# EXTERNAL AND LOCAL KNOWLEDGE NETWORKS: THE ROLE OF GATEKEEPERS OF KNOWLEDGE

**COMPETITIVE PAPER**

**Abtract:**

The objective of this paper is to analyse how gatekeepers behave, which internal characteristics they have, and how they integrate local interactions with non-local, international ones, that is, how they affect other firms that are directly connected with. We test this aim on the context of science parks. Our results show that knowledge gatekeepers have a higher innovative performance, a connecting role between international knowledge and local networks hardly evaluated how it works in previous studies. We have also observed that gatekeepers tend to have a more restricted local network which allows them to both improve in the development of shared routines and values and protect the experiential knowledge that they obtain internationally from local leakages.

**Keywords:**

Knowledge, networks, gatekeepers

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## INTRODUCTION

Because of globalization and the increasingly dynamic environment, knowledge, innovation and internationalization have become critical and interrelated ingredients in explaining the survival and competitive advantage of firms (Chiva et al., 2014; Puig et al., 2014). Previous research has claimed that creation, dissemination, and exploitation of knowledge is a dominant source of innovation for firms (Spender and Grant, 1996), as well as for their internationalisation processes (Gabrielsson and Gabrielsson, 2013; Leelapanyalert and Ghauri, 2007), at time there is a positive relationship between innovation and internationalisation (Pla-Barber and Alegre, 2007).

In this sense, according to the traditional international business theories, internationalization is an incremental process where the access to experiential knowledge play a relevant role for increasing firms' international competitiveness (Forsgren, 2002; Gabrielsson and Gabrielsson, 2013; Johanson and Vahlne, 1977). This experiential knowledge is considered difficult to transfer between firms, is learned through their personal international experience or learning by doing (Penrose, 1959) and although is tacit in nature contains codified and non-codified as well as cognitive and affective knowledge (Hohenthal et al., 2014). But, as an extension of this point of view, a network theory was developed to pinpoint the importance of relationships in internationalization (Sandberg, 2013, 2014). So, while part of the experiential knowledge could be developed internally by each firms' direct experience (Majocchi et al., 2005; Schwens and Kabst, 2009), another sources of knowledge focus on external indirect experience such as learning and grafting, and search of information (Fletcher and Harris, 2012), obtained mainly by interaction with the surrounding network of firms (Chetty and Agndal, 2007; Chetty and Eriksson, 2002; Johanson and Vahlne, 2006, 1990, 2009) and other institutions that have developed international experience previously (Ghauri et al., 2008; Sepulveda and Gabrielsson, 2013).

Therefore, understanding the learning process that allow firms to exchange and combine internal experiential knowledge with knowledge provided indirectly by their network is increasingly considered a key element for successful internationalization processes, even before developing international relationships (Coviello, 2006; Martin et al., 1998). Nevertheless, creating new knowledge by exchanging and combining knowledge from direct international experiences and knowledge provided by a local network entails several difficulties for firms due to the complex nature of knowledge (Bapuji et al., 2011; Eriksson

and Chetty, 2003; Henisz and Macher, 2004). In this sense, it tends to be easier and even higher when firms are in geographically concentrated spaces where knowledge flows through a local network developed among co-located firms and organizations (Tallman, 2013; Wu and Wu, 2014). Confirming this aspect, literature on geographical concentration have undertaken a network approach to understand how firms can learn, innovate and hold relevant positions in international markets thanks to their local and international relationships (Crespo et al., 2014; Molina-Morales and Martínez-Fernández, 2009; Ter Wal and Boschma, 2009). Firms located in agglomerated spaces, such as industrial districts, clusters, or science parks, tend to have a higher facility to transfer knowledge and create new combinations of it due to proximity advantages (Díez-Vial and Montoro-Sánchez, 2014; Ter Wal, 2014). From this perspective, most studies have tried to understand which structure of relationships and connections can be proper for connecting learning processes inside the local network with extra-local relationships, mainly international ones (Bathelt et al., 2004; Graf, 2010).

One factor that can help to better understand how international firms can successfully integrate local and global knowledge is the brokerage role developed by what is denominated as gatekeepers of knowledge. These gatekeepers are firms or institutions with strong connections outside the location "but contribute to the diffusion and recombination of external knowledge within the local context" (Giuliani 2011a:1330). By establishing relationships outside the location, gatekeepers are capable of both identifying new techniques, products or ideas and contributing to the diffusion of acquired knowledge at the local level (Allen, 1977; Boari and Riboldazzi, 2014; Munari et al., 2012). That is, the gatekeeper can help other local firms with poor extra-local connections to access new knowledge and improve their innovative capacity and internationalization process(Guercini and Runfola, 2010; Hervas-Oliver and Albors, 2012; Morrison, 2008).

Considering the above shortcomings in the extant literature, the objective of this research is to analyse how gatekeepers behave and how they affect other firms that are directly connected with. Not all firms can behave as gatekeepers, so we want to understand which internal characteristics they have, and more important, how they integrate local interactions with non-local, international ones. In certain way the gatekeeper establishing international relationships need to develop a kind of "translating mechanism" which makes knowledge produced outside the cluster understandable to its members (Morrison, 2008). It implies the establishment of a balance between local and international relationships, and gatekeepers should hold a certain leader position in the local structure that allow them to coordinate and integrate local and international knowledge (Giuliani 2011a; Rychen and Zimmermann, 2008). Among the

different kinds of networks developed among organizations located in proximity, this paper focusses the attention on science parks. Sciences parks are recognized as mechanisms that facilitate the transfer of knowledge and expertise among their tenants (Ferguson and Olofsson, 2004), and also from universities to the business economy (Hansson et al., 2005; Smith, 2007). Mainly comprising small high-technology firms that lack experience, knowledge flows inside science parks may help to overcome barriers to the successful international commercialization of their innovations (Colombo and Delmastro, 2002).

This paper is structured into the following sections: the theoretical framework is presented in section two. Section three offers a description of empirical context and the explanation of the measurement of the variables. Section four shows the main results obtained. Finally, section five extracts the main conclusions and future research lines.

## THEORETICAL FRAMEWORK

The concept of gatekeeper in managing information and knowledge local and global flows can be attributed to the seminal works of Allen (1977) and Tushman (1977). Nevertheless, the concept of gatekeeper was first coined by the social psychologist Kurt Lewis (1947, 1951) who developed a theory of channels and gatekeepers to explain social changes in communities applied to many different disciplines such as communication, sociology, psychology, and political science, among others. In general, the concept of gatekeeper has been associated with a role in the acquisition and utilization of external information (Tushman and Katz, 1980).

