Knowledge flows in technological poles: considerations on geographic and relational proximity

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Abstract: According to the concepts of the Sabato´s triangle (1968) and the triple-helix of Etzkowitz (1996), a technological pole is a region or area where there is interaction among universities, research institutes, companies and government in order to develop innovation. The studies of Malerba (2002) and Malerba and Vonortas (2009) about the sectoral systems of innovation and production, suggest that multinational companies with affiliates located in several countries develop effective flows of knowledge, based on networking, contributing to the idea that geographical proximity, although important, is not essential, studying also the relational proximity. In this context, this paper intends to show the role of networks in the development of knowledge flows within technological poles. We will use the case of companies located at the technology park of São José dos Campos to discuss networking in technological poles and analyze the implications of this case for a research on the Technological Pole in Guaratiba/RJ.

1 Introduction

The recent literature on post-fordism and its new organizational models suggests that it is superficial to believe that the installation of enterprises in technology parks will lead to a perfect interaction between them and with local universities, as many policy-makers do. In Brazil, the discourse of the Ministry of Science, Technology and Innovation seems to be based on a shallow reading of the concepts formulated by Sabato (1968). This author proposed a development strategy for technology poles – that is regions where companies, universities and government agencies were located - based on a triangle which vortices would be formed by Government, productive structures and science and technology. A similar concept considering three main actors was later proposed by Triple Helix authors (ETZKOVITZ & LEYDESDORFF, 1997), that enhance the importance of the interaction between universities, enterprises and Government.

Technology parks may be considered a special case of technological poles, being part of deliberate policies to create technological poles. According to the National Program of Support to Enterprise Incubators and Technology Parks devised by Brazil´s Ministry of Science, Technology and Innovation (MSTI):

> *Technology parks are economic and technological development complexes aimed at fostering and promoting synergies in the scientific, technological and innovation activities that take place in enterprises and scientific and technological public and private institutions, with strong institutional and financial support from governments (federal, state and municipal) local community and the private sector " . (Ministerial Order 139 / MSTI , 2009 , Art . 4)*

This definition relates proximities to innovation, emphasizing the importance of geographical proximity while neglecting other forms of proximity. However, as observed by Poncet et al.(2012) and Poncet (2012), several studies on technology parks in developed countries have found weak geographical proximity relations within these parks. These studies argue that other types of proximity, especially organizational or relational proximity should be taken into consideration. Other studies like those of Rodrigues (2014) consider that both geographical and organizational proximity relations are important for the performance of firms located in technology parks. These contrasting visions found in the literature may be explained by the fact that, as suggested by Melo (2012) and Poncet et al. (2012), the way by which the governance of the Park is established influences knowledge flows and determines how benefits related to proximity take place.

This paper aims to contribute to the discussion on knowledge flows in technological poles by making an exploratory study whose aim is to verify whether geographical proximity in a technology park eases the establishment of partnerships and cooperation link or if, in the case of the selected companies, what motivates their cooperation links and flows of knowledge is organizational proximity through insertion in enterprise networks or in other countries.

To reach this aim the paper will investigate three enterprises of the Technology Park of São José dos Campos (TecPq-SJC). The paper has as main objective to verify how these companies studied achieved advantages related to proximity after they were installed in TecPq-SJC. To reach this aim, the specific objective is to investigate the relationships of enterprises with other enterprises in the park and in the region, as well as their insertion in enterprise networks from other countries. The paper also investigates whether there is really "strong institutional and financial support from governments (federal, state and municipal) local community and the private sector" in TecPq-SJC and whether this support influences enterprise strategies. Therefore the paper aims to contribute for the discussion of the role of proximity and knowledge flows in technology parks and how involved institutions can establish governance mechanisms that ensure that the enterprises obtain benefits related to proximity.

The city of São José dos Campos has a population of approximately 630,000 inhabitants and accounts for a significant conglomeration of public and private higher education institutions such as the Technological Institute of Aeronautics (ITA) , State University of São Paulo (UNESP) , Federal University of São Paulo (UNIFESP) , Faculty of Technology of São Paulo (FATEC) , Paulista University (UNIP) and University of Paraíba Valley (UNIVAP); research institutions such as the National Institute for Space Research (INPE) and the institutes of the Department of Aerospace Science and Technology (DCTA) ; as well as high-tech companies such as Embraer , two technology parks as well as numerous enterprises that are suppliers to the aerospace industry. According to the managers of TecPq-SJC with all this critical mass of high scientific and technological content , the city is recognized in Brazil and abroad for excellence in the training of highly qualified human resources and the for industrial products[1].

Installed in this environment, the TecPq-SJC is in full operation since 2009. This park was the first to receive final accreditation by the Paulista System of Technology Parks and attracted a volume of investments of R$ 1.77 billion by December 31, 2013, of which R $ 1.33 billion were from the private sector and R$ 431 million from the government, at the federal, state and county levels. TecPq-SJC has three main pillars: the Technological Development Centers (TDCs), Universities and Training Institutions and the Enterprise Centers (ECs) that host the enterprises analyzed in this paper. Small and medium-sized enterprises (SMEs) resident in the ECs are in the center of TecPq-

[1] Source: interview with the managers of PqTecSJC on July 2014

SJC interests, as it considers its main mission to transform research and development (R&D) projects into commercial products[2].

