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Introduction

Organizing Inter- and Intra-Firm Networks: What is the Impact on Innovation Performance?

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Background

That firms can improve their innovative performance by taking advantage of knowledge residing in networks of external stakeholders has become a prominent idea in innovation studies, reflected in, for example, recent special issues of *Industry and Innovation* on “Innovation Networks” (2011), “Offshoring of Intangibles and the Organization of Global Innovation” (2010), “Managing Situated Creativity in Cultural Industries” (2008) and “Online Communities and Open Innovation” (2008).

The increased connectedness provided by new information and communication technologies greatly facilitates the search and in-sourcing of external knowledge, thus producing new and improved inputs for idea generation and innovation. Another potential benefit of networks is the access to diverse and distant external resources that a broader set of connections open up, something that may generate new innovative opportunities (Laursen and Salter, 2006; Holmén *et al.*, 2007). It is thus hardly surprising that the idea of open innovation (Chesbrough, 2004) has received much attention by both academics and practitioners, resulting in firms experimenting with new ways of interacting and collaborating with other organizations, communities and individuals. However—as it has been pointed out quite often—open innovation only represents one out of the many literature streams that for a long time have underlined the importance of networks for innovation. Earlier research on external sources of innovation (Rothwell *et al.*, 1974; von Hippel, 1976; Rosenberg, 1982), clusters (Porter, 2000), industrial marketing and business networks (Håkansson and Ford,

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2002), strategic alliances and inter-firm collaborations (Doz, 1996), communities of practice (Brown and Duguid, 1991) and social capital (Ahuja, 2000; Obstfeld, 2005) are prominent examples of these research streams.

Looking more closely at this vast amount of literature, which explores the relationship between networks and innovation, a few central observations are in order. First, it emerges that networks are conducive to innovation at different levels, ranging from individuals within single firms, interactions among firms and relationships among geographical areas. However, existing contributions often consider only one of these levels, setting the often-unavoidable interaction among the diverse levels aside. Furthermore, it is shown that networks of different types and characteristics do not only provide new opportunities for collaboration and innovation, but also pose considerable challenges to practitioners and scholars in economics, management and organization science. The potential advantages that can be derived from bringing together different competences and sets of knowledge and information are clear, but realizing the benefits requires new capabilities. Moreover, a sound understanding of the relationship between networks and innovation even requires, in some cases, a revision of established management theories and methodologies. We will now sketch out a number of identified issues in need of investigation.

Networks—From a Metaphor to a Tool

As pointed out in the many different streams of innovation literature, networks are considered to hold a potential for enhancing innovation performance. However, much research on network innovation has been of a mere descriptive nature, often downplaying the possibility of providing suggestions to managers who would like to master their firms' network. In other words, existing theory does not provide much detailed guidance for the purposeful design and management of networks for innovation. In particular, there is a lack of knowledge concerning the specific effects of network structures on innovation performance. Whereas theories on strategic alliances and partnerships have dealt in great length with the characteristics of network nodes, much less is known about what dimensions of network structure are conducive to innovation. This is very clear, for instance, in the literature on social capital and innovation, where the two dominant streams (Coleman, 1990; Burt, 2004) argue diametrically opposed conjectures regarding the effects of so-called *structural holes* on innovation. This limited conclusiveness highlights the present shortcomings of our understanding of network characteristics, as well as the difficulties encountered when trying to measure innovation performance. Even if progress has been made on this front (see e.g. Owen-Smith and Powell, 2004), arguably, the present state-of-the-art does not allow us to draw definite conclusions about the interrelationships between network characteristics and innovation performance. New tools, such as social network analysis, provide us with improved possibilities to measure networks in a valid and reliable manner, but we still need to understand the effects of different structures on innovation performance. Only then can we shift our view of networks from a mere metaphor describing things that do not take place in a hierarchically organized manner to a tool that at least to some extent can be designed and used purposefully.

New Challenges for Management

As knowledge markets become more developed and the transaction costs involved to acquire knowledge and information consequently drop, it becomes increasingly rational to rely more on other parties in a network for the knowledge and resources needed to realize innovations. Indeed, as relationships are increasingly seen as strategic capabilities (Lorenzoni and Lipparini, 1999), it stands to reason that firms need to attend more carefully to their inter-linkages to other organizations, for example, through the development of network competence (Ritter and Gemünden, 2003).