In geographically concentrated spaces, the existence of firms that behave as leaders, connecting internal knowledge networks and external sources of knowledge have been broadly considered as a key element for the development of the economic system (Boari and Lipparini, 1999; Ferriani et al., 2013; Lazerson and Lorenzoni, 1999). The dynamic of the local network of relationships must be considered together with the mechanisms by which knowledge generated outside the location is identified, accessed, and integrated (Boari and Riboldazzi, 2014; Munari et al., 2012). Communities of geographically concentrated firms and other institutions that are close to knowledge generated outside are at risk of losing their competitive position in international markets, locked in the same routines, beliefs and learning routines (Bathelt et al., 2004; Crespo et al., 2014; Grabher, 1993; Lazerson and Lorenzoni, 1999; Uzzi, 1997). Underlying these ideas it can be identified a kind of gatekeeper playing a mediation role providing each of the agents with a connectivity function that enables them to avoid the cost of maintaining side by side relations (Morrison, 2008). They contribute to the interconnection of internal and external sources of knowledge allowing local agents the access

to their own external relationships developed in other markets (Boari and Riboldazzi, 2014; Rychen and Zimmermann 2008).

Building on these ideas, we try to deepen on these aspects by analysing the external linkages through international relationships that the gatekeeper develops with clients, mainly by export activities. The involvement of firms in export processes has been broadly considered as an indicator of their overall performance and competitiveness (He and Wei, 2013; Zou and Stan, 1998). Firms that are able to penetrate foreign markets are exposed to more intensive competition, while they also incur the sunk costs associated with doing this (Sandberg, 2013; 2014). So only the most productive companies will choose to pay the entry costs required to compete with domestic and foreign firms for customers in those markets (He and Wei, 2013; Sandberg, 2013). Moreover, as long as firms from local production systems participate of global markets they will be able to interact with international providers, clients, consulters or institutions, local firms can acquire fresh knowledge and build new competitive advantages (Belso-Martínez 2010; He and Wei, 2013). In particular, actors who qualify as gatekeepers serve two functions in the geographically concentrated space: they have international knowledge sourcing and they diffuse it within the local system (Giuliani and Bell, 2005; Giuliani, 2011a; Graf and Krüger, 2011; Munari et al., 2012). In terms of network relations this means that the gatekeeper has to interact frequently and locally via a sufficient number of local interactions but also internationally, which require a specific structure that needs to be better understood (Boari and Riboldazzi, 2014). As it is not clear the local structure that they have and how they integrate the knowledge from the gatekeeper, it is also necessary to deepen on the consequences that are directly related with the gatekeeper have for the other firms.

This research focusses on science parks, which can be considered an environment conductive to innovation by providing for physical and social infrastructure that stimulates new knowledge creation and dissemination (Hansson et al., 2005; Smith, 2007). Within the literature, sciences parks are recognized as mechanisms that facilitate the transfer of knowledge and expertise from universities to the business economy. In particular, science parks foster partnerships between the university, the firms, and the own park management that improve their learning abilities and innovation capacity (Link and Siegel, 2005; McAdam and McAdam, 2008). While any of these actors may behave as a gatekeeper, we play special attention to the role developed by firms with international experience in connecting local with global interactions (Boari and Riboldazzi, 2014; Hohenthal et al., 2014). Local interactions have been considered a key element in developing local knowledge inside science parks by

either formal or informal relationships (Filatotchev et al., 2011; Hansson et al., 2005), but compared with the other agents of the park, they have been hardly analysed.

**The firm as a gatekeeper in the science park**

The role that the gatekeeper plays in coordinating international and local knowledge, although it can benefit other firms of the park, it should first benefit the own gatekeeper. In particular, these knowledge flows are positively related with a higher innovative capacity, the extent of its network and the kind of relationships they established with the other actors. Innovative capacity of firms is tightly related to the development of diverse relationships with other firms and organizations that prove them with new ideas, processes and experiences (Graf and Krüger, 2011). It is common understanding that firms generate novelty mostly through the combination of existing knowledge with that provided by others through a learning process created by repeated interactions (Boari and Riboldazzi, 2014; Molina-Morales and Martinez-Fernandez 2010;). These interactions can be local or international, but the more diverse these interactions are, the more opportunities the firms have to identify and exploit new sources of knowledge into innovative products (Gilsing et al., 2008). Firms connected across different markets and networks have more access to alternative ways of thinking giving more options for creating new combinations of knowledge valuable to compete internationally (Giuliani, 2013).

Moreover, the role of gatekeeper needs of firms that have the capacity to scan and exploit external sources of knowledge, as well as the position in the local network that allow them to transfer the new knowledge into the park (Munari et al., 2012). As a consequence, firms that behave as gatekeepers should have a knowledge base that allows them to incorporate new knowledge in an accumulative way. More precisely, new knowledge is incorporated into organizational knowledge only when it is shared and assimilated into organizational routines, documents, and practices (Cohen & Levinthal, 1990). Firms' learning is conditioned by the specific investments and complementary assets they possess, or have possessed in the past, and the portfolio of activities, technologies and markets in which they have been involved. As a consequence, firms that behave as gatekeepers should have a knowledge base that allow them not only to connect international and local linkages (Morrison, 2008), but also that confer them a higher innovative capacity (Graf and Krüger, 2011). Based on that, we can propose that:

*H1:* Gatekeepers have a higher innovative capacity than other firms.

Based on the above arguments, the presence of higher innovative firms that behave as gatekeepers should have a positive effect on the park as they work as a translating mechanism

of international relationships into local interaction. In this sense, most studies undertaken in concentrated spaces such as clusters and industrial districts consider that gatekeepers provide a sort of public good to the local innovation system (Graf and Krüger, 2011). Underlying this idea is that firms located in those kind of locations share common values, rules and languages developed after years of shared experiences, culture and other factors that form a cohesive social environment (Becattini, 1990). Social and cultural proximity along with spatial closeness enable knowledge to circulate freely among local firms and institutions (Maskell and Malmberg, 1999). As a consequence, firms outside that location cannot access to this local and tacit knowledge since they are physically and culturally distant.