2 Methodology of Research

There are relatively few studies on the advantages of proximities in technological poles and technology parks in Brazil. In a recent paper, Rodrigues, La Rovere & Casarotto (2013) suggest that although the discourse related to advantages of proximity is present in the official documents of Technological Poles, enterprises installed there do not necessarily search the region because of these advantages. Rodrigues (2014) investigated whether the same proposition could be applied in the case of technology parks. He investigated the technology parks of Rio de Janeiro and Porto Digital (in the city Recife, north-east of Brazil) and has found advantages related to geographical proximity in both as well as advantages related to organizational proximity at Porto Digital.

The research underlying this paper intends to continue this discussion analyzing the case of a technology park in the state of São Paulo. To build the case we analyzed official documents of the park, did interviews with managers of the park and also interviews with three SMEs from different sectors resident at the park. This exploratory research has as main goals to identify advantages related to geographic proximity for enterprises installed in TecPq-SJC and to discuss relational proximity by investigating cooperation networks before and after enterprises entered the park and whether partnerships with research institutes and Government are happening.

We interviewed three enterprises: ENGTELCO, LUNUS and TPG. They were selected for three reasons: 1) they are considered pioneers in the park by managers of the TecPq-SJC; 2) they are inserted into three different sectors and 3) they were easily accessible.

The first question of the interviews has sought to identify the advantages for enterprises after their entrance in the park, considering elements such as access to market, learning capabilities and innovation generation. The second question, about the formation of cooperation networks, has sought to identify whether the location in the park was promoting the formation of networks or most companies had already their networks before entering the park. In the third question of the interviews we sought to understand how partnerships with universities were being conducted and whether enterprises had greater access to Government funding at the federal, state, and county levels because of their location in the park.

3 Proximities, networks, innovation and governance of technology parks

Although there are several theories explaining how proximity effects take place, most of them do not distinguish between the levels of action of individuals, social networks, firms and markets (Grosseti, 2008). This author considers that proximity and embeddedness of local social networks are a specific context for the emergence of cooperation links and access of resources on the initial phases of creation of new firms only. Therefore proximity does not necessarily provide a basis for specific modes of regulation of professional or technological relationships. Grosseti (2008) drives attention to the need of deeper studies on effects of proximities and on the level of action of agents. As observed by Boschma (2005) although geographic proximity is neither a necessary nor a

[2] See: http://www.pqtec.org.br.

sufficient condition to develop innovation in a region, it eases interactive learning processes by strengthening other types of proximity.

In the literature on regional development we may find several studies on the role played by these types of proximity other than geographic (institutional, relational, organizational, cognitive, social) to promote knowledge flows inside a region, for example Colletis-Wahl & Pecqueur (2001), Boschma (2005), Massard & Mehier (2009), Cooke (2001, 2007, 2012), Torre (2008), Suire et al. (2006), Capello (2007), Rychen e Zimmermann (2008), Fontes et al.(2009), Basile et al. (2012), Mattes (2012).

Among the several approaches mentioned above, the most adequate to analyze technology parks is the one by Colletis-Wahl e Pecqueur (2001), that focus on three types of proximity to explain knowledge flows in a region: spatial (or geographic), organizational (or relational) and institutional. Spatial proximity refers to individual and resources situated in a same territory. Organizational proximity refers to sharing ways of transforming technical, economic and organizational resources. And institutional proximity creates the basis to establish coordination forms between agents involved in production and enhances the benefits of this coordination, as institutions are the "rules of game" that guide agents´ behavior: "Institutions have varied forms, from legal rules (contract law) to moral standards (honesty), and from social conventions (etiquette) to cultural traditions (civic attitude)." (p.456)

Technology parks, as hosts of not only existing businesses as well as technology-based startups, can be places where new knowledge flows and develop new networks are formed. La Rovere & Melo (2012) draw attention to the fact that technology parks can act as catalyzers of enterprise networks and to the relevance to make more studies on this subject as most studies on technology parks are centered in the conditions of generation and diffusion of innovations, leaving aside the issue of networks.

Amin & Cohendet (2005) remark that networks form in different localities and knowledge is not predetermined to happen in specific places or territories. For example, high rates of innovation in clusters may result from the links that these agglomerations have with different professional communities such as IT professionals, engineers, entrepreneurs and finance. Although relations between these communities occur in specific places, networks generated by them extend over the territory boundaries. These authors demonstrate that organizational proximity that motivates networks may be more important for innovation than geographical proximity defined in the Triple Helix approach. They also observe that knowledge generated in territories depend on internal and external connections.

