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| RESEARCH ARTICLE

Exploring the Impact of Relational and Geographic Search on Firm Innovation

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| ABSTRACT

This paper explores the interplay between geographic and relational search behaviors and their impact on innovation generation within firms. Extending previous research, our study explores the dual influences of geographic proximity and relational dynamics on both the quantity and quality of innovations. We develop a conceptual framework to examine the combined effects of these factors, identifying four distinct types of firm knowledge search behaviors and analyzing their repercussions on innovation outcomes. The study highlights the necessity for managers to adopt a balanced approach in strategic knowledge search. By acknowledging the trade-offs between different search strategies, managers can more effectively navigate the complexities of innovation processes. This balanced approach is essential for optimizing innovation outcomes and achieving sustained success in a rapidly changing business environment. Our study emphasizes the importance of a nuanced understanding of geographic and relational searches. By integrating these insights into their strategic planning, firms can enhance their capability to generate both incremental and breakthrough innovations, thereby strengthening their competitive position in the market. This paper provides valuable guidelines for firms aiming to enhance their innovation portfolios through informed and strategic knowledge search behaviors.

| KEYWORDS

Relational proximity, geographic proximity, strategic alliance, cluster, firm innovation, breakthrough innovation

| ARTICLE INFORMATION

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1. Introduction

Contemporary research emphasizes the increasing significance of analyzing how firms pursue knowledge as they strive to foster innovation (Ahuja & Lampert, 2001; Katila & Ahuja, 2002; Nerkar, 2003; Xiao et al., 2022). This literature stream suggests that firms face dilemmas in terms of where to look for knowledge—within the firm or outside the firm, within close proximity or beyond, within the firm's technological domain or outside. The literature on knowledge spillovers (Audretsch & Belitski, 2022; Blazsek & Escribano, 2010; Jaffe et al., 1993) indicates that knowledge often remains confined within the geographical limits of a cluster. Additionally, the cluster knowledge literature (Guo et al., 2023; Tallman et al., 2004) proposes that only firms within close geographic proximity to such clusters have access to this concentrated knowledge. While it might be simpler for firms to utilize knowledge that is locally available, accessing knowledge from outside their immediate geographic area can be challenging. Consequently, firms might end up utilizing local knowledge instead of the knowledge that best meets their needs. Alliances, which represent a form of relational (formal) proximity, might facilitate access to the necessary external knowledge (Arora et al., 2021; Mowery et al., 1996); however, the effectiveness of the knowledge acquired through these various channels remains poorly understood. Despite an increasing awareness of the critical role of external knowledge in enhancing a firm's innovation capabilities, there is still a lack of deep understanding concerning the impact of firms' knowledge-seeking behaviors, especially in terms of relational and geographical dimensions (Capaldo & Petruzzelli, 2014). In this study, we explore the relative effectiveness of searches for knowledge that are either geographically close or relationally close, aiming to determine how these searches affect both the quantity (innovation) and quality (breakthrough innovation) of a firm's innovations.

2. Conceptual framework

In this section, we develop a conceptual framework explaining how relational proximity and geographic proximity and their interactions jointly impact a firm's likelihood of innovation and breakthrough innovation. Breakthrough innovations are « technological inventions that shape the development of industries by opening new paths for many subsequent technological developments" (Ahuja and Lampert, 2001).

2.1 Role of Geographically Proximate Search

Geographic proximate search refers to the knowledge development efforts of a focal firm based upon the co-located firms' knowledge bases. We posit that an intensive search for geographically proximate knowledge can significantly enhance a firm's innovation output for three main reasons. First, there is an increased capacity to capitalize on the knowledge that is readily accessible. Second, the costs associated with searching for this knowledge are lower. Third, there is a higher probability of gaining early insights into the technological endeavors of other co-located firms.

