocal relationship. This view is in line with dynamic capabilities perspective embedding innovation performance in the need for firms to build capabilities that will enable them to face extreme changing environments (Hill & Rothermel, 2003, Teece, 2007; Helphat et al., 2007). Finally, integration of technological knowledge acquired post-acquisition have also received considerable attention with mixed conclusions. The explanation of such diverse conclusion can stem from the fact that firms have made acquisition of technology because other firms have also done so, whereas acquisition was not the right mechanism (Capron & Mitchell, 2013). Perhaps, scholars might shift the focus from post-acquisition mechanisms to criteria that foster firms to make the right choice of technology sourcing. Therefore future research can explore the following issues, (1) how do firms manage knowledge acquired over time to maintain innovation performance? (2) Under which condition unrelated acquisition can foster innovation performance? (3) How can firm respond to rivals innovation? (4) What are the criteria that can allow firms to make the right choice of technology sourcing? Finally, as scholars have taken into account market and technology relatedness and knowledge size (Cloodt et al., 2006; Ahuja & Katila, 2001), one can assume that market size remains also important. In such a context, (5) what is the effect of combination of market size and knowledge size on innovation performance?

6. Other Avenues for Future Research

6.1. Levels of Analysis

Scholars researching innovation performance have usually focused on a single level of analysis, like individual-level of analysis (Ernst & Vitt, 2002; Kappor & Lim, 2007), firm-level (Cassiman et al., 2006) or organization-level (Lahiri, 2010; Chen et al., 2012). However, industry-level analysis has yet to be discussed. However, many empirical scholars usually use high-tech industry sample and have called for future research investigating other industry samples (Hagedoorn & Cloodt, 2003; Tsai & Wang, 2009).
Although emerging scholars have pointed out that national innovation systems, which is embedded in the country’s (home or host) environment, supports innovative activities (Carlsson, 2006) and less is done on country-level analysis. Therefore, we expect scholars to increase this investigation. Finally, there is hardly or no scholars who have investigated cross-level analysis. Yet, exploring this avenue could help to take into account interaction between multiple indicators.

6.2. Statistical Measures of Innovation Performance

Diverse indicators have been used by numerous scholars, such as R&D, number of patents, patent citations or new product announcement (Puranam et al., 2006) in order to measure innovation performance (Hagedoorn & Cloodt, 2003). Some scholars have used one single indicator whereas other has suggested using a composite of multiple indicators (Garcia-Vega, 2006). Our review shows that research articles mostly use patent citations as it includes a measure of the quality of patent (Lahiri, 2010; Chen et al.; 2012; Miller, 2004). Hence, despite the interesting work of Hagedoorn and Cloodt (2003) suggesting that a composite indicator (including the four indicators) enables the capture of most innovation phenomenon; their sample consists of a single industry that is High-tech. Therefore, future research could examine, based on the same construct, the validity of the composite indicator with a sample of firms from other industries. More than to just improve the statistical validity of this indicator, the unclear results also perhaps call for a reconceptualization of the concept.

6.3. Time effect

All of the links studied in each of the articles reviewed are embedded in a temporal dimension. For example, scholars that have discussed network effect on innovation performance have given great attention to costs of network (Ahuja, 2000), but have also suggested that these costs could be overcome by the trust and the identity created by network density (Phelps, 2010). However, an interesting avenue of research could be: what are the long-term costs of alliance network and how can firms overcome it? Furthermore, despite having considered relatedness in the literature review as increasing the capacity to integrate knowledge from outside, scholars have not yet studied this effect in the long-term: How does relatedness impact link between acquisition and innovation performance in the long-term? Finally this question of temporality is critical as firm life cycle is embedded over time. Therefore we expect scholars to investigation the temporality question through longitudinal analysis.

7. Conclusion

In this review of the literature, we attempted to give a global view of scholars examining the link between innovation performance, its antecedents and outcomes. We highlighted many insights. First, two main factors impact innovation performance: internal technology development (Lahiri, 2010; Eisenhardt & Martin, 2000; Grant, 1996; Helfat
& Raubitschek, 2000) and external sources of knowledge such as acquisition and alliances (Cloodt et al., 2006; Tsai & Wang, 2008; Ranft & Lord, 2002; Vanhaverbeke et al., 2002). We must note that other modes of external technology sourcing, such as crowdsourcing, innovation intermediaries or corporate venturing (Van de Vrande, 2009), exists. However, less is known about whether internal technological capabilities impact the choice between the different modes of external technology sourcing (Hagedoorn & Wang, 2012), for instance alliance and acquisition and which are the main modes used. Ultimately less is known about the extent to which the previous link impacts innovation performance. Hence, our study attempts to investigate external knowledge sourcing as mediating the relationship between internal technology capabilities and innovation performance.

References