The concepts of networks and partnerships used in this paper are as follows. According to Rodrigues et al. (2013), partnerships may be understood as an ensemble of procedures and actions motivated by mutual respect and interest convergence between organizations and institutions, or between unities of a same institution. Involved parts are equal and partnerships are the basis for the establishment of cooperation links that are a necessary but not sufficient condition to form networks. Castells (1999,p.498) defines networks as a complex of interconnected nodes. What defines a node in practice depends on the very nature of the network: a node may be either stock markets or councils of European ministers. Networks are open structures capable to expand on an unlimited form and integrate new nodes as they can communicate with other nodes of the network , that is, all nodes have to share the same communication codes. This is why it is important to take into consideration the insertion in enterprise networks when we want to investigate other types of proximity such as the cognitive and the organizational proximity.

Tranos &Nijkamp (2013), studied the impact of relational and geographical proximity on costs of formation of internet infrastructure. They remark that even in the formation of the so-called cyberspace there is an influence of geographical proximity as interactions by the internet mapped by them are more intense when there is a greater geographical proximity. The authors use this finding to conclude that it is misleading to oppose geographical to organizational proximity as they may be complementary. Rodrigues (2014) has found that in the case of Porto Digital, both proximities are important for networks.

It is important to analyze the networks of a technology park because, as suggested by Malerba & Vonortas (2009), networks emerge not because their agents are similar but because they integrate knowledge, capabilities and specialized know-how, being therefore essential for the innovation process. According to these authors, network structures emerge as a result of a self-organized process whose conditions are given by industries´ characteristics. We could add that for the specific case of technology parks, initial conditions of a park constitution will influence how enterprises insert themselves in networks. There are parks where a linear vision of innovation prevails and where there is strong public or subsidized investment motivated by political reasons, as is the case of several parks in France; in these parks there is no stimulus for inter-firm cooperation (Poncet et al.,2012). In other European regions such as Germany, Austria and the Nordic countries, innovation policies are decentralized and network-based, leading to technology parks where there is transfer of knowledge from large to small firms and giving better chances of growth to small firms (Cooke, 2001).

In the absence of inter-firms relations in the parks, their managers must establish governance mechanisms to stimulate them, thus allowing for the development of synergies and knowledge flows between enterprises (Melo, 2011; Poncet, 2012). Poncet (2014) remarks that if we consider that knowledge generation is the strategic resource of a cluster (and of a technology park), the structure of governance is the key to promote trust and stimulate a collective learning process that leads to the creation of knowledge. This is why it is important to also consider institutional proximity of the agents involved in the park, because it is this type of proximity that gives conditions to set up governance mechanisms that lead to actions of agents in an effective way.

4 The case of the Technology Park of São José dos Campos

The Technology Park of São José dos Campos is presented as a place intended to house companies, universities and research institutes that coexist and generate a new business environment, easier access to knowledge and incentives to entrepreneurship, in order to strengthen and foster innovative, technology-based enterprises. For managers of the TecPq-SJC, production of technology-intensive goods allows for quality jobs, higher taxes and activities that are environmentally safe, thus contributing for the prosperity of the region and of the city. The perception of these managers is that people work organized in teams that are formed by partnerships between enterprises and universities and the products resulting from this work will bring benefits to society. The creation of innovative products has as main objective to create solutions to ease people´s life.

According to the managers of the TecPq-SJC, the ability for innovation is a characteristic of the human race across centuries and is becoming decisive in modern life. Therefore the importance of the Technology Park is justified because it “consolidates the tradition of São José dos Campos in the technological forefront of Brazil”. In addition to host universities and ease access of local

population to education, the TecPq-SJC also has enterprises that "in few years will be contributing decisively for a prosperous city and to improve the quality of life of everybody"[3].

The industrial pole of São José dos Campos has emerged after World War II, when Federal Government started to promote the reduction of Brazil´s dependence on imported goods. At that time there was an effort of Federal Government to develop strategic sectors for national development, such as aeronautical, aerospace, war artifacts and electronic goods. In addition, other elements contributed for the success of the pole, such as its location in between the cities of Rio de Janeiro and São Paulo, availability of energy supply, proximity to large consumer markets, good roads, as well as good climate and topography. As a result, the city has had for decades in its territory educational and research institutions at different levels, industry and Government and has been an example to other regions due to the production of goods such as airplanes, rockets and satellites (Medeiros & Perilo, 1990)

In the urban center of Sao Jose dos Campos are located federal institutes of scientific research, high-tech firms, universities, colleges and training centers in buildings of bold architecture. São José dos Campos is the main county of the region of the Paraíba Valley and it is close to beaches, hills and other touristic destinies. The city has three universities: the Institute of Aeronautics Technology (ITA), the University of the Paulista State (UNESP) and the University of the Paraíba Valley (UNIVAP). The city has two technology parks: the technology park of UNIVAP and the technology park of São José dos Campos.

Both technology parks consolidate the natural vocation of the city as a pole for development of science, technology and innovation, whose roots date back to the establishment of the Aeronautics Technological Center (CTA) and the Institute of Aeronautical Technology (ITA) in 1946 and 1950 respectively.

