

INNOVATION HABITATS IN THE INTERIOR OF SÃO PAULO: A STUDY ON THE REGIONS OF PIRACICABA AND SÃO CARLOS-SÃO PAULO-BRAZIL

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ABSTRACT

The present research has as objective to analyse the mechanisms of articulation, as well as the factors that promote and constitute the innovation habitats in the cities of Piracicaba and São Carlos. For both, it will be necessary to investigate the articulations promoted by the actors of the propeller triple helix extended-GUCRN (Government, Universities, Companies, Research Institutes and Non-governmental organization). As the object of analysis lies in the problematization: the extent to which the poles and the habitats of innovation promote the development of economic, social and technological areas studied? And which structural factors are necessary for the development of the hubs and habitats of innovation? The methodological approach of the research will be anchored in the vision of childhood. The field research will be conducted through semi-structured interviews. The results of the research point to the argument of the configuration of São Carlos and Piracicaba as the centre of a region - polo and innovative, where there is evidence of the dynamic functioning of the propeller triple helix extended.

Keywords: Triple Hélix, Extended, Innovation Habitat, Local Development.

INTRODUCTION

This research aims to analyse the factors that foster and constitute the innovation habitats in the cities of Piracicaba and São Carlos/SP. These cities are highlighted in the State of São Paulo, because they have indicators higher than the National average in terms of economic and technological development and training of professionals. Another relevant look is to investigate the territorial specificities that place them as regional poles of innovation promotion. The main actors in the municipalities of Piracicaba and São Carlos were highlighted for the research cut-out. As an object of analysis, the articulations promoted by the sectors will be investigated: public, private, universities, research canthers, and relevant social actors, with regard to the promotion and strengthening of the development hub and constitution of innovation habitats, orchestrated in order to improve the social capital and the dissemination relations of innovations.

The methodology was based on the interpretive approach. For the empirical research, interviews (semi-structured) were conducted with the main promoters/inducers of the constitution of the development hub and habitat of innovation.

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This study aims to contribute to the understanding of the dynamics of the constitution of development poles and innovation habitats in the aforementioned territories. However, to answer such notes, the problematization of the research is based on two central questions: a) to what extent do the innovation habitats enhance the economic, social and technological development of the studied territories? And b) which structural factors are necessary for the development of the innovation habitats? These questions meet the need to understand the mechanisms of articulation that arise from this relationship, and how it is necessary to strengthen public policies in order to stimulate and boost innovative territories.

The structure of this research consists of two stages: initially, the theoretical aspects that support the studies on innovation habitats were presented; then, the characterization of each territory was presented, as well as the determinants that characterize the innovation poles.

THEORETICAL REFERENCE

The theoretical bases for these researches have been conducted under a multidisciplinary perspective and have been stimulating debates about the integration of several currents of thought, especially from the notion Poles of development and habitats of innovation. (Perroux, 1967, 1977; Boudeville, 1969; Aydalot, 1986; Perrin, 1991; Maillat, 1991; Camagni, 1999; Kang, 2004; Zoain & Plonski, 2006; Dudziak & Plonski, 2008; Alvim, 2008; Veloso Filho & Nogueira, 2006; Link & Scott, 2003; Kihlgren, 2003; Phillimore, 1999; Sun et al., 2009; Guerreiro et al., 2009; Steiner et al., 2008; Jung Neto & De Paula, 2009; Andrade Júnior e Porto, 2005; Plonski, 1999; Almeida, 2004; Zouain et al., 2009). In order to structure a logical sequence of the theoretical framework, the research will be outlined by the studies of development pole, innovative environment and habitats of innovation, soon after on the theoretical current on the triple helix extended.

Innovation Habitats

The idea of innovation habitats began in Stanford, in the United States, in the 1950s, whose intention was to bring together in the same physical area companies that fostered innovation (Phillimore, 1999; Kihlgren, 2003). Currently these innovation habitats are constituted by incubators, research centres, laboratories and educational institutions (Plonski, 1999; Almeida, 2004; Zouain et al., 2009). The objective\ of this agglomeration is to create what they call an innovation ecosystem, i.e., several actors acting in the same space to develop innovative products and services (Dudziak & Plonski, 2008).

Thus, due to the search for the generation of innovations, the habitats promote the intensification of interactions between companies, universities, research institutions and the actors that produce the new knowledge (Sun et al., 2009; Steiner et al., 2008; Kang, 2004). In the view of these authors, the innovation habitat presents a configuration that provides new arrangements between companies, new types of organizations and networks of organizations, which in turn constitute a new dynamic of local development. That is, the existence of these environments becomes more relevant as the innovation generated strengthens the local economic, social and technological development.

