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THE SOCIAL UNDERPINNINGS OF ABSORPTIVE CAPACITY:

EXTERNAL KNOWLEDGE, SOCIAL NETWORKS, AND INDIVIDUAL INNOVATIVENESS

Abstract

In my dissertation I investigate the social process through which knowledge sourced from outside the organization is internalized and applied toward the creation of commercializable innovations. Building on absorptive capacity and social network theory, I present and test a theoretical model to explain the differences in individuals' contributions to organizational innovativeness. The model is premised on the notion that innovation stems from the novel combination of different sources of knowledge and, as such, is the result of collective rather than individual efforts. Focusing on the *type* of knowledge internalized, *by whom*, and the interaction patterns through which it is applied to the generation of innovations I argue that both the structure of knowledge and the structure of social networks are critical aspects of the absorptive capacity process. Hypotheses derived from the theoretical framework are tested using original sociometric data collected from 276 scientists, researchers, and engineers from 16 R&D labs of a multinational semiconductor producer. Results indicate that knowledge sourced from outside the organization enhances individuals' contributions to organizational innovativeness. These benefits however, are contingent upon the *type* of external knowledge sourced by individuals and how similar or different this knowledge is to the knowledge available through their network of contacts inside the organization.

THE SOCIAL UNDERPINNINGS OF ABSORPTIVE CAPACITY:

EXTERNAL KNOWLEDGE, SOCIAL NETWORKS, AND INDIVIDUAL INNOVATIVENESS[1]

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EXECUTIVE SUMMARY

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The ability to generate innovations inside the organization is a primary driver of organizational economic performance. However, in spite of the relevance of innovation for both practitioners and management scholars, the process through which individuals inside organizations generate innovations, has received comparatively less attention.

A recent survey conducted by Boston Consulting Group on a sample of almost 1000 executives from different industries and different countries offers some interesting insights into this issue (BCG, 2005). According to this survey, 91% of the respondents consider innovation critical to successfully compete in their industry and 74% of the respondents said that their organization will be increasing investment in innovation during 2006. However, more than half of the sample surveyed (51%) admitted that they are not satisfied with the return on innovation spending. An important element that emerges from this survey is that just hiking R&D expenditures does not guarantee a greater success rate in the generation of innovations. So the question at this point becomes: what determines individuals' ability to generate innovations?

This is precisely the focus of my dissertation project. In my thesis, I start from two basic assumptions about the nature of innovation and the innovative process: the first one is that innovations are not created anew but mostly comes from the recombination of different types of knowledge borrowed from different fields (Hargadon, 2002; March and Simon, 1958). The second assumption is that innovation is the result of collective rather than individual efforts (Hargadon, 2003; Simon, 1991). Under these two assumptions, I examine how individuals inside the organization source, absorb, share, and combine different types of knowledge in conjunction with the knowledge and expertise of their colleagues inside the organization to generate innovations. Conceptually my research is similar to previous work on organizational absorptive capacity (e.g. the ability of organizations to use external knowledge to increase their innovative potential). However while this body of work has mostly been done at the

firm/business unit level of analysis and has measured absorptive capacity in terms of standardized R&D investment (investment in R&D divided by sales), I focus specifically on individuals, on the type of external knowledge they source from outside and how this knowledge is shared and combined inside the organizations to generate innovations. In fact, instead of looking at innovativeness as the result of the amount of financial resources invested in it, I look at the social processes through which individuals activate and exploit different sources of knowledge to generate innovations. What I add to previous research on knowledge and innovation management is the explicit focus on *the process of absorptive capacity*. In fact, my analysis looks specifically at *who* inside the organization acquires *what* type of knowledge from outside and *how* this knowledge is used through knowledge sharing interactions to contribute to the collective effort of generating innovations.

Adopting a social network perspective, with my dissertation I provide a systematic examination of the role of external knowledge and individuals' knowledge sharing interactions to explain how individuals contribute to the generation of innovations. In the rest of this document I will first discuss the benefits of a social network approach to the study of innovation and then I will present the main findings of my project with respect to the role of external knowledge, the relationship between social structure and knowledge held by individuals, and local vs. global informational advantages provided by social networks.

Social networks and innovations

Generating innovations requires firms to activate their "current" knowledge to incorporate new inputs to pursue new opportunities and implement new ideas. This implies that individuals inside the organization, as repositories of different knowledge sets, should be able not only to share their knowledge but also to adapt, recombine, and transform it in a way that is conducive to the actual development of innovations (Dougherty, 1992). The study of knowledge

sharing interactions inside organizations represents therefore an ideal approach to understand how knowledge is mobilized throughout different parts of the organization.