Firstly, geographic proximity enables firms to more effectively monitor and engage with the knowledge development activities of their co-located firms (Howells, 2002). Knowledge often incorporates cultural elements, and understanding these elements is crucial for accurately interpreting and utilizing this knowledge. Being geographically close aids firms in grasping these nuanced aspects of knowledge, thus enhancing their comprehension of information that is available locally (Maskell, 2001). Additionally, the focal firm is likely to share a technological paradigm with its co-located firms (Dosi, 1988), meaning that firms within the same geographic area often operate within similar technological frameworks. This commonality facilitates easier monitoring and understanding of each other's technological advances. Consequently, the knowledge acquired locally is likely to align closely with the focal firm's own technological base, making it more relevant and familiar. This enhanced understanding of relevant knowledge also increases the firm's absorptive capacity (Cohen & Levinthal, 1990), further boosting its ability to capitalize on locally sourced knowledge.

Second, knowledge frequently spills over within its geographical area (Henderson et al., 1998; Jaffe et al., 1993). Informal interactions among employees in close proximity can enable the focal firm to access this spilled-over knowledge more easily and cost-effectively. Since the costs associated with local searches are lower, the focal firm can afford to engage in more extensive searching. Previous research also indicates that firms often acquire a significant portion of their knowledge from sources within their geographical vicinity (Rosenkopf & Almeida, 2003).

Third, the "stickiness" characteristic of knowledge (Szulanski, 2003) implies that firms located geographically closer to the source of knowledge are likely to access this information sooner than their more distant counterparts. Early access to knowledge can be particularly advantageous in environments where timing is crucial, enhancing the utility and potential impact of the knowledge acquired.

Thus, searching for knowledge within geographic proximity enhances understanding, reduces costs, and facilitates earlier access to information. Consequently, firms engaged in geographically proximate searches can afford more extensive exploration due to lower costs and can utilize the knowledge more effectively owing to better understanding and timely acquisition. However, there are potential drawbacks to this approach. As firms intensively search within their immediate geographic area, they might overlook valuable knowledge available in more distant locations. Close geographic proximity often leads firms to monitor and imitate each other, which can result in a convergence of their thinking and knowledge bases (Pouder & St. John, 1996). This local focus may restrict firms to using only the knowledge that is readily available, regardless of whether it fully meets their needs. As a result, these firms might be less likely to produce breakthrough innovations, which often require the integration of diverse types of knowledge. Accordingly, we propose:

Proposition 1a. *As a focal firm's intensity of geographically proximate search increases, the likelihood of innovation increases.*
Proposition 1b. *As a focal firm's intensity of geographically proximate search increases, the likelihood of breakthrough innovations decreases.*

2.2 Role of Relationally Proximate Search

Relational proximity refers to the presence of formal co-operative agreements between two firms. We argue that the relational proximity of the focal firm to its partner firms offers a significant opportunity to enhance the firm's innovation capabilities. This enhancement occurs through the interaction of organizational routines, a sustained focus, and a committed allocation of resources (Ahuja, 2000; Mowery et al., 1996; Powell et al., 1996). By fostering close relationships with partner firms, the focal firm can facilitate a more effective exchange of ideas and practices, which is crucial for innovative activity. This relational closeness not only encourages a continuous exchange of knowledge but also supports a collaborative environment where shared goals and commitments to resources further strengthen the potential for innovative outcomes.

First, it is important to recognize that organizational knowledge is typically dispersed among numerous individuals within a company (Pinch et al., 2003). Additionally, some of this knowledge may be embedded in organizational routines, transcending the individual knowledge held by employees (Nelson & Winter, 1982). Firms that are more innovative tend to incorporate a larger portion of their tacit knowledge into these routines (Lawson & Lorenz, 1999). The formal relationships between firms facilitate systematic and focused interactions among their teams and within their organizational structures (Dyer & Singh, 1998). Such structured and deliberate interactions are pivotal for the exchange of valuable knowledge, which, in turn, significantly boosts the innovation capabilities of the partnering firms.