However, there also appears to be a more radically different development of co-creation in networks, inspired by the sharing behaviors previously seen in, for example, Open Source Software development (von Hippel, 2001). What can be seen is that a non-negligible part of the information sharing in more open innovation settings is driven by motivational factors other than profit search (Bonaccorsi and Rossi, 2006), generating a need for new management techniques (Dahlander and Magnusson, 2005). One example of this is the issue of how to develop the absorptive capacity needed to fruitfully access, assimilate and utilize knowledge from the outside (Cohen and Levinthal, 1990; Dahlander and Magnusson, 2008). A more radical interpretation of the need to reconsider traditional management techniques in an increasingly networked setting applies to the internal organization of knowledge-intensive firms. Apart from general trends that innovation activities become more geographically distributed and draw upon a more composed knowledge base, we also see a gradual shift of power from management to employees as the relative importance of knowledge, as compared to other resources, increases (Tsoukas, 1996). As large parts of knowledge are not directly owned by firms but reside within the heads of their employees, and knowledge creation such as innovation can hardly be managed with a traditional managerial mechanism, a central task of management becomes to handle the interrelationships to and between knowledge workers so they can combine their individual knowledge and skills in a way that furthers innovation.

Applying Network Thinking to Firm Organization

As mentioned above, a closely related trend is that network structures increasingly come to complement, or even substitute, already existing hierarchical structures. Many firms are progressively giving up traditional hierarchical structures and mechanisms in favor of new internal organizational forms in which networks to an extent have replaced hierarchies, social relations pushing aside formalized coordination (Foss *et al.*, 2011), and firms are arrayed around processes or capabilities rather than functions, products or regions (Siggelkow and Rivkin, 2005). An effect of this is that external networking activities have become more and more coupled with the adoption of internal network structures formed, for instance, by employees participating in a given R&D project, teams working on different but connected projects, divisions jointly involved in the development of new products and services, or subsidiaries of multinational companies operating in different countries and dispersed geographical areas. Given the increased importance of informal relationships, the inter-linkages are often complex as they consist of a mix of formal and informal connections, with resulting difficulties in understanding what goes on at the micro level, and the managerial challenges involved in this new way of working. Specifically, whilst an increasing number of contributions is now exploring how firms should manage their portfolio of external

relationships with a variety of diverse innovation partners (e.g. Laursen and Salter, 2006), the interplay and co-evolution of internal and external networks and their impact on innovation performance are still poorly explored.

Summarizing the exposition above, we can conclude that despite the wealth of knowledge already existing about innovation and networks in a broader sense, there is still limited knowledge concerning how firms can fruitfully organize to use the innovation potential inherent in their inter- and intra-organizational networks. This special issue aims at addressing such organizing aspects of networked innovation, at different levels of analysis and with different perspectives and methodological approaches.

Presentation of the Papers Included in the Special Issue

The special issue includes five high-quality papers, which went through a rigorous peer review process. All of them tackle the aforementioned open issues in the study of the relationship between networks and innovation, thus contributing to fill gaps in the extant literature.

The first paper by Carsten Bergenholtz and Christian Waldstrøm is a comprehensive literature review on inter-organizational networks. We think that this contribution is highly valuable for researchers interested in the field. Indeed, while the literature on intra-organizational networks is still in its infancy as these kinds of networks have come under the spotlight only recently, the research stream on inter-organizational networks is vast and fragmented. In such a framework, Bergenholtz and Waldstrøm offer a well-structured systematization of the received knowledge. Their review is undoubtedly a useful starting point for those who are approaching the subject for the first time. Moreover, due to its original standpoint, we envisage that this literature review can also be of great help for scholars who have been studying network-related issues for a long time.