The role of external knowledge

The ability to acquire and use external knowledge is important in the innovative process (Cohen and Levinthal, 1990). Individuals are clearly central in this process of knowledge sourcing, yet very little research has focused explicitly on who, inside the organization, sources what type of knowledge from outside. This point is important because different individuals can source different types of knowledge from outside. While several studies distinguished between different types of internal knowledge - for instance tacit/explicit, codified/non codified, most research on knowledge management has implicitly assumed that all the types of external knowledge are equally important. But are all the types of external knowledge available outside the organization equally useful to generate innovations? Here I start addressing this issue by introducing the distinction between scientific and industrial knowledge. This distinction, although fairly general, is also very important because past research suggests that scientific and industrial knowledge have a different nature, being more universal and broader the former and more idiosyncratic, context specific, or problem driven the latter (Allen, 1977; Allen, Tushman and Lee, 1979). Another important distinction is that while scientific knowledge is generated to be made public (to be published) industrial knowledge has a more secretive nature because it is produced to reap the economic benefits that might be associated with it. In my dissertation I suggest that external scientific knowledge is likely to be more relevant than external industrial knowledge in developing people's innovativeness since it has broader scope, it is more readily available, and it is more likely to involve elements of novelty.

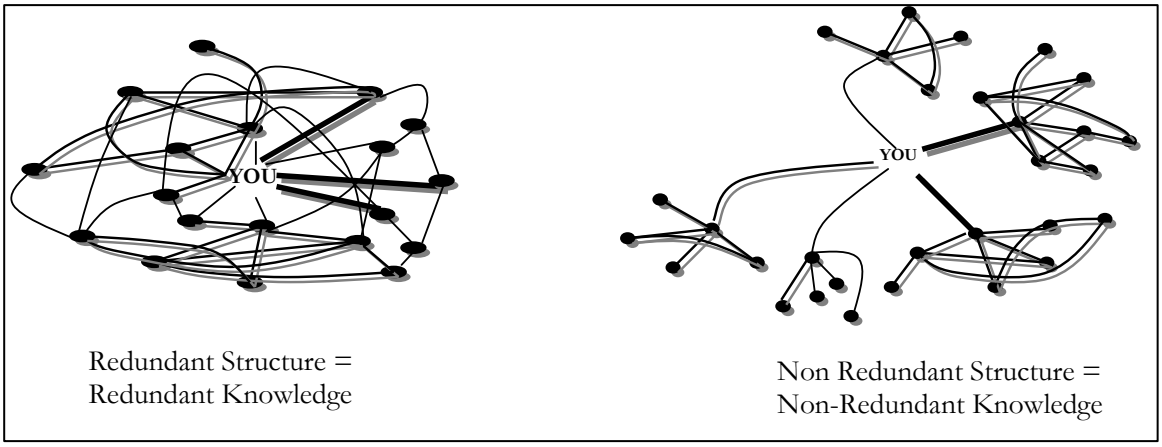
The role of social structure: social networks and knowledge types

In addition to external knowledge also the structure of knowledge sharing interactions inside the organization is important to understand individual innovativeness. Social structure is important for individual innovativeness because it provides access to knowledge and information. In particular, brokerage, as the ability to access otherwise disconnected social circles, has been considered to be important for the generation of innovations because it allows to access non-overlapping information (Burt, 1992).

However, the relationship between brokerage and innovativeness is not so straightforward (Ahuja, 2000). For two reasons: first because generating new ideas using someone else's knowledge requires a common knowledge base (Reagans and McEvily, 2003) while acting across social circles maximizes the heterogeneity of knowledge available thus reducing the areas of overlap. Second because having good ideas is different from acting on good ideas (Obstfeld, 2005). Paradoxically, if on one hand brokerage provides the richness and diversity of information necessary to spur innovation, on the other hand it is not clear that its underlying social structure offers ideal conditions to integrate knowledge, mobilize resources, and to coordinate individual efforts around new/emerging ideas. In other words it is not clear that brokerage offers the optimal conditions to share, understand, and take advantage of heterogeneous knowledge-sets at the base of the innovative process. To address this paradox I propose that individuals' knowledge should be considered independently of their position in the overall social structure (Rodan and Galunic, 2004). Previous research on social networks developed under the assumption that we can infer individuals' knowledge just by looking at their position in the network structure. As a result, knowledge within networks has typically been inferred from the social structure rather than directly measured. For instance individuals embedded in dense redundant structures have access to similar/overlapping types of knowledge

whereas individuals connected to otherwise disconnected groups have access to different/non-overlapping types of knowledge (see picture below).