Second, the establishment of formal relationships provides a clear direction for search efforts. Firms often form alliances with specific, predefined goals in mind, and these formal relationships offer a structured framework that shapes the context in which employee interactions occur. Innovation frequently requires sustained and focused interactions among groups of employees, rather than sporadic, undirected exchanges among individuals. Therefore, in the context of a formal relationship, the focal firm and its partners engage in more deliberate and systematic efforts to search for knowledge. This focused approach not only enhances the effectiveness of employee interactions but also enables the firms to commit the necessary resources to achieve their set goals.

Moreover, formal interactions bring essential organizational resources into play, which are critical for achieving innovation outcomes. Even informal interactions among employees take on a different quality in the presence of a formal organizational relationship compared to when such a relationship is absent. When employees interact within the framework of a formal relationship, their exchanges are more likely to influence organizational-level outcomes, particularly innovation. In contrast, informal interactions without the backing of a formal organizational relationship lack the organizational leverage necessary to mobilize resources effectively and, as a result, may have a limited impact on the firm's innovation capabilities.

Firms establish formal relationships based on the specific resources they require, making these relationships inherently need-based. Generating breakthrough innovations demands a diverse array of resources and capabilities (Ahuja & Lampert, 2001). Through formal relationships, the focal firm can access varied resources and capabilities from its partners, which can significantly enhance its potential to produce breakthrough innovations. However, setting up and maintaining a multitude of formal relationships can be both time-consuming and costly. Each formal relationship requires a certain investment of resources from the focal firm. As the number of formal relationships increases, the firm's capacity to effectively manage and utilize these relationships may diminish. This can lead to inefficiencies within its network of formal relationships. Moreover, the higher search costs associated with relationally proximate searches can impose significant constraints on the focal firm's ability to engage in this type of search effectively. Such constraints may limit the firm's overall ability to leverage its relational proximity to enhance innovation outcomes. Accordingly, we propose

Proposition 2a: *As a focal firm's intensity of relationally proximate search increases, the likelihood of innovation increases.*

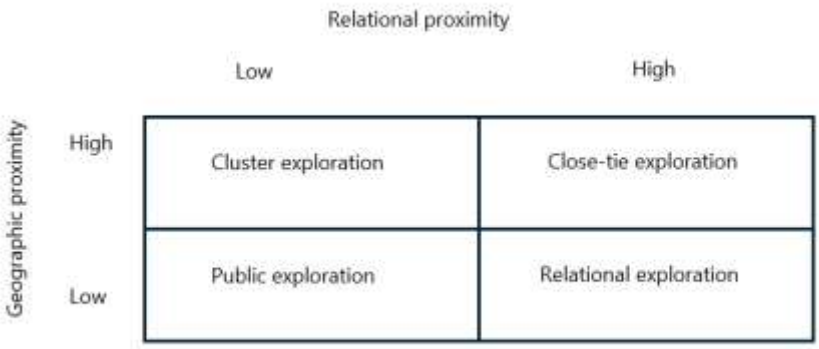
Proposition 2b: *As a focal firm's intensity of relationally proximate search increases, the likelihood of breakthrough innovations increases in an inverted U manner.*

3. Interaction of Geographic Proximity and Relational Proximity

By combining geographical proximity and relational proximity, we propose four types of innovation search behavior (Fig. 1.0). These four types are 1) close-tie exploration, 2) cluster exploration, 3) relational exploration, and 4) public exploration. We will discuss the implications of these in more details below.

Figure 1

Conceptual Framework of Firm Knowledge Search Behavior



3.1 Close-tie Exploration

Close-tie exploration describes a knowledge search strategy employed by a focal firm that relies on the knowledge bases of geographically co-located firms with which it also maintains formal cooperative relationships. This approach is rooted in the idea that being in close geographic proximity not only facilitates easier access to each other's knowledge but also builds a foundation of trust that can lower monitoring costs and reduce the risks associated with opportunistic behaviors. The development of technological capabilities involves both codified knowledge, which is well-documented and easily transferable, and tacit knowledge, which is more personal and context-specific. These two types of knowledge are complementary; codified knowledge provides clear, accessible information, while tacit knowledge offers deeper, experiential insights that are crucial for innovation.

