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SCIENCE PARKS AND THEIR ROLE IN THE INNOVATION PROCESS: A LITERATURE REVIEW FOR THE ANALYSIS OF SCIENCE PARKS AS CATALYSTS OF ORGANIZATIONAL NETWORKS

PARALLEL SESSION 1

STPs and AIs. Evolution of models and strategies: adapting to the new context

Authors:
Leonardo de Jesus Melo, Brazil
Science Park of UFRJ,
Federal University of Rio de Janeiro

Renata Lèbre La Rovere, Brazil
Institute of Economics,
Federal University of Rio de Janeiro

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Science Parks and their Role in the Innovation Process: A Literature Review for the Analysis of Science Parks as Catalysts of Organizational Networks

Leonardo de Jesus Melo – Science Park of UFRJ, Federal University of Rio de Janeiro, Brazil
Renata Lèbre La Rovere – Institute of Economics, Federal University of Rio de Janeiro, Brazil

ABSTRACT

This paper investigates the contributions of Science and Technology Parks (STPs) to innovation. In particular, we discuss whether the literature on innovation and SPs consider the fact that STPs can be catalysts of Organizational Networks (ONs). We consider that ONs are elements of knowledge production and can contribute to the development of core competencies to pursue dynamic innovation and sustainable competitive advantage. This paper is based on a literature review of scientific papers and theses which are included in indexed databases related to STPs and their contributions to innovation. Preliminary analysis of the literature shows that SPs have been mostly studied as part of innovation systems, and that less attention has been given to the role of ONs and STPs in the processes of technological learning and innovation.

KEYWORDS
Organizational Networks, Innovation, Science and Technology Parks, Knowledge Assets

INTRODUCTION

In accordance with the International Association of Science Parks and Areas of Innovation, a Science Park is an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting a culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities.

The STPs literature considers those institutions as ways of organizing enterprises in a territory that foster innovative activities (Squicciarini, 2008). Innovation in STPs is related to positive externalities that result from geographical proximity. Nevertheless, the fact that firms are close to other firms and universities in a Science Park does not necessarily mean that interactions among them will occur. Furthermore, the fact that the Science Park promotes the development of organizational networks among its firms does not mean that firms located in the Park will develop relations only with other firms in the Park. Rather, STPs should be viewed as spaces that not only allow for the creation of organizational networks but also strengthen organizational networks that existed before firms moved to the Park. As organizational networks have a role in promoting and organizing interactions between firms and institutions, they should be considered in studies of STPs, especially because organizational proximity may be as, or even more, important than geographical proximity in the development of innovations.

Networks can be formed by clusters of firms in the same territory or in different territories. Despite the variety of concepts and low level of accuracy of studies about clusters of firms (Hasenclever & Zissimos, 2006), all the authors who have analysed these agglomerations have pointed to the benefits that companies may obtain. Proximity provides economies of scale, possibilities for development of production chains, accumulation of knowledge and innovative activities, reduces transport costs and, in the case of urban areas, provides access to sophisticated clients. We define proximity not only as geographical proximity but also as relational proximity. Therefore, the research question addressed in this paper is the extent to which STPs, as spaces that can combine benefits related to geographical and relational proximity, contribute to the generation and strengthening of organizational networks for innovation and how these networks deal with the processes of creation, dissemination and appropriation of knowledge in order to develop sustainable competitive advantage.

This subject is directly related to the theme of innovation, since in the current techno-economic paradigm the ability to create and sustain competitive advantages in a particular territory is related to learning ability, the quality of products and processes, productivity, and companies' capacity for technological development. In this paradigm, companies seek to meet requirements for flexibility and speed by involving themselves in networks. Studies of local development highlight a variety of forms of association and network integration of these networks in global markets. Networks are key elements for the creation and diffusion of knowledge that underlies the generation of innovations.