But contrary to industrial districts and clusters, inside science parks it cannot be assumed that firms have develop this cohesive social environment that makes the transfer and collective creation of knowledge easier. Inside parks firms not only come from different industries, they also have different backgrounds, experiences and values. They can share a similar entrepreneur culture and may have received a comparable education, but they are not so tightly joined to the location as industrial districts firms (Díez-Vial and Montoro-Sánchez, 2014). In this sense, many parks have as a policy that after two or three years of incubation firms should leave the park (Phillips, 2002), losing the specific advantages associated with location and increasing the rotation of their co-located firms. Moreover, firms gatekeepers inside an industrial district or in a park, rather than distribute knowledge unintentionally may establish selective diffusion strategies by specific relationships created in their local network (Morrison 2008; Rychen and Zimmermannb 2008). Gatekeepers that contribute to the transfer of knowledge from international markets may be reluctant to share it with any other firms of the location, as there can be differences in the contributions and benefits that these firms can reciprocate (McEvily and Zaheer, 1999; Morrison and Rabellotti, 2009a). As a consequence, it would be reasonable to assume that inside parks firms prefer to develop more restricted relationships with other firms. A restricted network implies that the gatekeeper establish relationships with other firms who are connected to one another, so actors of this network loose freedom of action because they are all connected –constraint network (Burt, 1992). It does not imply few connections, but connections controlled. In doing so the gatekeeper can protect the knowledge provided from outside from undesirable leakages to other firms that cannot contribute that much to their own benefits. Also, these constraint network allow firms to develop close cognitive registers that make communication among them easier (Rychen and Zimmermann, 2008).

*H2:* Gatekeepers have a more restricted network than other firms.

Local relationships among co-located firms tend to develop a trustworthy environment. Sharing the same space in science parks makes it easier informal meetings, occasional encounters and face to face interactions (Mian, 1996), which generate trust (Graf, 2010; Keeble and Wilkinson, 1999). Even though firms do not share common backgrounds and meanings, the physical space fosters a mutual knowledge of one another, accumulated through each firm's own experience in the park, that fosters a relational trust (Dei Ottati, 2002; Granovetter, 1985). The presence of trust-based relationships enables the exchange of knowledge among different agents. Trust reflects the belief that a partner's word or promise is reliable and that a partner will fulfil its obligations in the relationship (Inkpen and Tsang, 2005). Trust plays a key role in the willingness of network actors to share knowledge by reducing the opportunism risk. Prior research has argued that trust between partners determines knowledge transfer. Therefore, trust allows the knowledge exchange since it increases firms' willingness to commit to helping others understand new external knowledge (Wijk et al., 2008). In trustworthy environments firms can find more opportunities and time for knowledge transfer, which is of special relevance when considering tacit knowledge (Levin and Cross, 2004; Tsai and Ghoshal, 1998).

Nevertheless, gatekeepers combine these local interactions with distant ones, which may affect the level of trust that they develop. Trust-based relationships tend to restrict the access to new or unconnected sources of knowledge, preventing members to establish relationships with members from outside in international markets (Sepulveda and Gabrielsson, 2013). Distant relationships tend to be considered as weaker ties based on infrequent interactions that do not necessarily evolve to trust interactions (Granovetter, 1973). They have been compared with structural holes of (Burt, 1992) but adding geographic distance. By establishing these distant relationships firms connect to actors that are not tied to one another as it happens inside a local network when firms are connected across structures holes, which are not otherwise connected to each other (Bell and Zaheer, 2007). In this sense, these international linkages have been considered as short-lived, being conditioned to the access to privileged resources and knowledge obtained by them (Burt, 2002; Hansen, 1999). In any case, gatekeepers need to invest time and effort to keep these international linkages in terms of meetings, informal encounters, coordination, etc.; and it is difficult to sustain relationships with those unlike oneself (Burt, 2002). This investment in international relationships may be difficult if the firm also want to develop strong local relationships with frequent and trust based interactions. As long as the relationships become more based on trust, firms need to

spend more resources to keep them (Lane and Lubatkin, 1998). As a consequence, we therefore propose that:

*H3:* Gatekeepers have a less strength in the local relationships of the network than other firms.

**The firm as a direct contact of a gatekeeper in the science park**

The benefits of the gatekeeper associated with its connecting role of local and international relationships are assumed to be dispersed across the park. In particular, it is considered that gatekeepers contribute to the diffusion of acquired knowledge at the local level, helping firms with poor connections outside the location to access new knowledge (Boari and Riboldazzi, 2014). So, it would be expected that firms connected to gatekeepers show higher levels of innovation and specialisation, as well as centrality position in their local relationships. First of all, as it was explained previously, the access to complementary sources of learning, local and international is considered vital for innovation. Following (Giuliani, 2011a), gatekeepers are characterized locally for providing more knowledge that the one they receive, so it is reasonable to assume that local firms can benefit from international knowledge that is obtained through the gatekeeper.

However, not all firms can access to the same flow of knowledge inside the park, being broadly recognized that the patterns of connections between actors configure a network that each firm develop, conditioning their behaviour (Phelps, 2004). One of the characteristics of relationships is that constitute influence their ability to access, transfer, absorb, and apply knowledge among firms (Johanson and Vahlne, 1990, 2006, 2009). In this sense, we consider that firms directly related with a gatekeeper would benefit most from the knowledge that they provide. Establishing direct contact with the gatekeeper allow firms to obtain knowledge without intermediation of others, which makes communication easier and faster. Direct interaction with the source of knowledge allow for personal contact, through frequent interactions; makes less costly the process of identifying and incorporating knowledge from the gatekeeper into the existing knowledge base of the firm (Boari and Riboldazzi, 2014) . Firms can learn about other firms' experiences through experience. Also, direct interaction allow for a timely access to a broader range of sources of knowledge that can make them more innovative (Phelps et al., 2012; Powell et al., 1996). Notably in technological intensive industries, product life cycles tend to shrink and there is a high pressure on firms to a rapid penetration into foreign markets in order to successfully commercialize their products (Gilsing et al., 2008; Ter Wal, 2014).

*H4:* Firms with direct contact with a gatekeeper have a higher innovative capacity than other firms.

Along with gaining access to knowledge that improve firms' innovative capacity; having exporters in the same network should also increase the capacity of the firms to also become exporter. Firms can access to experiential knowledge about distant markets through their interactions with other firms that behave as gatekeepers (Eriksson et al., 1997; Shaver et al., 1997). They can provide market research and consumer intelligence, industry-applied research and development, and diffusion of local practices (Sandberg, 2014). Also, they can more easily provide managerial experience with detailed information about contacts with international agents (Hohenthal et al, 2014; Keeble and Wilkinson 1998). Nevertheless, the positive effect of gatekeepers on other exporters is not clearly stated (Boari and Riboldazzi, 2014). On one hand, firms lacking direct experience in international markets face difficulties in understanding and exploiting knowledge from the gatekeepers to become exporters. International business research assumes that local links with other exporters not only increase a firm's knowledge about distant markets but also reduce the perceived risk associated with its internationalization (He and Wei, 2013). When firms lack direct experience they face great uncertainty and higher risks associated with exporting so they tend to pay more attention to other local firms that are also exporters, being not clear the consequences on exports (Barkema et al., 1996; Henisz and Delios, 2001).