Forjaz et al (2013), in their case study on technology parks and incubators of São José dos Campos , summarize the antecedents of the city and its conceived future:

> *The experience lived by São José dos Campos with the creation of a research, technological development and innovation (R & D & I) habitat, led to the city's growth in terms of population, quality of life and investment. In the past, the city has benefited greatly from the creation of the Aerospace Technical Center (CTA) and the Aeronautics Technological Institute (ITA). These institutions fulfilled the same characteristics that today are characteristic of modern technology parks with quality education, focus on R & D & I and encouragement of entrepreneurship, and were the embryo of modern Brazilian aerospace industry. Currently, the Technology Park - São José dos Campos and business incubator managed by the Center for Competitiveness of Cone Leste Paulista (CECOMPI) work in order to integrate the universities and science and technology institutes with small and medium sized enterprises for the realization of technological innovation projects. For the future, the Technology Park and the city government are working together to structure a planned occupation project in an area of 25.3 million m2 in complex technology park called Special Zone Technology Park - ZEPTEC, where the future of the city is conceived with the creation of a technological city or technopolis. (Forjaz et al., 2013, p.1)*

[3] According to the institutional leaflet that presents the TecPq-SJC.

Braghetta et al. (2007) conducted an exploratory study on the perceptions of agents installed on TecPq-SJC, and identified the following factors that determine the location of enterprises : characteristics of the environment , transport infrastructure, universities and research centers , tax incentives and development of the county, quality of life, entrepreneurial mindset , services and history of the city.

Every year, meetings are held in TecPq-SJC for presentation of established companies. Smaller companies present their respective product and service portfolios, highlighting their possibilities. Larger companies, such as Boeing, Embraer and Airbus, present their needs in order to enable other companies to establish buyer-supplier relations with them. TecPq-SJC also offers several lectures, workshops and meetings with companies for updating, training and dealing with difficulties.

4.1 ENGTELCO

ENGTELCO Telecommunications and Engineering LTD, operates in information technology and telecommunications. It is a consulting firm specializing in telecommunications equipment certification. It conducts tests and reviews of RF systems (wireless), with its own laboratory that is capable to measure devices up to 40 GHz with a strong presence in the DTH sector (Direct to Home - pay satellite TV). For this, it follows several national and international standards, such as: Resolutions Anatel , IEC , ETSI , 3GPP , FCC , ISO, ITU- R , etc. It has also extensive experience in the design and implementation of microwave systems, widely used to make up the core of telecommunications networks that is the cell interconnection to mobile telephony and multimedia communication services (SCM) .

The company aims to assist its customers to achieve a satisfactory quality of its products and considers that its main advantages are: service quality and speed; self-developed processes; compliance; and presents as its greater value, service reliability. In addition, the company has its seal of quality ENGTELCO as a result of constant improvements in test and measurement services. ENGTELCO is recognized because of its quality and efficiency, and is considered one of the best measurement laboratories of Radio Frequency in Brazil. Although founded in April 2004, it was installed in TecPq-SJC only in 2011 , at the Enterprise Center II .

ENGTELCO has decided to go the TecPq-SJC because it believed it was an environment that could provide synergies and opportunities. According to the enterprise managers, "*today we see that our expectation was not only fulfilled, but it was also exceeded*". The company considers that the environment in TecPq-SJC is a space with diversity of competencies that enables the development of new business models and partnerships with other firms of the park.

The company also declared that it has an innovative system to evaluate "ku" band antennae. It is developing in partnership with other enterprise of the park a methodology based on computational simulations for use in this system, reducing costs and time of evaluation. Although it recognizes the importance of the TecPq-SJC to strengthen learning and innovation capacity, it still does not perceive the location in the park as a way to expand its market (see table 1).

ADVANTAGES	YES	NO
Access to market		X
Learning capacity	X	
Generation of innovations	X	

Table 1 – ENGTELCO- Perceived advantages of location in TecPq-SJC

Concerning networks, the company was already in a network with other organizations before it went to TecPq-SJC. Because it is a laboratory of radio-frequency systems testing, providing services for cable operators (Claro TV , Sky and GVT), ENGTELCO is part of an international network of cooperation in this area. This network consists of the following agents: the TV cable operators based in Brazil; foreign companies (US and Europe based) who design equipment and other products for cable TV operators; Chinese industries that are contracted by foreign companies to manufacture the projects; and laboratories that evaluate and test equipment and products, which ensure the TV cable operators the quality of the purchased items. Just one member of this network is from São José dos Campos, and the network did not change with the company's entry in the park, although the company wants to attract another TV operator to expand its portfolio.

Although TecPq-SJC staff, together with the Center for Innovation and Competitiveness of Cone Leste Paulista (CECOMPI) [4],organizes meetings between companies, ENGTELCO does not seem to recognize these efforts as ways to promote and strengthen the formation of networks.