When firms are geographically close, the trust that develops between them can create a more favorable environment for the exchange and co-development of both types of knowledge. Geographic proximity also enhances the frequency and quality of interactions among employees from partner firms. These interactions allow employees to develop a better understanding of each other's work and communication styles, which can lead to more effective collaboration. This synergy not only promotes the sharing of tacit knowledge but also supports the integration of this knowledge into the firms' existing codified systems, thereby enhancing their overall technological capabilities.

Relational proximity facilitates systematic collaboration by enabling interactions between employees of two firms both at a personal and systemic level. This proximity allows for sustained, systematic interactions over extended periods and provides a structured framework that guides these interactions. Firms typically enter into alliances with clear, overarching goals, which drives them to engage in intensive searches within the relationship to achieve these predetermined objectives. The depth of such searches tends to increase with the strength of the ties between the firms (Uzzi, 1996).

When both geographic and relational proximity are high, partner firms are more likely to develop a greater partner-specific absorptive capacity (Lane & Lubatkin, 1998). This capacity is critical as the competencies of firms often reside in their organizational routines (Nelson & Winter, 1982). Creating highly valuable innovations frequently requires the merging of competencies from different firms. Effective collaboration at the firm level facilitates the interaction of organizational routines, which can lead to the development of shared knowledge routines (Dyer & Singh, 1998).

The combination of geographic and relational proximity enhances the ability to share a 'complete package' of knowledge. This dual proximity not only simplifies the exchange of tacit and codified knowledge but also maximizes the potential for knowledge spillover benefits that can occur through formal linkages with other firms, as suggested by Arora et al. (2021). This synergy enables firms to tap into a broader and more diverse set of resources and capabilities, potentially leading to breakthrough innovations and competitive advantages. The performance of an alliance can be negatively impacted by conflicting goals between the partner firms. However, resolving conflicts can be more straightforward when the firms are geographically close. Differences in organizational cultures and norms can obstruct the sharing of knowledge and effective collaboration. Being located in the same area often leads to greater cultural similarity, which can facilitate smoother collaboration.

Therefore, systematic, sustained, and focused interactions between firms, as discussed by Ahuja (2000), create an environment conducive to trust. This trust, in turn, enables the effective transfer of both tacit and codified knowledge. Such an environment not only potentially increases the innovative output of the partner firms but also helps them generate highly valuable

innovations. However, as these partner firms collaborate closely, especially within the same geographic cluster, their technological knowledge bases tend to converge. As the depth of the search within these close relationships increases, the firms become increasingly similar in their knowledge bases. Consequently, the novelty of the innovations produced by the focal firm may decrease as it intensifies its local search within these relationships. This trend highlights a trade-off between deepening existing knowledge and generating new, novel innovations.

Proposition 3a: *As a focal firm's intensity of close-tie exploration increases, the likelihood of innovation increases.*

Proposition 3b: *As a focal firm's intensity close-tie exploration increases, the likelihood of breakthrough innovations increases in an inverted U manner.*

3.2 Cluster Exploration

Cluster exploration characterizes the knowledge search behavior of a firm that leverages the knowledge bases of co-located firms with whom it has no formal cooperative agreements. In this scenario, the knowledge sourced from such co-located firms tends to be more accessible and likely falls within the public domain, often transmitted through what Michael Storper describes as "untraded interdependencies" (Storper, 1997). This refers to the informal and often unintentional exchanges of information that occur among individuals working within the same geographic area.