Similarly, firms that already have extensive international experience are also less likely to improve their export performance through using the experience of others as a knowledge source (Henisz and Macher, 2004; Hohenthal et al., 2014; Shaver et al., 1997). Instead of having local relationships, firms with significant international experience can learn about the institutional, technological, and competitive environments in foreign markets by using their direct experience, through the depth and diversity of their exports. Moreover, they can establish relationships with distant agents that provide a source of knowledge they can use to improve their performance (Belso-Martinez, 2006; He and Wei, 2013; Hendry et al., 2000). In contrast, firms with significant international experience do not depend on the knowledge and perspectives of local competitors to expand internationally, so establishing relationships with local exporters does not help to improve their performance, and it is even possible that they could weaken this performance (Barkema et al., 1996).

*H5:* Firms with direct contact with a gatekeeper have a possible higher export propensity than other firms.

Secondly, along with the relationship established with the gatekeeper, the position that each firm has in the local network created among other co-located firms also affect their innovative capacity (Felsenstein, 1994; Johannisson, 1998; Löwegren, 2003). In this regard, centrality has been considered as one of the most important positioning characteristics in the structure of knowledge networks. Network centrality refers to a firm's position in the entire pattern of ties creating a network and indicates the extent to which the firm is close to the centre of the action, being directly or indirectly involved in many important ties (Freeman, 1979; Ibarra, 1993). This central position is positively associated with innovation, because it increases timely access to a broader range of technical knowledge (Phelps et al. 2012; Powell et al. 1996). By accessing to many alternative contacts firms can gather knowledge about different technological developments and creating new combinations of them (Ahuja, 2000). Centrality also confers more status and power, since a firm that is involved in many ties will be considered to be a prestigious firm (Gnyawali and Madhavan, 2001). Central positions shape a firm's reputation and generate visibility, giving greater access to assets, such as technology, money, and management skills, provided by connected firms or other organizations outside the park (Gulati and Gargiulo, 1999; Powell et al., 1996).

This centrality in the knowledge network of firms can have a reinforcing effect to the international knowledge provided by the gatekeepers: firms that are central in a network will also be more active recipients of knowledge from gatekeepers. Gatekeepers facilitate access to valuable knowledge from outside the park, broadening the exposure of the firm to a greater diversity of perspectives, ideas, and experiences (Molina-Morales, 2005; Stam and Elfring, 2008). In this sense, centrality in the local network expands access to knowledge beyond what is available through each firm's direct contacts, so the firms that establish relationships with the gatekeeper will be the central participants in the local network (Bunker et al., 2009). In a similar way, gatekeepers would be interested in transmitting knowledge to central firms as they have a better reputation and a more important role in the science parks, (Phelps et al., 2012; Powell et al., 1996). Gatekeepers find that developing relationships with central firms facilitate the access to diverse local knowledge without the high costs of maintaining many different relationships (Brass et al., 2004; McEvily and Zaheer, 1999; Sepulveda and Gabrielsson, 2013). Moreover, firms with access to a more diverse set of knowledge sources develop more experience in understanding and transmitting knowledge, so they are likely to have more central positions (Powell et al., 1996; Zaheer and Bell, 2005). We thus propose that:

*H6:* Firms with direct contact with a gatekeeper have a higher centrality than other firms.

# METHODS

## Sample and data collection

We test our hypotheses in the Science Park of Madrid. It is a non-profit foundation created in 2001. Its aim is to promote research, development and innovation, paying special attention to interdisciplinary aspects, transferring knowledge to society, businesses and entrepreneurs; and implementing R&D&i results in products, processes and services that favour social well-being and progress. We gathered the information using a one hour structured interview based on earlier studies with managers from firms located in the Park. In particular, we generated a questionnaire that we pretested and discussed with firms of the Park and them used as the base for interviewing managers. The number of firms established and operating during the collection of information was 94. We obtained information from 78 firms which represent the 83% of the total. This sample include 54 of 64 firms located in Tres Cantos (84.3%) and 24 of 30 firms from CLAID (80%).

## Measurements

*1. Knowledge sharing among firms.* In this research we follow a social network analysis (Borgatti et al., 2002). Social network analysis allows measuring the knowledge exchanged among different firms and organizations inside a network, as well as the characteristics of the relationships developed among them. As a consequence, we create the measures by firstly evaluating each relationship created between two organizations of the Science Park. In the questionnaire-based interviews, these kinds of relational data were collected through a 'roster recall' method: each firm was presented with a complete list (roster) of the other firms and institutions in the Science Park, and they were asked about the relationship with each one of them (Giuliani and Bell, 2005; Morrison and Rabellotti, 2009b; Ter Wal and Boschma, 2009). So, we gathered information about each relationship that surveyed firms have developed inside the park, which means 5,550 dyadic interactions. These interactions are considered asymmetric, as the fact that the firm *i* considers firm *j* as a source of knowledge exchange, does not mean that unit *j* also view unit *i* as a source of knowledge exchange (Hanneman and Riddle, 2005; Tsai, 2002). Each variable is represented by a different matrix in which each cell contains information about the relationship between each pair or organizations. In our research we have 128 organizations -78 surveyed firms (76 for the innovation variable), 41 firms that surveyed firms have linkages with them, and 9 institutions, so we construct for each variable a matrix 128x128 where the cell *ij* represents any characteristic of the relationship between the organization *i* and the organization *j*.

To measure the knowledge sharing among firms of the Science Park and based on previous literature (Bell and Zaheer, 2007; Boschma and Ter Wal, 2007; Giuliani and Bell, 2005; Hansen, 1999; McEvily and Zaheer, 1999; Morrison, 2008). We asked each manager to indicate (importance and frequency in a 7 likert scale) the organizations which they received from and gave to knowledge for the last 2 years:

$Q_1$: *To which of the local organizations mentioned in the roster have you received technical knowledge such as advice about new production processes, product development, or more efficient machinery?* (Boschma and Ter Wal, 2007; Giuliani and Bell, 2005; Giuliani, 2007; Hansen, 1999; Morrison, 2008)

$Q_2$: *To which of the local organizations mentioned in the roster have you received market knowledge such as client preferences, failures in the product offered or factors that influencing sales evolution?* (Boschma and Ter Wal, 2007; Sammarra and Biggiero, 2008).

$Q_3$: *To which of the local organizations mentioned in the roster have you received managing knowledge such as how to run the business or integrate different activities and functions inside the firm?* (Bell and Zaheer, 2007; Sammarra and Biggiero, 2008).

This information is the basis to create several variables of the study, as we will explain in the following lines.

*2. Gatekeepers*. The role of the *gatekeeper* has been considered in several studies, but research has been mainly descriptive, not measuring the gatekeeper but assuming that gatekeepers are large firms in the industrial district (Morrison and Rabellotti, 2009a) with a leading role inside the network (Munari et al., 2012).In this research we follow the measurement of (Giuliani, 2011b) who consider gatekeeper as a firm that meets two criteria: a) in local relationships it has a giver role, providing more knowledge to their local partners that the knowledge that he has received from them; and b) it has international relationships.