Figure 1. Traditional view of social structure and knowledge structure



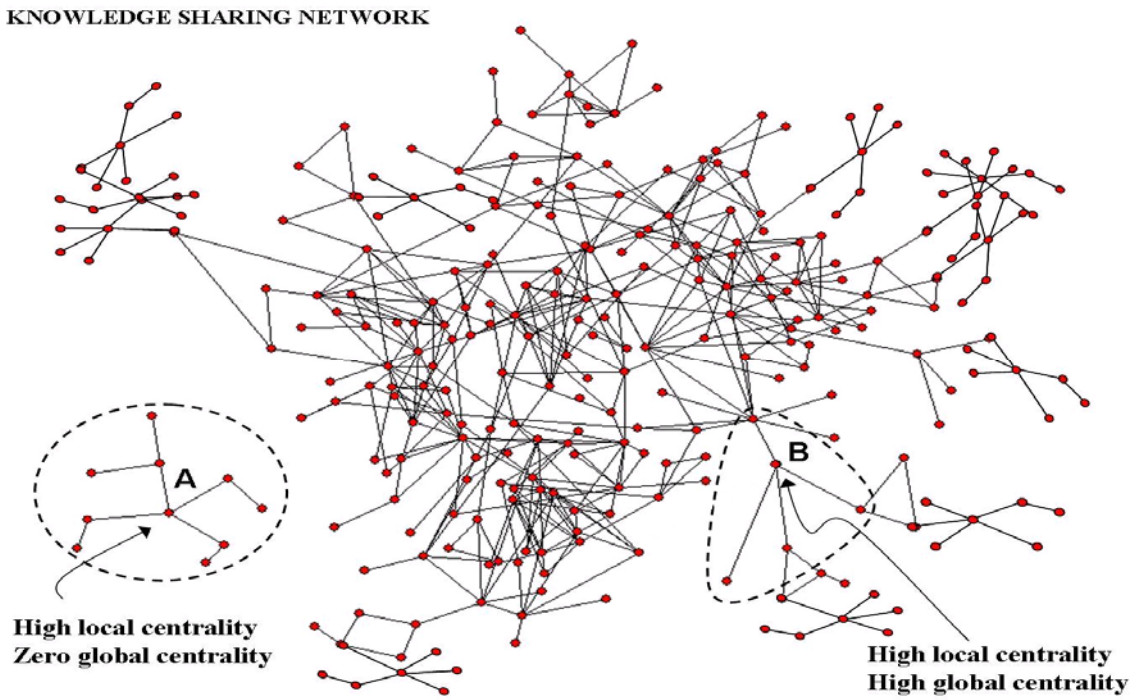
However, this relationship between type of social structure and resulting knowledge structure is just an assumption. What if individuals' knowledge is at least partly independent of their position in the social structure so that knowledge in close-knit networks is not entirely redundant, and knowledge in sparse networks is at least in part overlapping? This is a very reasonable statement to make since, particularly in the study of innovation, differences in external knowledge sourced from outside are a plausible reason why individuals' knowledge should be *at least in part independent* of their internal social structure. External knowledge, almost by definition, presents elements of novelty with respect to the knowledge available inside the organization and heterogeneity in the knowledge sourced from outside implies that individuals have different knowledge sets independently of their position in the social structure. If this is the case then being embedded in a close redundant network structure should have a positive impact on individuals' ability to generate innovations. Differences in knowledge and perspectives held by different actors will be more easily reconciled and re-arranged into

something new if they have frequent and repeated interactions with one another. Third-party ties in dense networks would allow for additional opportunities to present and reiterate diverse ideas and diverging views. Further, social cohesion affects the motivation of an individual to devote time and effort interacting, exchanging, and transferring knowledge to others, whereas a disconnected network structure would not offer such opportunities for repeated interactions and fine-grained knowledge exchange.

The role of social structure: local vs. global informational advantages

An important caveat of the previous argument is that the benefits of cohesive networks for innovation through coordination and cooperation are essentially local, that is defined within the immediate neighborhood of the social actors considered. However, being able to reap the benefits that social structures affords locally, does not exhaust all the resources available in the network particularly if those advantages are represented by access to information. Consider the graph below where nodes are individuals and ties are information sharing relationships.