The processes of creation, dissemination and appropriation of knowledge are enhanced when organizations are linked in a network and develop mechanisms for governance and management aimed at coping with the knowledge assets generated and traded in their context. After a review of the literature on business networks, Britto (2002) identifies three possible types of network: subcontracting networks, where a company outsources part of its activities; Marshallian industrial districts, where the interaction between the components of the network allows for the acquisition of static and dynamic advantages related to geographical proximity, and technology networks, where the interaction between the components takes place with the specific purpose of developing innovations.

In STPs the actors involved are located in the same area and they are influenced by an institutional initiative whose main objective is to foster technology networks. In this type of network geographical proximity is not necessarily more important than organizational proximity.

This paper assumes that STPs, as innovation environments, stimulate and manage flows of knowledge and technology between universities, research institutions, companies and markets, and are presented by current literature as a mechanism for local development capable of catalyzing the generation of organizational networks that act as means of articulation among the principal agents of innovation.

The methodology used is a review of the literature. This paper will present the main results of a search in scientific papers and theses included in indexed databases related to STPs and their contributions to innovation. Our discussion will be based on concepts drawn from the Evolutionary and New Institutional Schools, which have made the most significant contributions to the literature regarding innovation and regional development in the Post-Fordist period.

The study of the relationship between STPs and organizational networks will primarily contribute to the debate about the role of organizational proximity and geographical proximity in the creation of sustainable competitive advantages. Secondly, we will analyse the existing potential and the main challenges involved in the generation of networks capable of dealing with the processes of creation, dissemination and ownership of knowledge assets; in addition, we also aim to understand the challenges and opportunities faced by companies regarding the management of their resources and cooperation with other members of the network.

BACKGROUND: SCIENCE PARKS AND THEIR ROLE IN INNOVATION

The theoretical framework of this paper is in line with the Evolutionary Studies approach. These studies assume that firms have limited rationality and asymmetric information, so their decisions concerning innovative activities and production will be affected by the decisions of other firms and institutions. The interactive processes that shape the decisions of the firms are self-organizing and will determine the properties of local networks (Vicente, 2000). The paper also draws on literature from the New Institutional School, as it assumes that networks of companies and their worlds of production can be organized in different ways with different impacts on territory (Markusen, 1996). Furthermore, we assume that the interaction between companies, institutions and local community in a given territory affects the spread of knowledge and innovation (Storper et al., 2007, Storper, 2008).

Science Parks originated in the United States during the 1950s, as a consequence of the emergence in the postwar period of a large number of high-tech companies, many of which were created to support ongoing research activities in universities. In accordance with IASP (2007), the second half of the 1980s was the period when the largest amount of STPs was created (23%), as Figure 1 shows. But one can see that the curve rises steeply in the first decade of the 21st century; this period of just five and a half years is responsible for 26% of all the STPs in the sample.

According to IASP (2007), Science Parks are mostly an urban (or semi-urban) phenomenon, with 66% of the Parks surveyed being within a city and 27% being quite close to one (25 km or less). Furthermore, 36% of STPs worldwide are located on a university campus or adjacent to one, while 8% are located on land owned by a university, although not on a campus or adjacent to it. However, the majority of STPs (53%) are located outside university campuses and on land not owned by a university. In Brazil the physical spaces chosen for the deployment of STPs usually comes from public agencies or universities (ANPROTEC,2007).

Science Parks may be analysed as clusters that are deliberately promoted by local institutions to enhance innovation and learning in a particular territory. Therefore, to discuss the role of these institutions as catalysts of networks we must first look at the literature on the benefits of proximity for firms. Zander (2004) argues that entrepreneurs prefer to be geographically close to their clients, suppliers and competitors for several reasons. First, they need to identify their competitors and learn to prepare adequate competitive strategies from their competitors' movements. Second, there is a demonstration effect on the territory, whereby successful enterprises influence local entrepreneurs' perceptions of socially desirable businesses. Third, the educational level of entrepreneurs, conditioned by the territory, will affect local entrepreneur choice of business. Fourth, when recognizing an opportunity local entrepreneurs will establish new businesses by assimilating local knowledge and recruiting members of their social network.