These innovation habitats should emphasize the interaction of the triple helix (Government, Company & Universities). Such proposition should contemplate some basic conditions, such as: a) existence of teaching and research institutions that have technological

density-knowledge; b) cooperation between teaching and research institutions and companies through partnerships and joint projects; c) government support; d) research capable of being transformed into technical innovations; e) entrepreneurs who conduct projects and create technology-based companies; and f) qualified professionals (Jung Neto & De Paula, 2009; Andrade Júnior & Porto, 2005).

The premises assumed for the functioning of the innovation habitats are spaces for collective learning, exchange of knowledge, interaction between companies, research institutions and government agents for conducting research that can be transferred to the productive sector, contributing to the economic development of a city, region or country (Benevides, 2013).

Triple Helix Model

Contemporary studies point to the relevance of the interaction of the protagonists of the triple helix. For González (2009), the model of the triple helix idealized by Etzkowitz, 1994; Leydesdorff & Etzkowitz, 1996, is imbricated in the process of interrelationship-University, private initiative and Government. This is an area of knowledge that has resulted in academic research of international relevance. In the Table 1 below it is possible to verify the interactions and intersections of each protagonist of the triple helix.

To illustrate the interaction of the triple helix, the author González (2009) presents the development process, as well as the characteristics and implications of the model proposed by Leydesdorff & Etzkowitz (1996), follows Table 1-Stages and Characteristics of the Triple helix model:

Development Stage	Characteristics
Creation of a knowledge area	It focuses on regional innovation habitats where different actors work to improve local conditions for innovation, concentration of related R&D and other relevant operations.
Creating a space for agreement	Ideas and strategies generated in a triple helix of multiple interrelations between the institutional sectors (academic, public and private).
Creating a space for innovation	After the attempts to achieve the objectives articulated in the previous phase; it is central to establish and / or attract public and private venture capital (combination of capital, technical knowledge and business knowledge).

Source: González, 2009.

When approaching the concept of the triple helix, it can be seen that this theory partially explains the relationships present in the development poles and habitats of innovation. Nevertheless, there are difficulties in understanding the relationships between the institutions that are not part of this model. Therefore, this research cites the studies of Benevides (2013), whose author developed the expanded concept of the triple helix, which was called GUCRN (Government, Universities, Companies, Research Institutes and Non-governmental organization). The research will pursue the concept of GUCRN with a proposed model of categorization and analysis of the dynamics of constitution (or not) of the development pole and habitat of innovation in the selected territories.

RESEARCH METHODS

The scientific method offers two main types of approaches: (a) the rationalist method,

based on positivism and (b) the interpretive approach, centred on the depth of the phenomenon studied, seeking explanations about the causes of phenomena and their development (Hart, 1998). The studies carried out by the main authors of the French school of innovation (milieu innovator) use the interpretative approach to analyse and explain the phenomena inherent to the dynamics of innovation habitats.

The objective of this school is to purify/deepen the discussions around the phenomenon-Habitats of innovation. Therefore the predominant methodological approach was interpretivist.

The emphasis of the methodology will be guided by the qualitative approach, because the nature of the study aimed to deepen the analysis about the phenomena that reveal how, when and why it develops/arises (or not) the development poles and innovation habitats in the cities of Piracicaba and São Carlos.

Therefore, it was necessary to develop a research protocol to structure the empirical study. For Yin (2010) this protocol should include the following topics: a) an overview of the study; b) field procedures; c) central issues of the study; and d) a guide for the final report of the study.

The research protocol is based on five key questions, which were conceived in a semi-structured way, and which will be answered by the agents that are directly involved with the theme development hub and habitat of innovation, in the target territories of the research.

RESULTS AND DISCUSSION

Characterisation of the Territory of Piracicaba

According to data obtained through the Institute of Research and Planning of Piracicaba (IRPLAP), the municipality is located in the interior of the state of São Paulo, in the northwest of the state capital, about 164 km away from it. In 2015, its population was estimated by IBGE at 391,449 inhabitants, being the 17th most populous in São Paulo.

In 2015, Piracicaba's Gross Domestic Product (GDP) was the largest in the Piracicaba Microregion, the 14th largest in the State of São Paulo and the 52nd largest in the entire country. According to IBGE data for 2015, the municipality's GDP reached R\$ 20.2 billion. In 2000, the Human Development Index (HDI) of income was 0.795, and that of Brazil in that year was 0.723. The city is the fifth city in the state in terms of export value.