Figure 2. Local vs. Global informational advantages



A has access to non redundant contacts and therefore she enjoys a high local centrality in terms of access to novel/non-redundant information. However if we consider the whole network we can see A is actually rather marginal. B instead, in addition of having high local centrality (he has exactly the same number of non redundant direct ties as A), also has a high global centrality, whereas A's global centrality is limited to its immediate neighborhood. This picture is a nice illustration of the difference between local and global informational advantages. Theoretically this distinction has implications for the way in which individuals search and find the information they need. We know that having access to non redundant contacts increases the likelihood of coming across novel and potentially useful information. However if we consider the distinction between local and global informational advantages, having non redundant contacts that allows *a broader reach* into the overall network is going to be particularly important because it further increases the likelihood of coming across novel and potentially useful information. The greater the reach in the network, the higher the likelihood of performing successful searches.

Empirics

Data for my dissertation were collected from the R&D division of a large multinational semiconductor's firm. Specifically, I surveyed 276 scientists, researchers and engineers located in 16 labs at different locations around the world. Before starting the data collection process I run 24 preliminary interviews with several managers and engineers and I have worked closely with top management and several researchers to identify and develop questionnaire items. Also I have developed a customized software application to collect social network data through the web. In total I obtained 251 complete questionnaires for a response rate of 91% which is quite remarkable give the nature of the study. Although only 9% of the population didn't respond, I

checked for differences between the two samples, and there was no statistical difference between respondents and non-respondents.

Findings

To test my theory I have used several OLS regressions considering individual innovativeness (expressed as a weighted peer evaluation) as the dependent variable. My results show that not all types of external knowledge are equally important to promote individual innovativeness. Instead I found a significant positive effect for scientific knowledge and no significant effect for industrial knowledge. However there is only some evidence for the effect of scientific external knowledge on innovativeness because this effect goes away in the full model where I explicitly consider how this knowledge is used through internal knowledge-sharing activities. Specifically, about the role of social structure I observed that, consistent with previous network research constrained social structures are bad for innovations if the type of knowledge used by individuals is not taken directly into account. However I also found support for the competing hypothesis according to which redundant structure are good for innovativeness when the knowledge structure of individuals presents some element of heterogeneity.

About local vs. global informational advantages my study reveals that local non-redundancy is positively associated with innovativeness, however, global non-redundancy has a stronger impact than local non-redundancy in the promotion of individual innovativeness.

Contributions

My dissertation is an important first step toward a better understanding of the social process of innovation, because it provides systematic evidence for the role of individuals' interaction, external knowledge and knowledge sharing to explain individuals ability to contribute to the generation of innovations. Three are the key points in my thesis:

1. The distinction between different types of external knowledge

2. The distinction between social structure and knowledge structure

3. The distinction between local and global informational advantages

In terms of the contributions to the area of social network theory it is quite remarkable to observe how taking individuals' knowledge into account instead of inferring it from the social structure changes our understanding of how social structure contribute to innovativeness. Another important contribution to this area of research is the distinction between local and global informational advantages; in fact, while much work on social structure tend to focus exclusively on the immediate neighborhood of an individual, it is actually also important to consider the larger context in which local social ties are embedded. My research also contributed to the broader area of knowledge management by providing a fairly comprehensive test of how socially coordinated activities of knowledge sourcing, sharing, and combination allows to improve individuals ability to contribute to the generation of innovations. One result is that is particularly interesting here is that external knowledge does not matter in and of itself for the generation of innovations but its effects are actually realized through collective internal efforts of knowledge sharing and recombination.

Limitations and future research

There are certainly some limitations in this research that should be acknowledged. First of all the distinction used between industrial and scientific knowledge is both very general and context specific at the same time. It is very general because we can imagine many different distinctions between different types of knowledge even within the two broad categories of industrial and scientific knowledge. At the same time this distinction is also context specific because the difference between industrial and scientific knowledge could be very useful in particular industries or companies like the one studied here, but might not be as useful in other industries. Another limitation regards the dependent variable which is based on a peer

evaluation instead of a more objective measure of innovativeness like, for instance, some sort of innovative output.

Both these limitations are very important and I am planning to address them in the development of my research agenda. For instance, I am presently collecting data in a different project on three business units at the same company where respondents are asked to identify their knowledge profile based on 14 different knowledge categories suggested by the top management of these three units. About the second point, the company allowed me to access information available on the R&D monthly report of each lab where there is a detailed description of the activities performed by individuals in the lab as well as specific information about the innovative outputs generated in each lab in terms of patent applications, prototype devices, algorithms, software codes, etc. This additional source of information will allow me to extend my research about the social structure of innovativeness by considering different types of outcome variables.

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