Clusters are also institutional forms in which loyalty relations are easily built, because, according to Frigant (2001), agents have a sense of embeddedness. Therefore the territory is relevant as a locus of social capital and entrepreneur action. Positive effects of entrepreneurship and agglomeration on innovation were verified by Acs and Varga (2005), in an econometric study using data from the European Union. They came to the conclusion that knowledge spillovers are positively related to clustering and entrepreneurship. This is why STPs are built: institutions promoting them expect that Parks will generate benefits in terms of the stimulation of new businesses, development of innovative activities and generation of local knowledge.

Studies of innovation that emphasize the role of territory suggest that enterprises are rooted in institutional arrangements consisting of social relationships that feed creativity and adaptability. Innovation is seen by these studies as an "island of activities" determined locally (Amin & Cohendet,2005). The formation of clusters of firms is seen as the result of a selective mechanism that provides favourable conditions to meet the demands posed by technological change. Growth opportunities are shaped by the legacy of accumulated knowledge and learning that is geographically

determined (Iammarino & McCann, 2006).

More recent studies, however, propose the concept of another type of proximity, which is independent of territory: relational proximity. Amin and Cohendet (2005) argue that relational proximity, whose concept was developed from the text of Nonaka and Konno (1998) on space-sharing relationships (ba) is fueled by travel, common routines, databases and common software and provision of training to communities through temporary project groups and task forces. Relational proximity can be achieved through a variety of regional mobilizations.

Some authors, such as Lemarié et al. (2001), use the term 'organizational proximity' to describe relational proximity. They contrast geographical proximity, which is space-related, with organizational proximity - related to affiliation (same relational area) and similarity (from an organizational point of view). For these authors, both forms (geographical and organizational proximity) increase the sharing of tacit knowledge in the innovation process (Davenport, 2005). Kaufmann et al. (2003) carried out a study of innovative firms in Austria with similar purposes. They argue that, as the principles that guide innovative process are learned, face to face communication is no longer a prerequisite for innovation, and geographic proximity may be replaced by relational proximity. The authors suggest that geographical proximity is important in the beginning of the innovation process (in design) and in its end (in testing phase), whereas in the intermediate stages of development and prototyping communication can take place remotely.

Amin and Cohendet (op.cit.) note, from a review of previous studies, that the same attributes of networks of firms identified as success factors for innovation, such as flexible learning expectations, commitment to partnership, trust of partners, excessive tolerance, ability to manage conflicts, cancellation of myopia linked to performance at all costs, and acceptance of partnership as a long-term investment, are also the ones identified as success factors for territorial agglomerations. The authors then conclude that knowledge is not confined to particular sites, as networks may be formed with firms in different locations. Adherence (stickiness) of knowledge to specific places derives from unique combinations and interactions of bodies, minds, languages, technologies and objects that can be found in territories, crystallized in attitudes. Thus, a specific cluster is not restricted regionally, but it is rather a container of relations that combine and transmit knowledge, which may come in pieces, with a number of different distances and directions. Clusters with high rates of innovation are characterized by the existence of dense relations among different professional communities (engineers, entrepreneurs, financing professionals, computer professionals). The growth of these clusters results from the successful management of diverse knowledge assets of the local professional community. Relationships between these communities occur in certain places, but the networks of these communities extend beyond the territory, therefore the knowledge developed within the territories depends on internal and external mobility and connections.

Davenport (2005) confirms Amin and Cohendet's propositions and shows the results of a survey of innovative firms in New Zealand. He observes that firms do not draw on local or national knowledge to be innovative; since they provide competitive solutions their products are designed to meet customer needs and building knowledge comes from strong relationships with networks of customers, distributors, employees of international companies, consultants with complementary skills, as well as with networks of 'sister' (similar) companies. He suggests that companies which seize opportunities presented by the external market go through a process of rapid internationalization and present few linkages with the territory.