Employees of a firm often learn about new developments and current technological trends through casual interactions with peers from other nearby firms. In essence, the focal firm captures what is colloquially known as knowledge "in the air." This type of knowledge transfer is predominantly facilitated by word-of-mouth, playing a central role in disseminating information within clusters (Saxenian, 1994). The proximity of these firms not only makes such interactions more likely but also more relevant, as firms within the same cluster often share similar technological paradigms (Dosi, 1988). This similarity enhances the relevance and absorption of the exchanged knowledge.

Another potential mechanism for knowledge transfer in clusters is employee mobility. When employees move from one firm to another within the same cluster, they bring with them not only explicit knowledge, such as awareness of their previous firms' patents, but also tacit knowledge gained from their prior experiences. However, while these individuals are likely to contribute to the new firm's knowledge base, their impact on significantly enhancing the firm's innovative output may not be substantial. Instead, their primary value lies in reinforcing the existing knowledge network within the cluster, helping to maintain a flow of information and ideas. The nature of knowledge gained through 'cluster exploration' tends to be less unique and novel due to the similarities in technology and approach among firms within the same cluster. As a result, this type of knowledge is often less valuable in contributing to significant breakthroughs in innovation. Instead, the knowledge acquired is more likely to reinforce existing competencies and lead to incremental rather than radical innovations.

Given that firms engaged in cluster exploration often work on similar technologies, the knowledge exchanged tends to have less potential to disrupt existing paradigms or create path-breaking innovations. Instead, this type of local search helps firms build what Rosenkopf and Nerkar (2001) refer to as 'first order competence.' This competence enables firms to make gradual improvements on existing products or processes but does not typically lead to the kind of groundbreaking innovations that can redefine markets or create entirely new ones.

Over time, relying predominantly on cluster exploration might lead to a cycle of diminishing returns in terms of innovation impact. As firms continue to exchange and utilize knowledge that is not markedly different or new, the innovations that result tend to be increasingly marginal. This could limit the long-term competitiveness of firms that do not supplement their local search strategies with efforts to tap into more diverse and novel knowledge sources outside their immediate geographic and technological confines.

Proposition 4a: *As a focal firm's intensity of cluster exploration increases, the likelihood of innovation increases.*

Proposition 4b: *As a focal firm's intensity cluster exploration increases, the likelihood of breakthrough innovations decreases.*

3.3 Relational Exploration

'Relational exploration' describes the knowledge search behavior of a firm that taps into the knowledge bases of partners that are geographically distant but linked through formal cooperative agreements. Firms often form alliances to overcome the inherent limitations of local search, leveraging these relationships to access a broader array of knowledge (Rosenkopf & Almeida, 2003). These alliances are designed to facilitate the exchange and sharing of knowledge through systematic, sustained, and focused interactions.

However, there are challenges associated with this approach, particularly when it comes to sharing tacit knowledge, which is often deeply embedded in the company's culture and informal practices. Cultural differences between firms from diverse geographical locations can further complicate the sharing of knowledge. Nonetheless, when relational proximity is high—meaning that the firms have developed strong, trust-based connections over time—the challenges of cultural differences and tacit knowledge transfer can be mitigated. Firms in such relationships can develop more effective ways of working together, learning from each other's strengths and navigating around potential pitfalls.

Additionally, there is a selection bias in relational exploration. Firms typically choose to establish deep relationships with those that possess valuable and complementary technological capabilities. This strategic selection is guided by the maxim "you can choose your friends but not your neighbors." The choice to partner with firms operating in different technological paradigms can, while making the assimilation of knowledge more challenging, spur the creation of path-breaking innovations. This is because the combination of complementary competencies from different technological backgrounds can lead to novel solutions and significant advancements that might not be achievable within a single technological paradigm. Thus, relational exploration not only broadens the scope of accessible knowledge but also enhances the potential for substantial innovative breakthroughs.