Taking into account the amount of knowledge that each firm receives inside the network as well as the amount of knowledge that each one gives, we can create different “cognitive positions”. Following (Gould and Fernandez, 1989), and based on the knowledge exchanged locally, firms can develop different roles or “cognitive positions” inside the park: they can be givers, when they provide more knowledge than they receive; they can be absorbers when they receive more than they give; they can be mutual exchanger, when there is a balance and finally they ca be isolated when there is no knowledge exchange locally. In particular, we consider that a firm is a source of local knowledge, that is a giver, when the ratio between the knowledge received (in-degree centrality) and the amount of knowledge that is transferred by that firm to other local firms (out-degree centrality) is lower than 1. On contrary, firms that

have a ratio in-degree/out-degree higher than 1 are classified as local absorbers, and firms that have a ration near to 1 are defined as mutual exchangers. Finally, there are firms with no exchange of local knowledge, which are considered as isolated firms.

The second condition for identifying gatekeepers deals with international experience. In measuring international relationships, we focus specifically on relationships based on exports, that is, we ask firms to be exporters. The involvement of firms in export processes to transfer their goods and services across national boundaries has been broadly considered as an indicator of their overall competitiveness (Malmberg et al., 2000). As a consequence, firms that dedicate part of their effort to selling abroad need to intensify the search for their source of competitive advantage in both national and international markets. Also, exporters have been broadly considered a valuable source of knowledge and information about distant markets (Guercini and Runfola, 2010; Sapienza et al., 2005; Schwens and Kabst, 2009). Figure 1 represents the local network of the knowledge network developed inside the park, differentiating the position of exporters and non-exporters. As firms are more centered in the network they have a more active position in knowledge exchange inside the park.

----Insert figure 1 around here----

Once we have identified the gatekeepers inside the science park, we also established which firms have *direct contact with a gatekeeper*. In this sense, we create a dummy variable in which those firms that have direct knowledge exchange with a gatekeeper takes value “1” and “0” otherwise. Taking into account these two conditions-behaving as a giver in the local network and being an exporter- we can identified and represent them in the knowledge network of the park, as it is illustrated in figure 2.

----Insert figure 2 around here----

*3. Network characteristics.* In order to test most of the hypotheses we need to measure several characteristics of the network that it has been locally developed inside the science park. In particular, we first need to know if the network is constraint to the direct contacts, which is measured by the *constraint* of the knowledge exchanged between the gatekeeper and their direct contacts. Constraint measures the extent to which ego's connections are to others who are connected to one another. It deals with the idea of dependence to others in the network as your connections are direct or indirectly connected. Following Burt (1992:54) the expression of constraint between nodes *i* and *j* is as follows:

$$P_{ij+\sum_q P_{iq} P_{qj}} \qquad q \neq i, j$$

Where $P_{ij}$ is the proportion of knowledge exchange between nodes *i* and *j*; $P_{iq}$ the proportion of knowledge exchange between nodes *i* and *q*; and $P_{qj}$ the proportion of knowledge exchange between nodes *q* and *j*. It measures the level of investments the relationship between I and j, directly and indirectly; being highest when firms invest in other firms that are already connected indirectly by other contacts.

Secondly, we need to measure the *strength of the relationships* that each firm develops inside the network. For doing it, we measure the strength of the relationship that the gatekeeper has with all his/her direct contacts in the ego-network. As Marsden & Campbell (1984) have pointed out, it is difficult to design measures of relationship strength given the lack of a precise conceptual definition. According to Granovetter (1973), most of the literature has paid special attention to the level of closeness and friendship in the relationship, the frequency of the relationship and the mutual confiding and acknowledgement of contacts. Following previous studies we measure the strength of the relationships by considering the frequency of the interaction among firms and their degree of friendship (Hansen, 1999; Reagans and Mcevily, 2003). This is calculated by asking the following questions:

$Q_4$: *How close/friendly do you feel to the organizations mentioned in the roster?* (7 Likert scale). (Bell and Zaheer, 2007; Ingram and Roberts, 2000).

$Q_5$: *How frequently do you have contact with the organizations mentioned in the roster (conferences, informal encounters in meetings, formal or commercial relations, etc.)* (7 Likert scale). (Hansen, 1999; Reagans and Mcevily, 2003)

$$CL_k = \sum_{i=1}^{n} b(p_i, p_{k)}$$

$$FR_k = \sum_{i=1}^{n} c(p_i, p_{k)}$$

Where $b(p_i, p_{k)}$ takes a value from 0 to 7 depending on the answer given in $Q_4$ for the relationship between $p_i$ and $p_k$; and $c(p_i, p_{k)}$ takes a value from 0 to 7 depending on the answer given in $Q_5$ for the relationship between pi and $p_{k.}$ Once we calculated these data for each node $P_{k,}$ we calculate de mean value of each these values for each point (correlation of 0.891; $p<0.01$). The variables results

$$CL_k = \frac{CL_k + FR_k}{\sum_{i=1}^{n} d(p_i, p_{k)}}$$

Where $d(p_i, p_{k)}$ =1 if and only if $p_i$ and $p_k$ have any relationship between them. By dividing the variables with this denominator, we are in fact measuring the strength per relationship avoiding that the higher the number of relationships, the higher the probability of having frequent and close interactions.

Thirdly, we need to measure centrality in the local network to test hypothesis that deals with firms directly related to the gatekeeper. Once the knowledge network has been mapped, we can also measure *centrality in the network*. Centrality depends on the number of links between one node and the others in that network. We measured this by counting the number of other firms from which a firm has received knowledge. With this approximation we try to understand the position of the firm simply in terms of the structure of the network, without considering the type of relationships (Ahuja, 2000; Freeman, 1979).

In particular, centrality is the count of the degree or number of adjacencies for a node, $P_k$:

$$C_k = \sum_{i=1}^{n} a(p_i, p_{k)}$$

Where $a(p_i, p_{k)}$ =1 if and only if $p_i$ and $p_k$ are connected by a line in the technical knowledge network or cero otherwise.

Finally, we measure the *diversity in the ego-network* of each firm in terms of industries that are implied. Inside the science park under research firms can undertake either of these activities: Information technology and communication; Environment and renewable energy; Life Sciences and Chemical; Nanotechnology, new materials and engineering, other sectors and support services of the park. Taking these data for each firm, and based on previous studies (Boschma and Iammarino, 2009; Gilsing et al., 2008) we calculate the degree of diversity in the ego-network of each firm, we follow the heterogeneity measurement of Blau, as follows:

$$H = 1 - \sum_{k} P_K^2$$

Where $P_k$ gives the proportion of alters that fall in each activity *K*.