The authors acknowledge the preeminence in the network research field of methodological aspects, which play a role in shaping theory developments. They notice that methodological research on inter-organizational networks is plagued by inconsistencies and incompatibilities, which hinder knowledge advancement and steal coherence to the field. Through the analysis of the papers on inter-organizational networks published in the last 12 years, the authors intend to restore order in the field, thus tracing clear avenues for future research. They find that few previous studies have taken advantage of the full array of methodological techniques, thus restraining theory deduction and induction from available data. At present, the most cited papers and those appearing in top-ranked journals use mainly methodologies based on social network analysis, but a recent tendency exists among influential papers to go beyond a narrow application of this methodology to adopt a more eclectic approach.

In line with the call of this special issue, the next four papers explicitly centre on the relationship between networks and innovation. They have been arranged in the special issue by their units of analysis: from the macro to the micro level.

The contribution of Evila Piva, Luca Grilli and Cristina Rossi-Lamastra has geographical areas as its units of analysis. It speaks in favor of the preeminence of networks for the creation of high-tech entrepreneurial ventures (New Technology-Based Firms, NTBFs), which are considered by the literature a fundamental prerequisite of the innovation performance of territories. The authors rely on rigorous econometric techniques to study the role of human

capital for the creation of NTBFs at the local level, an issue that has been investigated in the entrepreneurship literature. However, the authors succeed in offering a fresh perspective on it by investigating how human capital *available* in a *geographical area* or *accessible* from it through communication infrastructures breeds the networking activities that lay at the basis of the creation of new high-tech ventures. Along this line of reasoning, the paper provides an original addition to the current literature in that it finds a differential impact of local competences and communication infrastructures on NTBF creation in manufacturing and service industries due to the diverse characteristics of their productive processes. Whereas local competences have a more positive effect on manufacturing, communication infrastructures affect more services. Indeed, the creation of manufacturing NTBFs at the local level requires the formation of localized networks of owner-managers and employees that work and reside in the area. Thus, local competences are crucial for the formation of these firms. Conversely, the production process in the service sectors can be managed even by relying on long-distance networks of skilled individuals that interact through communication infrastructures.

Another interesting result emerges from the analysis of the moderating effects of local economic and technological development on the inquired relationships. Whereas economic development seems to weaken the effect of local competences in manufacturing and reinforce that of communication infrastructures in services, technological development has no moderating effects. In other words, the paper suggests that communication infrastructures are going to become an increasingly crucial local asset. Of course, local competences are important, as skilled individuals are potential Schumpeterian entrepreneurs who seize technological opportunities and network inside their area to launch new ventures. Nonetheless, long-distance communication infrastructures enable new forms of virtual networking, which give perspective entrepreneurs the opportunity to organize (some) technological production processes in novel ways. This holds even truer as relevant knowledge is currently more and more dispersed across countries and geographical areas.

However, by focusing on the macro level, the paper by Piva *et al.* sets aside interesting phenomena, which unfold at the firm and individual level. The authors black box new ventures to focus on local characteristics that enable their formation. The next contribution by Marcel Bogers and Stephane Lhuillery enters the firm black box and studies the *intra-organizational* antecedents of firm-level absorptive capacity (AC) towards diverse external sources of knowledge. The paper originally adds to the field of study of networks and innovation in various ways. First, it focuses on internal networks, thus contributing to advancing knowledge on these still poorly explored topics. Second, the paper considers the intra-firm network formed by a firm's functional areas of R&D, manufacturing and marketing. In so doing, it approaches the study of intra-organizational networks from an interesting perspective. Indeed, works focusing on intra-organizational networks have mainly referred to networks of individual employees or teams. Consequently, such works fail to recognize explicitly that functional areas form *by definition* an intra-organizational network. This network is undoubtedly crucial for knowledge creation, transformation and sharing inside the firm. Therefore, its proper dialogue with the inter-organizational network formed by a firm's external knowledge sources is likely to have a major impact on innovation. Along this line of reasoning, the paper accounts for the interplay between intra- and inter-organizational networks by studying how the diverse functional areas form an internal network which specializes in absorbing knowledge coming from different external sources. Third, a