Proposition 5a: *As a focal firm's intensity of relational exploration increases, the likelihood of innovation increases in an inverted U manner.*

Proposition 5b: *As a focal firm's intensity relational exploration increases, the likelihood of breakthrough innovations increases.*

3.4 Public Exploration

'Public exploration' characterizes the knowledge search behavior of a firm that leverages knowledge bases of distantly located firms with which it does not have any formal cooperative relationships. This type of knowledge typically resides in the public domain, which can be both a strength and a limitation. Since such knowledge is accessible to everyone, it may be perceived as less valuable to the focal firm's innovation efforts because it lacks novelty and exclusiveness; other firms can equally capitalize on this knowledge, potentially diluting its impact.

Additionally, because this knowledge is often far removed from the focal firm's existing knowledge bases, it can be challenging to assimilate and build upon. The cognitive and technical distance between the focal firm's current capabilities and the external knowledge can create barriers to effective integration and utilization.

However, the fact that the focal firm is drawn to knowledge from distant sources suggests a recognition of its potential value. Such knowledge can introduce a much-needed diversity of ideas and perspectives that the firm's current knowledge bases might lack. This diversity is crucial for fostering innovation, particularly when it comes to generating breakthroughs. By integrating externally sourced knowledge that is substantially different from its existing expertise, the firm can potentially create innovative solutions that are truly path-breaking. Thus, while public exploration presents certain challenges, it also offers significant opportunities for enhancing the firm's innovation capabilities by infusing fresh, diverse insights into its research and development processes.

Proposition 6a: *As a focal firm's intensity of relational exploration increases, the likelihood of innovation may not be influenced.*

Proposition 6b: *As a focal firm's intensity relational exploration increases, the likelihood of breakthrough innovations increases in an inverted U manner.*

4. Discussion and Implications

While recent research in firm search behavior has focused on the importance of technological search, there has been less understanding of the implications for innovation generation associated with geographic and relational search. Our study fills this gap by investigating these two search behaviors jointly and suggests that geographic and relational search have important trade-offs regarding the quantity and quality of innovation generated. For managers, we suggest that they can organize their strategic knowledge search behaviors by factoring in the trade-offs involved between these different search strategies. It is not enough to consider formal cooperative ventures, but managers also need to consider the impact of co-location in order to improve the innovativeness of their organizations.

Our framework highlight that while geographic proximity facilitates easier access to knowledge, enhances trust, and lowers transaction costs among co-located firms, it may also limit the novelty of innovations due to similar technological paradigms and knowledge bases prevalent within the cluster. This phenomenon, known as 'cluster exploration,' tends to produce incremental innovations rather than groundbreaking ones as firms often capitalize on readily accessible, less unique knowledge. Managers should be aware that while leveraging local knowledge can optimize resource use and foster quick collaborations, it might also constrain the potential for radical innovation.

In contrast, 'relational exploration' with distantly located partners can introduce more diverse knowledge into the firm's innovation processes. Although managing relationships and integrating diverse knowledge from distant partners involves higher complexity and cost, it holds the potential for more disruptive innovations. This approach allows firms to access and recombine a wider range of technological capabilities and knowledge, which is crucial for breakthrough innovations. However, the success of such endeavors heavily relies on the strength and depth of the partnerships, underlining the importance of selecting partners with complementary capabilities.

Moreover, 'public exploration' represents another strategic avenue for firms seeking to enhance their innovation portfolio. By tapping into knowledge that is in the public domain and often distantly located, firms can incorporate a variety of perspectives that differ significantly from their existing knowledge bases. Although this knowledge is more challenging to assimilate due to its detachment from the firm's core competencies, it can catalyze novel innovations by bridging disparate technological domains.

In conclusion, our study underscores the necessity for a balanced approach to knowledge search strategies. Managers need to strategically combine geographic and relational searches with public knowledge exploration to cultivate a diverse and robust innovation ecosystem. This balanced approach enables firms to not only refine existing capabilities but also to drive pioneering innovations that can redefine their competitive landscape. By understanding and navigating the trade-offs between these search behaviors, firms can better position themselves to harness the full spectrum of available knowledge and achieve sustained innovation success.

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