*4. Innovative capacity*. Innovativeness means a firm's tendency to lead the industry in creating and introducing new products or services and using new technologies to produce these (Zaheer and Bell, 2005). In general, the number of patents that firms have has been broadly considered a good proxy for this measure (Jaffe et al., 1993), but many companies, at least in Spain, do not tend to protect their innovations through patents (Expósito-langa, Molina-Morales, & Capó-Vicedo 2011). In our survey we asked companies about their patents, and the low level of patenting confirms this argument.

As a consequence, we have measured innovation as the number of new products or services launched that are not only new for the firm but also for the market (Tsai and Ghoshal, 1998). This is the same measure as used in the Community Innovation Survey. The Community Innovation Survey is the main data source for measuring innovation in Europe.

## RESULTS

### Analysis

The objective of this research is to both better understand the characteristics of the firms that behave as gatekeepers inside parks (hypotheses 1 to 3) and identify the consequences that this imply for firms that belong to their direct contacts, i.e. share the same ego-network (Hypotheses 4 to 7). To test the first 1 to 3 hypotheses, we split the sample of firms into two mutually exclusive groups: those firms that are gatekeepers and firms that are not gatekeepers. We created these two groups by taking into account the two dimensions previously considered (being a knowledge provider locally and being exporter).

---Insert table 1 around here---

The main characteristics of the gatekeeper can be observed in table 1. Gatekeepers inside parks have 6 years old as media (5 of median), not different from the total sample. Surprisingly, near 41% of the gatekeepers and spin-offs from the university (nearly double from the total sample) but none are spin-offs from other firms. They have 10.9 employees as media, which is a slightly higher than the media of the science park, and there seem to be no differences between the entrepreneurial orientation of the gatekeepers and the entire sample.

---Insert table 2 around here---

Also, table 2 presents the distribution of the gatekeeper across the different activities represented in the park, and we can observe gatekeepers are mainly from Nanotechnology, new materials and engineering (38% of all the firms in this activity in the park), Environment and renewable energy (33%) and Life Sciences and Chemical (32%). Variables employed in the research are not normally distributed so we need to apply a non-parametric equality-of-medians test, the Rank Sum test that we run in STATA. The test showed whether or not these median values were significantly different, as it can be observed in table 3. Results confirm that there are significant differences between gatekeepers and other firms from the park in terms of innovative capacity, radical or not, and constraint of the network. In particular, gatekeepers are more innovative and have a more constraint network, but contrary to expected, the strength of the relationships developed inside the park does not significantly change from gatekeepers to others.

---Insert table 3 around here---

To test hypotheses 4 to 7 we split the sample between firms that have as their direct contact (ego-network) a gatekeeper and firms that not. We also run the Rank Sum test and results are presented in table 3. Results confirm that the gatekeeper tends to establish direct relationships with firms that have central positions, but direct relationships with the gatekeeper do not seem to affect either their innovative capacity or their export activity. Finally, firms with a direct relationship with a gatekeeper do not have a less diverse ego-network.

---Insert table 4 around here---

**Discussion**

Results confirm that gatekeepers have a higher innovative capacity than other firms of the park, since firms that become exporters have a higher competitive capacity as they have to sell their products in local and global markets (Malmberg et al., 2000). Moreover, innovative capacity of firms is tightly related to the development of diverse relationships with other firms and organizations that prove them with new ideas, processes and experiences (Graf and Krüger, 2011), so it is expected that gatekeepers outperform the rest. In general, previous studies have analysed gatekeepers have also found a higher absorptive capacity and size (Graf, 2010; Morrison, 2008). Also, Hervas-Oliver and Albors (2012) in their dynamic evaluation of the district, found that gatekeepers, with high absorptive capacity and high-intensity R&D expenditures, shape the district learning process. Nevertheless, Graf and Krüger (2011) found that the benefits of being a gatekeeper on innovative capacity only appear up to a point of external-internal combination of activities.

We also confirm that firms tend to develop a more restrained network in order to protect the knowledge that is provided to only certain firms. In doing so, they avoid valuable knowledge leakages. This result is coherent with those firms that, having higher capacities or knowledge, prefer to keep isolated rather than establishing many relationships. This is the case of exporters firms in the wine industry that obtained (Morrison and Rabellotti, 2009), the negative effect of many other hotels near large and reputed ones (Baum and Mezias, 1992), or the location of direct investments established by Shaver and Flyer (2000). But also, gatekeepers may prefer to have a selective direct network to develop shared routines and procedures that make communication among their direct contacts more easily, as it has been tested previously (Díez-Vial and Montoro-Sánchez, 2014; Yli-Renko et al., 2001).

Contrary to expected, the strength of the local relationships do not significantly differ between gatekeepers and no gatekeepers. Based on previous studies we proposed that firms that need to establish local and global relationships need to dedicate time and effort to these different relationships and this makes it difficult to establish trust based, frequent and friendship

relationships (Burt, 2002; Molina-Morales and Martínez-Fernández, 2009). In any case, (Morrison, 2008) points out that the translating mechanism of the gatekeeper to the local network will be with firms that have a relatively well-established relationship. Nevertheless, a plausible explanation for this result deals with the characteristics of the relationships developed inside parks. Most previous studies where undertaken in industrial districts or clusters where there were more shared values, norms and history than inside parks. Those studies that have evaluated the relationships developed among firms inside parks have pointed out that they are scarce (Bakouros et al., 2002; Filatotchev et al., 2011; Hansson et al., 2005),

With respect to the effect of the gatekeeper on other firms that have established direct relationships with it, results do not seem to confirm the expected benefits associated. Most previous studies have tended to assume these benefits, so it is difficult to establish comparisons but we will try to identify possible explanations. We confirm that gatekeepers tend to establish direct relationships with firms that have a central position in the local network, which is coherent with previous studies that consider that the gatekeeper tries to establish a leader role, or connection function to transfer knowledge from outside to inside the network (Giuliani, 2011a; Morrison, 2008; Munari et al., 2012).

Nevertheless, we do not observe that firms establishing direct relationships with gatekeepers had a higher innovative capacity or export propensity. Similar results were found by (Morrison, 2008) where he observed that the knowledge from leaders does not circulate pervasively among all district members but in a limited way. Drawing on the Italian packaging machinery case, Malipiero et al. (2005) stress that technological gatekeepers play a triple role in coordinating and stimulating innovation by capturing external relevant knowledge, absorbing it and diffusing it within the cluster, but they recognize that knowledge gatekeepers are likely to adopt selective diffusion strategies because the network they create must also contribute to their own productive efficiency.