According to our interviews, the partnerships made by ENGTELCO were the result of individual efforts of the major partner. He believes that there are possibilities of synergies with other companies installed in TecPq-SJC and has so far established three cooperation agreements with other companies of the park (see table 2).

ADVANTAGES	YES	NO
Creation of new networks	X	
Expansion of existing networks	X	

Table 2 – ENGTELCO-Advantages concerning networks related to location in TecPq-SJC

Concerning cooperation with universities and research centers, the company declared that there are partnerships but those are still precarious. A great difficulty faced by the company, according to our interviews, is to “reconcile the rhythm things happen in companies with the velocity of university and research centers” that usually are more slow.

Research and training institutions at University levels offer Master courses aimed especially for professionals. Those courses are interesting for the company, that is studying the possibility to ask an employee that is doing a MSc to join the development team of the company to work in a new antenna project that ENGTELCO is developing together with FEMTO, other company of the park.

Other service provided by TecPq-SJC is to facilitate the offer of consulting services of the Faculty of Technology of São Paulo - FATEC to companies in the park. The park is seem as a facilitator of knowledge diffusion but ENGTELCO considers that its role is not active. Therefore the company declared it did not take advantage from partnerships with universities and research centers. The company also declared that its business strategy does not include Government agencies in partnerships (see Table 3).

[4] CECOMPI has the mission to promote innovation and competitiveness of economic clusters of the region of Cone Leste Paulista. See http://www2.cecompi.org.br/st/

ADVANTAGES	YES	NO
Access to universities	X	
Access to Government funding		X

Table 3 - ENGTELCO – Advantages of partnerships related to location in TecPq-SJC

According to our interviews, the company stimulates its employees to engage in training and updating activities organized by TecPq-SJC. The company mentioned in the interviews that is important to improve the environment for social networking, offering more services such as restaurants, banks, convenience shops, gyms, etc. Managers of TecPq-SJC agree that this is necessary and are make studies to implement such services.

4.2 LUNUS

LUNUS Trade and Representation Ltd. started to operate in 1994. The company´s headquarters is located in São José dos Campos and it has a subsidiary in Alcântara, at Maranhão state (where Brazil has a platform to launch satellites) and other subsididary in PqTec-SJC since 2010, installed in the Enterprise Center I. The company used to be called Lunus Enviromental Services and decided to change its name to Lunus Technology Innovation because of several business opportunities that emerged after the company installed its affiliate in PqTec-SJC.

Management of the company is located at its headquarters and coordinates its two divisions: an environmental services division and an aerospace services division. Although different these divisions produce complementary instruments and services. LUNUS acts in engineering, production, trade, commercial representation and services. In the aerospace area, LUNUS focuses on stations of Control, Telemetry and Remote Commands, remote sensing (with stations to receive and process information from several satellites), telemetry, tests to certify satellites, viability studies and infrastructure to launch rockets. In the environmental area, it focuses on instruments for meteorology, oceanography, hydrology and remote sensing.

The first subsidiary of the company has been installed in Alcântara for 11 years next to the Center for Launching Rockets of Alcântra (CLA). This subsidiary was created with the specific purpose to provide services and aerospace materials to CLA. The second subsidiary has been installed in TecPq-SJC for three years.

TecPq-SJC has facilitated the contact of LUNUS with large companies that are also in the park such as Airbus. Most foreign companies represented by LUNUS, especially in the environmental area, were born in incubators or are located in technology parks. The company related that one of its European partners, after visiting the company´s subsidiary in TecPq-SJC, has become more confident to strengthen the partnership as LUNUS has the same facilities in the park that its partner has in its country. The aim of the partnership is to reduce costs of product commercialization and exports from Europe to Brazil and qualify LUNUS to act as technical service provider in Brazil.

There is a knowledge transfer between foreign companies represented by LUNUS in the processes relating to technical support. Normally LUNUS gives support to clients in the acquisition of a product made by a foreign company, participating of meetings of sales, and activities of installation and technical support. As those activities happened before the company located its subsidiary in the park, LUNUS does not associate changes in learning capabilities for development of radical innovation with its location in PqTec-SJC. However it recognizes that the park has brought opportunities to develop incremental innovation (see table 4).

ADVANTAGES	YES	NO
Access to market	X	
Learning capacities	X	
Generation of innovation	X	X

Table 4 - LUNUS - Perceived advantages of location in TecPq-SJC
* Yes for incremental innovation, no for radical innovation

An example of knowledge transfer happens in the production of a very simple equipment, the mechanical flowmeter model 2030BR, used to measure the volume of water filtered in plankton networks, although some customers also use this tool to measure the flow of water in rivers and canals. Such transfer of knowledge is the conclusion of a long process of negotiation between LUNUS and the American company GENERAL OCEANIC. This company authorized LUNUS to manufacture this equipment, making the payment of royalties as the equipment is sold in Brazil. With the provided technical support, the company declared that it has innovated in the procedures that are adopted, while taking into account the requirements set by the manufacturer.