distinction between knowledge absorption that results in product innovation and knowledge absorption that results in process innovation is provided. It is well established that these two innovation typologies are likely to have different drivers. However, such heterogeneity is under-reported in the network literature. The empirical evidence presented in the paper is based on a survey taken on a representative sample of Swiss firms, which provided data on the importance of R&D, manufacturing and marketing functions for product and process innovation. Econometric results show that the R&D function is considered by firms as particularly important as an absorber of knowledge from public research organizations for product innovation, manufacturing is important as an absorber of supplier knowledge for product innovation and of competitor knowledge for process innovation, and marketing helps to absorb customer knowledge for product and process innovation as well as competitors' knowledge for product innovation. Whereas mainstream AC literature has mainly related absorptive capacity to firms' internal knowledge base as proxied by R&D expenses, this work overcomes this narrow approach. It suggests that employees working in R&D can easily network with scientists, thus being able to absorb the knowledge they produce. At the same time, employees working in manufacturing and marketing are in a good position to network with customers, suppliers and competitors, thus absorbing the knowledge embedded in these stakeholders.

It is hard to deny that knowledge creation, transformation and sharing in intra-organizational networks is more conducive to innovation when it is supported by organizational mechanisms and practices operating at the individual level and aimed at boosting the interactions and exchanges among firm staff. Individuals are undoubtedly the main characters of innovation processes, the networks that they form are the real engine of such processes. Mechanisms and practices favoring the networking among individuals can be both formal and informal, the latter being of more and more importance according to practitioners and scholars alike.

The paper by Grazia D. Santangelo and Paolo Pini focuses on formal mechanisms: human resource management (HRM) practices adopted by firms at the shopfloor level. The authors argue that the adoption of new HRM practices at the shopfloor level is positively related to the introduction of exploitative innovation through firm productive capabilities, as employees' ability and learning incrementally improve a firm's existing products and processes. In so doing, the authors answer the calls for more research analyzing networking activities among line workers and for a less monolithic treatment of innovation when studying the relationship between innovation and networks. The paper offers interesting insights to practitioners alike in that it tackles the open question on whether and to what extent the findings obtained when the relationship between HRM practices and innovation is explored at the managerial level continue to hold when focusing on lower levels of the firm hierarchy. Using a sample of 166 Italian firms, the authors show a positive relation between the adoption of HRM practices and firms' innovative performance when measured as incremental innovation, but as expected, the effect is an indirect one, as it is mediated by firms' productive capabilities. Certainly, employees become better able to incrementally improve their firm's existing products and processes when they are networked through (formal) HRM practices.

Finally, the paper by Jennie Björk, Fausto Di Vincenzo, Mats Magnusson and Daniele Mascia acknowledges that networking among individuals can also rely on informal mechanisms, which turn out to be crucial in the ideation phase of innovation processes.

Not only are innovation processes heterogeneous in their outputs (i.e. product, process and organizational innovations), but consist of different interrelated phases. Ideation is the most creative part of the whole innovation process. Use of formal HRM practices in this area is not always a winning strategy. In this framework, the paper addresses the impact of informal networking among individuals at their workplace on the quality of the ideas they generate. As to ideation at their workplace, individuals possess a social capital, which consists of two dimensions: the degree (i.e. size) of individuals' networks of ideation relations and the structural holes (i.e. gaps between nodes) of those relations. In exploring structural holes, the paper heeds the call for more nuanced treatment of networks made possible by recent methodological advances in social network analysis. Not all the networks (formal or informal) have a structure that is conducive to innovation. Structural holes represent the dark side of networks: they separate diverse sub-networks, thus promoting isolation. Previous research has presented different and even conflicting, empirical results concerning the effect of structural holes on innovation activities, and has not dealt specifically with the ideation phase of the innovation process. By drawing upon an idea database from a Swedish company that has worked systematically with idea management for an extensive period, the paper investigates the interrelationship between social capital and ideation. The empirical analysis reveals that the larger the size of an individual's ego network, the higher is this individual's innovative performance in terms of high-quality ideas, whereas the larger the number of structural holes in an ego network, the lower the quality of ideas generated by the individual in question. These findings support the conclusion that social capital, in terms of individuals' relationships with fellow employees within firms, has a positive influence on idea-generating behavior. Moreover, the results reveal that the presence of structural holes is negative for ideation performance, thus providing important new input to the recent debate on the interrelationship between structural holes and innovation in general.

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