In the case of exports, we had already presented some doubts about the capacity of any firm to identify and incorporate knowledge provided by the gatekeeper. In particular, abundant literature has pointed out that firms without experience in international markets can hardly take advantage of the experience of other firms that have broad international experience (Eriksson et al., 1997; Shaver et al., 1997). Similarly, it could be that firms inside parks are still developing their products and they want to establish direct relationships with gatekeepers as a way to become international in a fast way (Coviello, 2006; Sepulveda and Gabrielsson, 2013). The relationship between the gatekeeper and other local firms can be understood as reciprocal, but in fact gatekeepers may feel that this is not the case. When the gatekeeper

provides a higher stock of knowledge that the offered by local firms the gatekeeper may feel reluctant to share its knowledge. Finally, we proposed that specialization foster the learning process as firms learn in a path dependent way, but results are not significant.

## CONCLUSIONS

This study addresses the issue of the role of gatekeepers on the local knowledge networks in science parks. In particular, this research is an exploratory study that has firstly tried to deepen on the characteristics of knowledge gatekeepers inside a science park. Following previous studies we assumed that knowledge gatekeepers are firms that have international activities, in this case they are exporters, and also they behave as providers of knowledge in the local network created inside the science park. We confirmed that knowledge gatekeepers, compared to other firms of the park, have a higher innovative performance. In great part, it can be explained by their access to different ideas, clients, and knowledge sources that obtain internationally and combine with the access to the local network. As such, the gatekeeper has a connecting role between international knowledge and local networks hardly evaluated how it works in previous studies. In this sense, we have observed that gatekeepers tend to have a more restricted local network which allows them to both improve in the development of shared routines and values and protect the experiential knowledge that they obtain internationally from local leakages. Along with deepening on the characteristics of knowledge gatekeepers inside a park, our second major objective was to evaluate the consequences of these gatekeepers on other firms of the park. In particular, we focused on those other firms that have established a direct knowledge exchange with the gatekeeper inside the park. Although coherent with previous studies, results are at least surprising since they indicate a low level of influence (Morrison, 2008). Firms that are in direct contact with gatekeepers neither significantly improve their innovative capacity nor are exporters. These results can be considered as a first approach to a topic hardly analyzed.

In any case, this paper can contribute to managers and practitioners to better understand how knowledge flows inside parks interact with international sources of knowledge. First, from the perspective of the gatekeeper we would recommend those firms that connect local and global sources of knowledge to restring their local network in order to avoid leakages and foster a mutual understanding. Also, a certain level of trust, friendship and frequent interaction seems to be relevant. Secondly, from the point of view of the rest of the firms, and although results do not confirm this point, we would recommend them to try to establish connection with these firms. Maybe in a short period of time we do not obtain the expected results, but proximity to

firms that have international relationships and have a higher innovative capacity should help them to develop their own business.

Finally, this exploratory study about how gatekeepers can connect local and international relationships inside the park has several limitations that can be the base to develop new research lines. In particular, we have observed that the local network of the gatekeeper has a more restricted local network than other firms of the park, but we have no data to explain in detail the reasons that are under this behavior: Do gatekeepers inside parks fear of spreading their experiential knowledge locally, as it has been observed in industrial district previously? This possibility seems to have more sense among firms that share the same industry and in many cases the final client, but not necessarily inside a park where firms are form different industries. Alternatively, this result may imply the following question: Do firms inside parks need to develop a shared culture and language to share knowledge from different sources? This explanation would makes sense because, contrary to most research undertaken inside industrial districts, parks do not develop this kind of environment; on contrary, many firms can only stay for a short period of time inside the park. Contrary to expected to save time and efforts, knowledge gatekeepers do not have weaker linkages locally. Again, it seems that inside parks there are few knowledge interactions and firms do need to invest on developing trustworthy and frequent interactions not make them worthy. Another limitation of this research deals with the lack of dynamic data that would allow us to better understand the evolution of the network of the gatekeeper or the consequences of having a gatekeeper in proximity. In this sense, we have observed that having a gatekeeper in proximity neither improve exports nor innovative capacity. One explanation for these results can be related to previous studies in international business that consider that firms need of a stock of knowledge previously assimilated to be able to take advantage of locations in proximity to firms that are exporters. As long as they want to incorporate their learning into their routines and procedures they have to previously developed assets and procedures that fit into them (He and Wei, 2013, Sandberg, 2013). But further research would be necessary. Alternatively, it could be related with the evolution of the relationships that entrepreneurs have across their different moments of development, that we have not considered in this research. There are some models (Hoang and Antoncic, 2003; Larson and Starr, 1993), that deal with changes in the importance of relationships of entrepreneurs, playing more attention to family and friends at the beginning of their business. Under this approach, entrepreneurs tend to have stronger relationships outside their familiar network as they evolve in their new project. Nevertheless, the lack of consensus in previous studies about the timings and the changes in the

relationships developed, impede to further analyze it. In any case, future research line could deepen on this literature to better understand the dynamics inside parks.