The existence of relational proximity may help to explain why clusters of firms differ. Markusen (1996), in her work on industrial districts, identifies four types of agglomerations of firms, each one with different configurations of firms and governance structures: hub-and-spoke districts, satellite platforms, state-anchored districts and Marshallian districts. She contests the idea that Marshallian districts will prevail as the dominant form of clusters and points out that in hub-and spoke districts and satellite platforms, knowledge diffusion among members of the cluster is very limited. Iammarino and

McCann (op.cit) also propose three forms of agglomeration of firms: the first is pure or Marshallian agglomeration, where firms do not have market power, continuously change their relations with other firms and exploit market opportunities. Entry and exit costs in this market are low, and these agglomerations often occur in urban spaces. The second is the industrial complex, characterized by long-term relations between stable and predictable firms in the cluster. Access to this cluster is limited by entry and exit barriers, and their location is regional but not necessarily urban, and dependent on transport costs. The third form is the cluster that arises from a social network with ties of trust and cooperation among enterprises. Geographical proximity is necessary in this type of agglomeration, but access is limited by the relations of trust, built on a common culture. Iammarino and McCann suggest that all agglomerations may have characteristics of the three models, but one model will always prevail over the others.

Arguments about the spillover of knowledge between firms implied by the models of pure agglomeration and social networking are not always applicable when dealing with multinational or oligopolistic firms with many affiliates. This argument is confirmed by Crespo and Fontoura (2007), who made an extensive review of literature on the externalities generated by multinational companies and showed that there is not enough empirical evidence to argue that these externalities will in fact occur. In particular, the impact on local enterprises will depend largely on their capacity to absorb technology, thus conditions in each site will differ.

It should also be noted that if the company decides to locate in a given territory to be close to other companies, it will generate positive externalities that will benefit other companies (free riding effect). According to Meyer-Stamer (2005), companies, particularly large ones, take into account free riding when making location decisions, and seek to limit it through contracts. Contracts may limit the diffusion of knowledge to local firms that is highlighted as one of the advantages of clusters.

Studies of relational proximity and of different types of knowledge diffusion related to diverse types of clusters support our proposition that to understand how innovation takes place in a territory, analysts have to consider networks of firms. Lawson et al. (2009) point to the relevance of networks for innovation with their study of knowledge sharing in inter-organizational product development teams. These authors did an empirical study of 111 manufacturing organizations in the UK and found that relationships between firms, buyers and suppliers are crucial in new product development. Furthermore, the inter-organizational teams that are formed to develop new products are strongly influenced by informal socialization mechanisms, therefore face-to-face contacts are crucial to share sticky and tacit knowledge.

To summarize, the available literature on the benefits of territorial agglomerations of firms explains the reasons why STPs are viewed as spaces for innovation and thus are promoted by institutions that want to enhance learning and knowledge production in a territory. However, if we consider that what is relevant for innovation is not the territory per se but the networks that are located in the territory, an analysis of STPs governance structures (including the hierarchy structure of local networks and contracts) is needed to assess whether STPs are catalysts of organizational networks. Our survey of scientific papers on STPs found that few authors have been working in this direction.

Recent literature on STPs may be divided in two broad categories: studies that focus on firms as the main object of analysis and studies that focus instead on the Science Park as an institution located in a region, using therefore a Meso approach. While in the former view innovative activity is seen as a competitive tool for firms and traditional indicators are focused on, such as productivity of firms, job creation and value generation, the latter view focuses on a particular region, policy or technology. In relation to methodology, studies use statistical models, case analysis or a combination of both.