The city of Piracicaba, due to its relationship with sugarcane, is responsible for the production of approximately 65% of all equipment consumed by the national sugar-alcohol sector. The city has public and private universities of national prominence (USP, UNICAMP, UNIMEP, UNIP, EEP, FATEC, FATEP & ANHANGUERA). It is estimated through the data made available by the MEC that the city has 50 thousand university students.

Listed actors that promote innovation and technological diffusion in Piracicaba: Piracicaba Technology Park, Luiz de Queiroz School of Agronomy (ESALQ)-USP, ESALQtec, APLA, Agtech Valley, FUMEP, SEBRAE Piracicaba, ATEPI, UNIP, UNIMEP, FATEC, EEP (Piracicaba Engineering College), SENAC PIRACICABA, FATEP-Piracicaba Technology College and ANHANGUERA Educational College.

Actors and Their Contributions to the Habitat Development of Innovation in Piracicaba Local Production Arrangement for Alcohol in the Piracicaba Region (Lpaapr)

In its conception, the local productive arrangement of alcohol in the region of Piracicaba was structured under the globalized point of view of the Municipal Public Power, in partnership with public and private entities and institutions, the first actions were initiated in 2006 aiming at

the effective organization of the companies that compose the productive chain of the sugar-alcohol sector, so that they could attend, through a joint work, all the national and international needs related to the sector. The Local Productive Arrangement for Alcohol in the Piracicaba Region (LPAAPR) was created, consisting of 70 industries, 10 mills/distilleries, 6 research institutions and entities linked to the Piracicaba River Valley region, with the mission of promoting and facilitating the interaction of members in an organized and structured manner, generating greater value to the productive chains of renewable fuels and their partners, contributing to sustainable development.

According to Flavio Castelar (2016), at the beginning of 2005, coordinated by the Secretariat of Industry and Commerce (SIC), the companies of the Piracicaba region that make up the productive chain of the sugar-alcohol sector began organizing actions, with the objective of meeting, through joint work, all the national and international needs of this sector. It is, therefore, a set of companies, products and services linked to this sector in the region of Piracicaba, whose main mission is to foster and facilitate the interaction of members, in an organized manner, generating greater value to the production chain of renewable fuels contributing to the sustainable development of both the region and the country.



FIGURE 1
ACTORS THAT ARE INVOLVED WITH THE GENERATION OF KNOWLEDGE /
PROMOTION OF INNOVATION IN THE TERRITORY OF PIRACICABA/SP

Characterization of the Territory of São Carlos

São Carlos-SP is located in the geographical centre of the State of São Paulo (232 km from the São Paulo capital), the municipality of São Carlos has characteristics that make it an outstanding place in several aspects. The mild climate, with an average annual temperature of 19.6°C, added to the average altitudes between 800 and 1,000 meters, makes São Carlos a very pleasant place, with numerous waterfalls, curious geological formations and landscapes (IBGE, 2017).

Founded in 1865, the municipality has an estimated population for 2016 of 243,765 inhabitants, in a territorial area of 1136,91 km² and belongs to the Mesoregion of Araraquara ((Figure 1) (Source: Geo referencing using, 2018)), subdivided into two, being part of the Microregion of São Carlos, together with the municipalities of Descalvado, Ibaté, Ribeirão Bonito, Dourado & Analândia, adding 308,738 inhabitants (IBGE, 2010).

São Carlos has a Municipal Human Development Index (IDHM) of 0.805 (IBGE, 2010), falling into the Very High range among Brazilian municipalities. The dimension that most contributes to the municipality's IDHM is longevity, with an index of 0.863, followed by income, with an index of 0.788, and education, with an index of 0.766 (IBGE, 2010).

The average per capita income of São Carlos grew 42.24% in the last two decades considered by IBGE, going from R\$ 758.91 in 1991 to R\$ 898.67 in 2000 and to R\$ 1,079.45 in 2010. The evolution of income inequality in these two periods can be described through the Gini Index, which went from 0.50 in 1991 to 0.52 in 2000 and to 0.49 in 2010 (the Gini Index is an instrument used to measure the degree of income concentration. It points to the difference between the incomes of the poorest and the richest. Numerically, it varies from 0 to 1, where 0 represents the situation of total equality, i.e., all have the same income, and the value 1 means complete income inequality, i.e., if a single person holds all income from the place in question) (IBGE, 2010).