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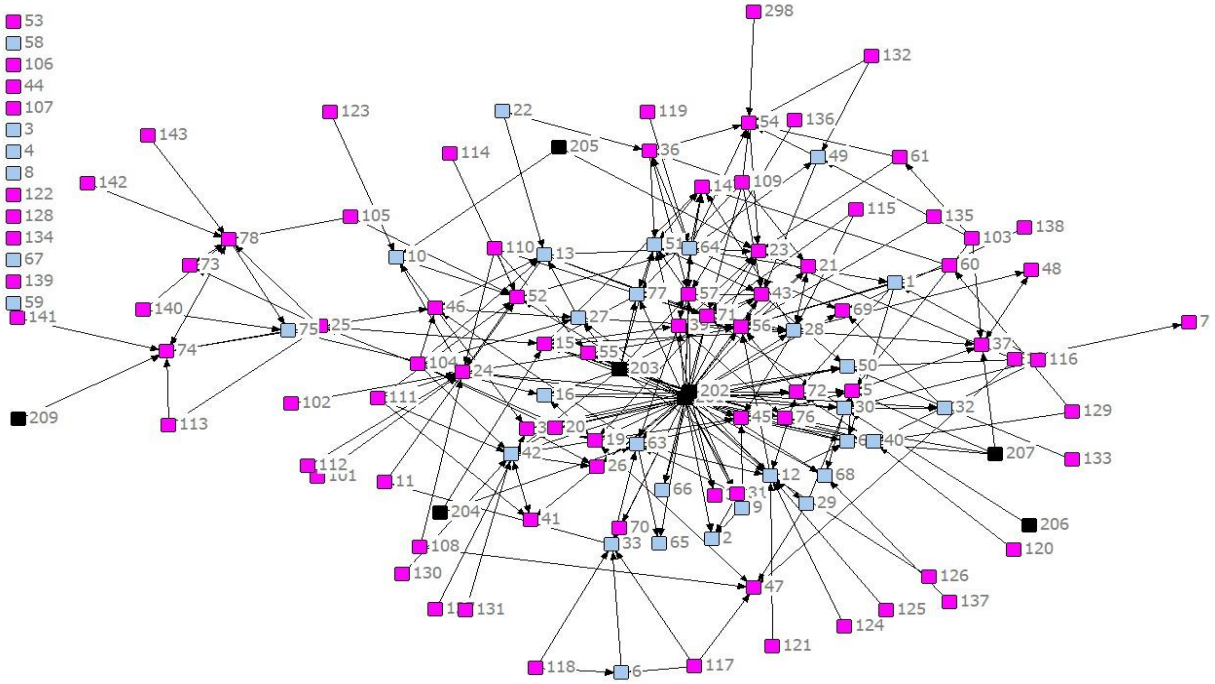
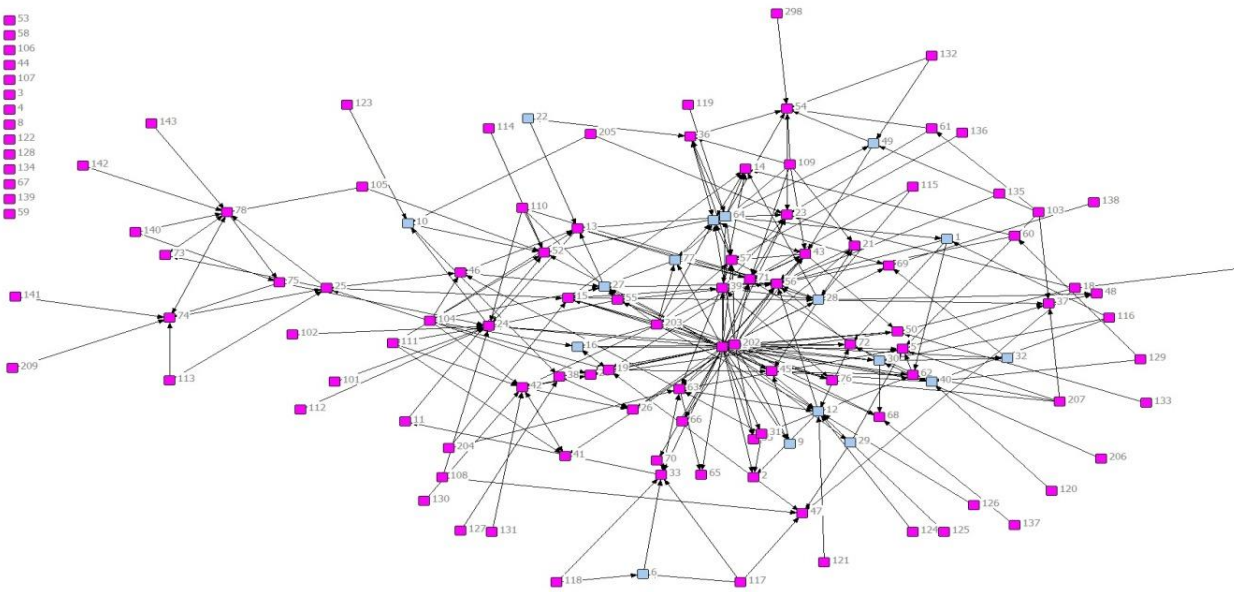
**Figure 1. The network of exporters and non-exporters**



Each node represents a firm or institution and lines implies any knowledge exchange between them. Blue node: exporters; pink node: non-exporters and black node institutions and non-respondent firms

**Figure 2. The distribution of gatekeepers inside the network**



Each node represents a firm or institution and lines implies knowledge exchange. Blue node: gatekeepers

**Table 1. Description of the gatekeeper**

| | Gatekeeper | | Total | |
|---|---|---|---|---|
| | mean | median | mean | median |
| Age | 5.76 | 5 | 6.01 | 5 |
| Spin-off firm | 0 | 0 | 0.04 | 0 |
| Spin-off university | 0.41 | 0 | 0.25 | 0 |
| Employees | 10.93 | 7 | 9.68 | 6 |

**Table 2. Activities where gatekeepers are specialized**

| | Gatekeeper | No gatekeeper | % gatekeepers |
|---|---|---|---|
| Information technology and communication | 2 | 21 | 9% |
| Environment and renewable energy | 1 | 2 | 33% |
| Life sciences and chemical | 11 | 23 | 32% |
| Nanotechnology, new materials and engineering | 3 | 5 | 38% |
| Other sectors | 0 | 4 | 0% |
| Support services | 0 | 3 | 0% |
| Total | 17 | 58 | 23% |

**Table 3. Rank sum test between gatekeepers and non-gatekeepers**

| | Gatekeeper | Non-gatekeeper | Rank sum |
|---|---|---|---|
| Innovative capacity | | | Z=-2.02** |
| Median | 6 | 4 | |
| Media | 9.58 | 8.83 | |
| Standard deviation | 9.61 | 26.81 | |
| Innovative capacity radical | | | Z=-2.36*** |
| Median | 3 | 1 | |
| Media | 4.058 | 4.01 | |
| Standard deviation | 4.36 | 13.46 | |
| Constraint network | | | Z=-1.67+ |
| Median | 0.50 | 0.42 | |
| Media | 0.57 | 0.42 | |
| Standard deviation | 0.29 | 0.29 | |
| Strength of the relationship | | | Z=-0.65 |
| Median | 3.66 | 4 | |
| Media | 4.08 | 3.31 | |
| Standard deviation | 3.06 | 2.97 | |
| N | 17 | 54 | |

***p<0.01; **p<0.05; +p<0.1

**Table 4. Rank sum tests: gatekeepers in the ego-network**

| | Ego gatekeeper | Ego without gatekeeper | Rank sum |
|---|---|---|---|
| Innovative capacity | | | -0.180 |
| Median | 3 | 4 | |
| Media | 13.54 | 5.66 | |
| Standard deviation | 35.65 | 5.84 | |
| Innovative capacity radical | | | 0.306 |
| Median | 1 | 2 | |
| Media | 6.15 | 2.47 | |
| Standard deviation | 17.90 | 2.73 | |
| Export | | | 1.147 |
| Median | 0 | 0.5 | |
| Media | 0.36 | 0.5 | |
| Standard deviation | 0.48 | 0.50 | |
| Degree | | | -5.147*** |
| Median | 4 | 2 | |
| Media | 4.6 | 1.81 | |
| Standard deviation | 2.44 | 1.84 | |
| N | 33 | 38 | |

***p<0.01; **p<0.05; +p<0.1