Studies focusing on firms investigate whether STPs generate spillovers (Squicciarini, 2009), if they have significant patenting activity (Squicciarini, 2008), how they compare with firms located outside the Park (Squicciarini, 2008, Yang et al., 2009), and identifying the conditions for their growth

(Link & Link, 2003, Lofsten & Lindelof, 2005, Yu et al., 2009). These issues are explored because, as Squicciarini (2009) and Hansson (2004) observe, empirical evidence on the effectiveness of STPs regarding the development of technology is mixed. The mixed results may derive from the fact that the traditional indicators such as revenue, survival of firms, job generation and patents used in most analysis fail to properly measure knowledge creation in the Park and related benefits (Hansson, 2004). Dettwiler et al. (2006) tried to measure knowledge creation by comparing firms located inside a Park with firms located outside it and concluded the former have a slightly superior performance. Squicciarini (2009) suggests that knowledge creation may be assessed by comparing the patenting activity of firms before and after entering a Science Park and by analyzing patenting activity of incubated firms. Her model used a database of Finnish firms and confirms that size, sector and time elapsed before joining the Park are all relevant for patent capacity. She also suggests that there is a path dependency in Park activities that creates firstmover disadvantages. STPs, in her words, "look unable to learn and improve their performance over time" (Squicciarini 2009:187). This result may be explained by the fact that Park management must define their objectives in goals that are measurable. Therefore, they use the same traditional measures of performance mentioned above (Link and Link 2003). If directors use traditional measures, the governance structure of the Park will have a limited scope concerning the creation of knowledge.

Papers that take a Meso approach focus on different countries and present results complementary to the findings of those focused on firms. Dettwiler et al (2006) indicated that cost of facilities is an element considered by firms in deciding to locate in a Park, a result also found by Sun et al. (2009) and Hu (2007). Tan (2006) found evidence of aging in a Beijing Science Park that gives further support to Squicciarini's ide (2009) that Park management must take into account the Park's path dependency. Bigliardi et al. (2006) suggest that, in addition to the life cycle of firms, Park managers must also consider proximity to universities and legal conditions. Proximity of universities and adequacy of management are considered crucial by Ratinho and Henriques (2010). Zhang (2004) found that the critical factors for the success of a Park are location and management. Chen et al. (2006) also consider the importance of the sector in the performance of firms located inside a Park.

Whether the focus is on the firm or the Park, what appears to be the common element in all the studies reviewed is that they try to investigate Park efficiency by assuming that innovation depends on active interaction between universities, industry and government, a concept known as the Triple Helix (Etzkovitz & Leydesdorff, 1997). As Hansson (2004) and Wicksteed (2004) observe, the dimension of knowledge creation and networking – crucial for innovation in the creative economy – is frequently lost in these studies. Some studies of knowledge creation in STPs use patents as a proxy for knowledge creation. However, patents measure only codified knowledge. Case studies like those of Grassler and Glinnikov (2008) provide better insights into codified and tacit knowledge diffusion in STPs. Nevertheless even case studies may not take into consideration organizational networks as spaces for knowledge creation and diffusion, which are essential to understand growth and innovative activities of firms inside Science Parks. Grassler and Glinnikov (2008), for instance, mention in their work that partnerships found in their case "are far from exploiting promising options". This result may be explained by the fact that firms, in establishing partnerships, take into consideration their organizational networks to set the boundaries of these partnerships.

Also revealed by the literature review was that in making the choice to locate in STPs, firms tend to prioritize physical infrastructure and financial and tax incentives, to the detriment of the creation and strengthening of organizational networks which can generate sustainable competitive advantages. When networks are mentioned in studies, they are seen as providers of specific advantages to the firm.

This observation is supported by Manella (2009) in a study of factors that limit the attractiveness of Science Parks for innovative firms. The investigation of these factors in five Brazilian STPs in highlighted certain factors of attraction, such as main source of capital accessibility, partnership with universities, transportation facilities, infrastructure and common services, local incentives. Of the fifteen most important factors considered, seven were directly related to the

arrangement of financial support by the Park and the rest were directly or indirectly linked to locational factors. The companies surveyed gave little importance to the presence of universities and R&D, with the establishment of research projects in partnership with research centres being an uncommon practice.