As LUNUS was already a established company when it started to operate in TecPq-SJC through its subsidiary, it had already relationships with other organizations, among them 20 foreign companies that are represented by LUNUS in Brazil. Therefore the company does not recognize any advantage related to the formation of networks (see Table 5).

ADVANTAGES	YES	NO
Creation of new networks		X
Expansion of existing networks	X	

Table 5 - LUNUS-Advantages concerning networks related to location in TecPq-SJC

In addition, as LUNUS is constantly working in the expansion of its network, it recognizes support of TecPq-SJC when the park organizes meetings with universities, Government agencies and enterprises to promote new contacts with potential suppliers, clients and partners. As these meetings are frequent, the company sees in them a form of action by the park to support new partnerships that may lead to cooperation links and innovation.

According to the company, managers and staff of TecPq-SJC know each of the companies and institutions located in the park and several companies and institutions located outside. Thus, whenever a demand for a partnership is identified, park personnel organize meetings so that synergies between companies and institutions may be identified.

After the company started its activities in PqTec-SJC, it made several partnerships with research institutes, most of them located outside São José dos Campos. Most of these organizations are based in other cities , such as the Marine Biology Center at the University of São Paulo (CEBIMar / USP) located in the city of São Sebastião in the state of São Paulo; the Center for Innovation in Port Logistics at the University of São Paulo (CILIP / USP), based in the city of São Paulo ; the Federal University of Rio de Janeiro (UFRJ) ; and the Federal University of Rio Grande do Sul (FURG) . The only local University is the University of Paraíba Valley (UNIVAP) , located in São José dos Campos. The company thus consider partnerships with universities as an advantage of location in PqTec-SJC (see Table 6).

ADVANTAGES	YES	NO
Access to universities	X	
Access to Government funding		X

Table 6 - LUNUS - Advantages of partnerships related to location in TecPq-SJC

The company has already established formal agreements with UFRJ, CILIP/USP and FURG and it is formalizing agreements with UNIVAP and CEBIMAR/USP, with the aim to develop new services as well as to train and upgrade personnel in the activities of technical support and marketing. Meetings with partners are done regularly through the internet (email and Skype) and personal contacts occur during specialized conferences. As a result the company is able to develop new products and to improve the capabilities of its personnel. Although the company declared it does not have access to Government financing, most of its partners in the aerospace area are linked to the Government, as for instance the Brazilian Air Force that gave the company a certificate of quality.

4.3 TPG

TPG Industry and Trade Ltd, is a company specialized in oil, gas and renewable energy technology. It was born to provide some services to Petrobras , working specifically with oil and gas from the on-shore oil fields in the state of Rio Grande do Norte. It was founded in 2005 in order to act in project development and manufacture of equipment for several activities such as: the production and transportation of natural gas; drilling for oil and gas; development, deployment and operation of alternative energy projects; development of projects for methane gas, as well as consulting and advisory services in oil and gas projects; training and organization of seminars in universities, and companies.

With its operational base in Natal, capital of the state of Rio Grande do Notre, the company was born with a proposal to explore the small oil fields as a small producer. The company declared that after acquiring market confidence, thanks to the quality of the service offered it became a producer of oil and gas. It has two fields in operation with capacity to perform all the necessary services, end-to-end.

In addition to its headquarters in the city of Natal the company has a support office in Miami, USA. And to meet the demanding market oil, gas and renewable energy it has settled as a Center for Research and Project Development in the Technology Park of São José dos Campos since 2013.

The company's focus is on developing solutions through new technologies and / or adaptation of technologies used in other industrial activities, for the industries that produce oil, gas, renewable energy, landfills, sewage treatment plants and onshore basins.

Since it was founded the company developed many projects having as partners large enterprises such as Petrobras, Potigas, Petrobras Distribuidora de Gás Natural, Moinho Dias Branco, Lumina Resíduos Industriais, and Esbra.

The decision to locate in the Park was due to the fact that it is in a favorable region in the State of São Paulo, near to Rio de Janeiro, with an excellent structure for the development of projects and partnerships. According to a manager of the company, "the possibility for interaction and partnerships will small, medium-sized and large enterprises is most interesting". The interviewee also added that having its name in the list of resident companies of the park helps to diffuse the name and the trademark of the company.

However the company considers that the infrastructure of the park is still precarious. For example, our interviewee complained that there are still problems with internet access although fees paid by the companies to be located in the park should be used to avoid these problems. Interaction between small firms, one with another, is considered weak. Although in the discourse of PqTec-SJC managers relationships between small and large firms are considered important, our interviewee declared that in practice these relationships do not exist. Nevertheless the company considers that location in the park is "an investment" (see Table 7).