The academic, technological and industrial vigor conferred to São Carlos, by initiative of the local city hall, the title of 'Capital of Technology' in 1999, which began to be disclosed in the main media, through the appreciation of advantages that the city could offer to investors (Dozena, 2008).

This development process is explained by Silva (1998) as a market of places where the positive image of cities is presented as a differentiating element in attracting investments. In this sense associated with the image of a technological city, another process presents great importance in what relates to the dynamization of activities in São Carlos: the successful industrial and urban deconcentration of the state of São Paulo.

According to Devescovi (1987), São Carlense industrial activity developed after the last decade of the 19th century, when traders and small industrialists organized an incipient industry subordinate to the coffee economy which, after the coffee crisis, contributed to the consolidation of an urban-industrial economy.

It should be noted that unlike other cities in the interior of the state that were industrialized through agro-industrial activities, São Carlos had little support in its rural productive structure. According to Devescovi (1987), during the course of its industrialization process, the sectors that stood out most were electrical/communications equipment and mechanical-metallurgical. Over the years, on the initiative of local businessmen, some larger establishments expanded and diversified their activities, becoming competitive in relation to industrial plants in the metropolitan region of São Paulo. Proof of this is that in 1940, São Carlos accounted for 0.7% of the state's working class population, occupying ninth place among the most industrialized São Paulo municipalities at the time (Dozena, 2008).

Still, with the substitution of the agrarian elite for the industrial elite, the industrialization process gained momentum in São Carlos. According to Lima (1994), two businessmen of national projection had outstanding participation in the incentive to the installation of industries: Germano Fehr and Ernesto Pereira Lopes. Thus, their prestige and political skill contributed to the installation of the University of São Paulo in 1948 and the Federal University of São Carlos in 1967 (Dozena, 2008).

Faced with the concentration of universities and research centres, São Carlos has a high concentration of scientists and researchers: one doctoral researcher (PhD) for every 230 inhabitants and one researcher for every 42 inhabitants. The industrial activity is marked by the presence of large industries: Volkswagen (engines), Tecumseh (compressors), Faber Castell (pencils), Electrolux (refrigerators and stoves), in addition to textile companies, packaging, machinery, paints, washers, optical equipment and a large number of medium and small industries from the most diverse production sectors. We highlight the technology-based companies, resulting from the scientific and technological capacity installed in the city.

The two universities (UFSCar & USP), in which there is a preponderance of exact courses, contributed to the structuring of the Technological Pole, as the first initiatives for the formation of technology-based companies emerged from the two universities.

The movement to create technology-based companies can already be observed in the context of São Carlos, from the 1960s on, but it intensified from 1980 on. In 1984 a foundation was established, the Fundação Parque de Alta Tecnologia de São Carlos (FPARQTEC), with the mission of being the manager of this organizational arrangement. Currently, São Carlos is home to 60 technology-based companies, some of which are still in the incubation phase. These are technologically intensive companies that operate in areas considered state-of-the-art technology, such as microelectronics, information technology, robotics, precision mechanics, and fine chemistry, among others. Most of these companies were born from the relationship with universities and/or within these institutions.

Besides the technology-based companies and the PARQTEC Foundation, a number of other local agencies and institutions have played an important role in the formation and development of this techno pole, among which stand out USP and UFSCar, the city's own City Hall, SEBRAE, SENAI, CIESP/FIESP, among others. The networks outlined in this context involve, therefore, a great diversity of actors and institutions.

Some Actors that Promote Innovation in São Carlos:

São Carlos received the title of National Capital of Technology, celebrated in 2011 by the then president of the republic, Dilma Rousseff. The fact is that the city has the highest number of PhDs per capita. While in Brazil there is one doctor for every 5,423 inhabitants, in São Carlos there are one doctor for every 180 inhabitants, that is, 40 times the national average. Moreover, while in Brazil the average number of patents registered is 3 per 100,000 inhabitants, in São Carlos this average is 14.5. (G1, 2012) ((Figure 2) (Source: Geo referencing using, 2018)).

Another finding is the amount of investments in technological development and innovation financed by FAPESP. São Carlos is only behind São Paulo and Campinas and the first in quantity of PIPE per inhabitant.



FIGURE 2
INNOVATION IN SÃO CARLOS

CONCLUSION

Conclusion of the Results of the Research-Piracicaba

The city of Piracicaba is recognized as a pole of development and business in the sugar-alcohol area, with industrial mesh pulled by this sector. In the last 20 years we have been going through a diversification of the industrial base, once it was identified the formation of qualified labour for the automotive sector.