The analysis of the STPs literature shows that although they have been studied as part of an innovation system, little attention has been given to the role of organizational networks in the process of technological learning and the generation of innovation. The result of this analysis involves a series of issues relevant to the theoretical field of organizational networks. The first issue is that within the literature it appears that companies in Science Parks, while noting the possibility of establishing and strengthening networks as a factor of attractiveness, use Parks mainly to obtain benefits related to financial/operational issues and not as a differentiating factor related to the ability to create and disseminate knowledge and promote (environmental, social and economic) sustainability. As mentioned above, the self-organizing process that shapes firms' decisions concerning innovation and production limits the ability of firms to have independent long-term strategies that may ensure sustainability of activities. Firms tend to recognize more easily static advantages of location, such as access to financial benefits, than dynamic advantages, such as knowledge generation.

The second issue is that understanding that we must go beyond the use of networks to achieve certain and specific short-term goals implies that we must understand them as mechanisms for generating business opportunities, relationships and learning. Therefore, to study networks that are formed within a Science Park analysts have to look not only at the number of networks and the number of interactions each firm has in the network, as suggested by the authors from the New Institutional literature that we reviewed. Network analysis must also look at the specific sector of the firms in question to assess the potential of the creation of business opportunities and the learning generated by the network to develop innovation. Osajalo (2009) mentions other elements, such as duration, planning, control and trust, as being essential to the analysis of innovation networks.

The third issue is that the current evaluation of firm performance located in STPs is based on traditional indicators such as patenting and value-added generation and does not consider intangible assets, such as organizational networks. This is because, as noted above, authors implicitly assume in their analysis that the presence of institutions that form the Triple Helix in the Park will be a sufficient condition to develop innovation. This may be true in those cases where geographical proximity is sufficient to develop the necessary interactions required for innovation, but as observed above the literature on clusters suggests that relational proximity must be considered as well.

Finally, more studies are needed not only to understand the role of the relational proximity of the firms located in Science Parks for their innovation activities, but also to contribute to the development of SP governance mechanisms that ensure their sustainability. Although the literature confirms that Science Parks are environments for the development of skills aimed at building sustainable competitive advantage, few studies point to the need to develop mechanisms that allow the use of the benefits generated by intangible assets. In this sense, Zhang (2004:1) calls attention to the fact that "intangible aspects of Science Park management such as marketing, services and the quality of Park management team emphasized were in the third decade of Science Park development." Hansson (2004) suggests that the concept of ba, which combines three central elements of knowledge creation – process, learning and complexity, should be used in the Science Park literature. However, we found few recent studies dealing with knowledge creation or about how the tacit and social elements of knowledge creation pose challenges to STPs governance structures.

These results are not surprising. Grandori (1997, 2001) indicates that there is some neglect of governance mechanisms as antecedents of knowledge processes (creation, dissemination and appropriation). Developing this argument, the author analyzes the different types of governance mechanisms and management that contribute to the coordination of knowledge sharing and integration between networks and organizations within their own companies, suggesting they are important

elements when proposing some form of governance knowledge. Nooteboom (2009) also observes that governance and competencies are complementary and essential for innovation.

Therefore, more research is needed on Science Parks with the aim of assessing the contribution of organizational networks to the creation of knowledge and how STPs can develop governance mechanisms that contribute to the creation and strengthening of organizational networks. As Hansson et al (2005) observe, a possible role for STPs is the development of the social capital necessary for enabling and facilitating entrepreneurship in networks.

ANALYSIS OF SCIENCE PARKS AS CATALYSTS OF ORGANIZATIONAL NETWORKS

To conduct an analysis of Science Parks as catalysts of organizational networks, certain research steps must be followed.