ADVANTAGES	YES	NO
Access to market	X	
Learning capacities	X	
Generation of innovation	X	

Table 7 – TPG - Perceived advantages of location in TecPq-SJC

According to the company´s manager:

> *"The park will be good. The park is still not good [because] it costs for us. The fees for and use of facilities here today are not cheap. We would be better off in another park. The park has this defect in the structural sense: the costs of the Park are large, which would make it feasible for TPG to be somewhere else…**We are in TecPq - SJC because we believe in the Park project. "***

Because its headquarters are located in Natal, TPG has managed to establish its trademark in the north-east of Brazil region and as a result developed several partnerships. Its office in the United States was set up to establish new relationships with suppliers and customers as well as strengthen existing contacts. Help from PqTec-SJC in this activity is considered indirect and takes place in the meetings and conferences organized (see Table 8).

ADVANTAGES	YES	NO
Creation of new networks		X
Expansion of existing networks	X	

Table 8 - TPG-Advantages concerning networks related to location in TecPq-SJC

Before its entrance in the park the company had already some joint projects with the college of the region as well as contacts with suppliers outside Brazil, in countries such as Portugal and the UK. The company also had a relationship with a research group located at CTA and with several suppliers of technology-based equipment.

Contacts that occur in networks are both formal and informal. They occur monthly in seminars, workshops, emails and over the phone. As practical results, the company develops consulting services and projects through partnerships that involved its personnel. The main goal in the formation of networks is to allow for the development of high quality technological projects and products and to increase theoretical and practical knowledge.

As to partnerships with universities and Government, the company declared that its location in the Paraíba Valley has made the establishment of partnerships with federal training institutions and universities of the region possible, involving consultancy from professors and internships for students of those institutions to develop projects. For example, the current internship program of the company searches for top students of the universities located in the region that have interest and competencies to develop projects for sustainable energy reuse as well as corporate development.

In 2014, TPG has signed an agreement to establish a partnership with FATEC. This agreement concerns a program for the provision of specialized services by six professors to support small and medium-sized enterprises that are resident at the two Enterprise Centers of PqTEc-SJC. In addition, TPG has hired two students from FATEC to work as trainees in management of industrial production and logistics services. These partnerships allow the company to access information in universities and research institutions and to develop joint projects with them.

The company does not have direct relationships with Government and does not receive any support for investment, working with its own resources. The enterprise has been trying for the last four years to set up a partnership with the county of São José dos Campos to get financing for treatment of the gas generated by the waste disposal facility of the city, but so far it did not have success. Table 9 summarizes the perceptions of the company concerning advantages related to partnerships.

ADVANTAGES	YES	NO
Access to universities	X	
Access to Government funding		X

Table 9 - TPG - Advantages of partnerships related to location in TecPq-SJC

However, the internship program has limits as TecPq-SJC is a bit far from the city. As distance in this case hinders access, the company supports the park´s efforts to develop its social environment. The installation of restaurants, cinemas and hotels as well as the organization of cultural and art events is considered important to generate a more attractive environment. This initiative not only could generate more jobs, contributing to the region´s development, but could also attract more people to work in resident companies, therefore TPG fully supports it.

5. A brief discussion of the case

The Technology Park of São José dos Campos, located in an industrial and technological pole, presents itself as having great potential for growth and support for the development of the region. Our research tried to identify whether geographic proximity of companies in the park has facilitated the establishment of partnerships and cooperation links or if, in the case of selected enterprises, what has prevailed for the setting up of partnerships for innovation was the insertion in networks motivated by organizational proximity. We also investigated whether the location in the park has eased the setting up of partnerships with universities and Government agencies.

The results can be summarized as follows. For two enterprises (LUNUS and TPG), location in PqTec-SJC was considered important for greater access to markets, due to visibility effects that led to the strengthening of partnerships.

About learning capacity, two enterprises related it has improved after location in the park. However, as all companies participated of networks before they were established in the park, this improvement is mostly related to organizational proximity.

Thus, organizational proximity seems to prevail as a motivation for partnerships and projects that lead to innovation. Just one enterprise of the three interviewed related a case where geographic proximity favored the establishment of a partnership with another company located in the park.

Therefore, our preliminary results confirm the findings of Rodrigues et al. (2013) that organizational proximity is the main motivation that leads companies to form partnerships for innovation when these partnerships occur between companies. We did find cooperation links between companies motivated by geographical proximity, but this happened just in one of the three surveyed companies.

In case of university-enterprise relations, Rodrigues suggest that geographic proximity may be important mostly in projects where students do part-time work in companies. Our research confirms this finding, having found a company that has internship programs and other that declared that the rhythm of universities and enterprises is different.

We did not find any evidence of relation between location in PqTec-SJC and Government funding of companies. However, two of the three companies declared they had Government organizations as customers.

Concerning institutional proximity, we observed a convergence of the discourse of the managers of the park with the discourse of companies, mentioning the city of São José dos Campos as a place where several opportunities linked to innovative activities emerge due to concentration of highly qualified resources. However, the findings of the research suggest that companies do not consider use of local resources essential, opting to continue in their established networks. This is why one company declared it could be better off outside the park.