Observing the GUCRN model (interaction of local Government, Universities, Companies, Research Institutes and Non-governmental organization) it can be seen that the local government in the last 12 years has invested in the dissemination/attraction of new companies to the city of Piracicaba, as the case of the coming of Hyundai. However, the local government invested and sought to articulate the private initiative with the Universities to develop the Technological Park of Piracicaba (PTP). This initiative by the public authorities triggered a movement towards the implementation of the PTP.

It should also be noted that the public universities have incubator and accelerated projects, which in turn foster the local innovation ecosystem. However, they do so in isolation, as is the case of the University of São Paulo, which develops research and development activities in an ESALQtec incubator.

Companies in need of research are approaching public universities for the development of new products/solutions. This finding was verified with ESALQ. Another finding of the research

refers to the strong concentration of qualified labour, which enhances the market and attracts entrepreneurs to the territory of Piracicaba.

Universities are spaces that foster knowledge, however, it should be noted that public universities have little interaction with private universities, which shows that there is the possibility of stimulating research that could be shared.

The Piracicaba Research and Planning Institute (PRPI) have the role of informing and pointing out the socioeconomic indicators of Piracicaba, as well as developing a planning agenda for the city.

In Piracicaba, there is a movement that is in the process of being consolidated and that is in the embryonic phase. This is Agtech Valley. This institution has the function of spreading the innovative actions of the territory.

The Technological Park of Piracicaba was implemented in August 2012. The PTP is a joint action between the Piracicaba City Hall and the State Government, managed by LAPA (Local Alcohol Production Arrangement). Currently, TPP (Technological Park of Piracicaba), does not have incubated companies, since the park is in the process of consolidating itself. TPP is an initiative to strengthen the innovation habitat. However, the TPP is very recent and is not operating along the lines of other technology parks. It can be said that the initiative was very important for the City of Piracicaba, and that the results will be collected in the long term. It can be evidenced that the Piracicaba Development and Innovation Habitat Pole is in the process of formation, considering that the protagonists of innovation in the territory are polarized in the Universities and in the companies, being necessary greater engagement of the public power (Local Government) so that in fact the local innovation system will bear fruit (be successful). Nevertheless, joint efforts are needed to strengthen the TPP and, consequently, the innovation ecosystem of Piracicaba. It is concluded that the innovation habitat of Piracicaba is in the middle of the structuring process, which in turn requires more structured institutional articulation mechanisms that enhance the innovation habitat of the territory.

Conclusion of the Results of the Research-São Carlos

Different from Piracicaba, the city of São Carlos has several protagonists within the Habitat of innovation. The local system of innovation of São Carlos already dates back more than 40 years of existence, being vanguard among the innovation habitats in Brazil. The articulation and interaction of the taxonomy GUCRN is present in São Carlos, and the territory in question began its actions in the field of innovation through the Universities. Nevertheless, the predecessor managers had a long-term vision and bet on the drive of innovation as a source of competitive advantage, and the companies-Research Institutes-joined the Universities and technological parks present in São Carlos. It is worth highlighting the role of the institutions: USP, UFSCar, ParqTec-São Carlos Science Park, EMBRAPA, in the actions of research-innovation. Such institutions are boosting the Ecosystem/Habitat of local innovation.

Given the concentration of universities and research centres, São Carlos has a high concentration of scientists and researchers: one doctoral researcher (PhD) for every 180 inhabitants. In Brazil, the ratio is one doctor for every 5,423 inhabitants. Thanks to the research centers São Carlos also bears another important mark: the annual average of patent registrations is 14.5 patents per 100 thousand inhabitants. In the country, this ratio is 3.2 patents per 100,000 inhabitants. The city also houses 39 undergraduate courses and 200 companies are considered high-tech, in sectors such as optics, new materials and instrumentation. Based on the data obtained, these 200 companies that are considered high-tech, most of them were incubated by

ParqueTec and/or had their researches associated with the public universities of São Carlos. Another important point that is worth mentioning is the way in which the innovations are disseminated. Most of the innovations are propagated through papers and another part becomes patents, which consolidates the territory of São Carlos as fertile ground for innovation. Based on all the notes made, it is worth mentioning that São Carlos is generating an asset of great importance, which is the constitution of the Culture of Local Innovation. This allows for a vanguard vision in terms of innovation and consequently a differentiation among the innovation centres in Brazil.

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