The first step is the assessment of the role that organizational networks play in the generation of business opportunities, learning, training and empowerment in the specific sectors of the firms that are located in the Science Park being analyzed. This can be done by a literature review, to understand differences and similarities between experiences based in specific contexts, and also to assess how organizational isomorphism is related to involvement in institutions with global representativeness (Dimmagio & Powell, 2005).

The second step is an assessment of organizational networks prevalent in the Science Park. This can be done by applying a questionnaire to firms in the Park. The relevant research questions in this step are: do the firms in the Science Park belong to networks? If yes, how many? Are the networks local, national or global? Do networks involve formal or informal contacts? What are their aims? What is the frequency of relationships? How interactions take place (emails, meetings, workshops, videoconferences, social events etc.). What are the results of interactions? Did the firm enter new networks after entering the Park? Is the purpose of new networks different? To understand the process of network creation and strengthening is crucial for Park managers, because they can enhance this process by tapping their own networks and extending benefits of networks to all organizations located in the Park.

The third step is an assessment of the role of Park services in the fostering of organizational networks. This can be done by interviewing Park managers. The relevant research questions in this step are: what are the specific services provided by STPs to disseminate knowledge? What is the role of each Park agent in the provision of these services? The services provided will differ according to the stage of maturity of the firm. For instance, services provided to mature firms such as research laboratories of transnational companies will focus on the strengthening of networks that already exist so that risks associated with the entrance of new partners attracted by their location in the SP are mitigated.

The fourth step is an assessment of the governance mechanisms and their relation to knowledge generation in the Park. This can be done through interviews with firms and Park managers. The relevant research questions in this step are: how are information flows in the network organized? How are the results of interactions disseminated through networks? How is it possible to control results of interactions and their appropriateness?

These questions are important because the demand for high speed and quality businesses deals generated by existing networks. Clear and efficient governance mechanisms can provide a significant reduction of transaction costs for the enterprises and for the Park itself.

SUMMARY AND CONCLUSION

By having a systemic profile, STPs present a great challenge for their managers: to intensify their role in coordinating activities related to the processes of the creation, dissemination and protection of knowledge, and developing governance mechanisms that take into account the creation and strengthening of organizational networks.

Based on a review of cluster characteristics, we suggested that organizational networks are important to develop innovation since they allow for benefits that stem from relational proximity. Therefore, the research question dealt with here was how STPs, as innovation focused clusters, can contribute to the generation and strengthening of organizational networks and how these networks deal with the processes of knowledge creation, dissemination and appropriation in order to develop sustainable competitive advantages.

We tried to answer these questions by reviewing in scientific indexed papers studies of Science Parks. As clusters are created with the specific goal of innovation development, we expected to find papers that included in their analysis an assessment of organizational networks as core competencies that sustain the organization in the pursuit of dynamic innovation. However, the analysis of the STPs literature showed that although they have been studied as part of an innovation system, little attention has been given to the role of organizational networks in the process of technological learning and generation of innovation.

Science Park literature, therefore, should broaden its scope. While studies focusing on performance of firms and the attractiveness of STPs are important to assess their relevance as tools for regional development, studies of knowledge creation inside the Parks are needed to assess whether STPs provide a relevant contribution to innovative activities and can thus meet the original objectives of the Park. As Parks seem to have a path dependency and can present signs of aging with declining performance, understanding how innovation is created inside the Park may provide tools for actions that can guarantee their sustainability. The contributions of the New Institutional and the Evolutionary Schools are important in this effort. As observed by Foss (1994), the contributions of these two schools provide analytical tools to understand agent rationality, change and learning processes, and the role of institutions.

The analysis of the literature also allowed us to identify a series of issues relevant to the theoretical field of organizational networks. Based on a discussion of these issues, we then proceeded to suggest a step-by-step method to analyse Science Parks as catalysts of organizational networks. We

hope that this method contributes to the literature on organizational networks by stimulating more studies on specific cases as well as comparative studies.

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