At present, PqTec-SJC is going through a process of “realignment of management strategies” according to managers interviewed. This realignment is based on the diagnostic that the park must define clearly its identity, its advantages and its role for the region. Although São José dos Campos is well known, the park is still confused with the industrial pole of São José dos Campos. The definition of its identity is important so that it avoids the creation of high expectations by the part of companies who opt to be installed in the park, especially the smaller ones.

The results of this exploratory research suggest that it is indeed misleading to oppose geographical to organizational proximity. Each type of proximity may be important depending on the type of partnership created by proximity links. The findings also suggest that the model of the Triple Helix that is present in the policy of technology parks in Brazil may not be found in practice. To confirm these results, an expansion of the research is needed.

6. Summary, Conclusions and Future Research

This paper had the objective to discuss the role of different types of proximity for knowledge flows in a technological pole. To do this we used the results of an exploratory study of the Technology Park of São José dos Campos, investigating advantages related to geographical proximity and to organizational proximity.

The park is located at São José dos Campos, a city known for the concentration of technology-based enterprises. We found that geographical proximity favors access to universities and may also stimulate partnerships between companies that generate innovation. But it is also important to consider organizational proximity to understand the dynamics of knowledge flows of companies in the park, because companies settle there with their networks already formed. As governance mechanisms of the park are relevant to promote the establishment of cooperation links between companies and between companies and universities, it is also important to understand whether there is institutional proximity between companies and managers of the park.

The exploratory study will be later extended and its results will be used to propose a model of analysis of knowledge flows in technology poles that will be applied to the case of the Project of Science and Technology of the Brazilian Army in Guaratiba, at the city of Rio de Janeiro (PCTEG).

About PCTEG is important to note that on 31 July 2013, the mayor of the city of Rio de Janeiro enacted Guaratiba as a Special Area of Environmental Interest. This decree, in a way, imposes some restrictions on the deployment of PCTEG therefore the industries to be established in the region should be clean industries. The cornerstone of PCTEG was launched with a military ceremony, where several authorities were present, on 20 September 2013. Highlighting the importance of the dual characteristic of military technologies for the purposes of science, technology and innovation as great encouragement for economic development, the Army says that "the main feature of the pole is encouraging a productive chain that generates benefits and it is fully committed with the question of technological duality" [5]

PCTEG objectives are: 1) foster research materials, equipment, and military and civilian systems, according to the scientific and technological priorities resulting from the National Defense Strategy (END); 2) providing efficient access to the technologies demanded by the Brazilian Army; 3) leverage the national defense industry in view of the END; 4) increase the synergy of the Army with science and technology Institutions and other technological innovation organizations in the country such as companies, universities, development agencies and technology transfer institutions; 5) encourage innovation processes, competitiveness, generation and transfer of knowledge; 6) reduce costs in design and production of defense equipment, in considering its duality since the beginning of development of new products; 7) create an economic cluster capable of attracting

[5] According to the institutional leaflet that presents PCTEG.

investment in S,T&I; 8) perform research, development and scientific and technological development in the areas and Brazilian Army interest activities; 9) collaborate with the modernization of Brazilian industry, using the human resources and technological potential available in the Military Organizations of the Brazilian Army; 10) support the activities developed by the Brazilian Army in the fields of standardization, metrology, technical regulations and quality certification.

The project of PCTEG is an attempt to rescue a project that dates back from the 1980´s. At that time the Brazilian Army elaborated a grandiose project that forecasted the installation of a huge system of science and technology that included the Institute of Military Engineering (IME). The original project was later reduced to the partial construction of the Technological Center of the Army, that develops several innovations in equipment and materials and is based on a model of interaction between Army, universities and enterprises very similar to the Triple Helix vision.

In an attempt to rescue the original idea, the PCTEG project includes the construction of new premises of the IME, the creation of the Military Institute of Technology (IMT), new support buildings, as well as areas for the installation of incubated enterprises. The proposal covers a strong pole focused on the following activities: engineering, Cyber Defence, robotics, energy materials, nanotechnology, artificial intelligence and alternative energy sources. With this project the Army intends to contribute to regional and national development, creating companies and promoting synergy among the various actors to create favorable environments for innovation, technology and development of domestic industry.

PCTEG will be formed by the following organizations and institutions: Institute of Military Engineering Institute (IME); Institute of Military Technology (IMT); The Army Technology Center (CTEX); Army Evaluation Center (CAEX) ; Industrial Development Center (CDI) ; Innovation Management Agency (AGI); Institute for Advanced Technological Research Advanced (IPTA) ; Incubator of enterprises of defence (FDI); War Arsenal of Rio de Janeiro (AGR) ; PCTEG Management; Command and Service Battalion.

This brief explanation of PCTEG project suggests that it is based on the model of the Triple Helix - and that nothing is mentioned about the role of networks that may exist for the development of this technology pole. The project highlights the juxtaposition of research centers and companies, valuing the geographical proximity to the detriment of relational or organizational proximity. A deeper understanding of the types of proximity relevant to knowledge flows in a technological pole is essential so that new projects of technological poles (and technology parks) promote innovation and contribute to the development of a region.

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