Local systems of innovation: a comparative analysis of technology parks located in the Northeast region of Brazil

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Abstract

The objective this paper is to identify the potential to economic development and innovative place technology parks that are in operation in northeast Brazil. The results are derived from a qualitative research study, based on descriptive and exploratory research, which through a five case studies it was possible to obtain information about the topic. The finding indicates that the technology parks presents potentials that identify them, as inductors of the economic development and local inovativon. Also, it presents limits that in spite of it they do not lessen the potential the localities of excellence for the transfer of technology based in technological base companies. It presents itself as difficulties that should be minimized or depending on the situation, solved through actions of the actors involved in behalf of the economic development and local inovativon.

Keywords: Economic Development. Local Development. Technological Innovation. Technological Parks.

1 Introduction

The current dynamics of the economic scene has increased the complexity of companies, and the competitiveness between them, since many transformations are happening in the environmental, social, economical and political spheres, with phenomena such as capitalist restructuring, globalization and technological development (VASCONCELOS *et al.* 2009). Such phenomena have emphasized people and their intellectual abilities, given the search for competitive edge in this new context. The use of this strategy has become a resource of differential strategic value, which led to the emergence of organizations based on information and knowledge.

Thus, the emergence of dynamic industries, with productive processes based on the intensive use of new technologies of automation, represents, according to Alvim and Castro (2005), a new paradigm for the organization of productive activities, and for labor relations, with reduced jobs in the direct production process, smaller salaries, and growth in service industries.

Hauser, Zen, and Lopes (2004) assert that one of the main traits of this new productive profile is the tendency towards what they call "dematerialization of production," which implies a increasingly smaller consumption of energy and raw materials, smaller spaces, and the necessity of boost and dissemination of knowledge and innovation.

From the perspective of Hauser, Paladino, and Medeiros (1997), innovative environment is the system of social, institutional, organizational, economical, and territorial structures that creates the necessary conditions for the continuous generation of synergies, and its transformation, in a productive process originated from this synergetic capacity.

The implementation of local systems of innovation – organizations directed to developing activities based on new technologies are being used as an instrument for the local and/or regional economic development. They possess distinct nomenclatures, depending on aspects such as location, cooperation between companies and universities, administrative notion, insertion in the enterprise, and insertion in the city and region (ALVIM and CASTRO, 2005).

In the face of this evidence, Stainsack (2003) claims that technology parks are generally characterized as companies reunited in a common location, and tied to a university campus – within its space or next to it. In these enterprises, there is an administrative and coordinative entity responsible for facilitating the integration between university and companies, and for managing the usage of the existing installations.

Thus, in order to foster the local innovative and economic development, Albuquerque (2004) says that it is indispensable to formulate mixed policies in which the measurements taken to achieve the main macro-economical balances are accompanied by actions that aim to foment existing potentialities in each territory. In this task, both the regional and the local governments must play a decisive role in encouraging and facilitating the creation of business development opportunities.

Therefore, since we consider technology parks as relevant for the development of the local conjecture, the focus of this research is to analyze the potentialities for the local economic and innovative development of technology parks that function in the Northeast region of Brazil, as well as their strategic actions to continue stimulating and supporting the creation of micro and small technology-based companies, fulfilling their mission of promoting the generation of work and income, and economic and innovative development, as well as the improvement of the region's quality of life.

2 Methodological procedures

This research has a descriptive and exploratory component. The main discussion was based on five case studies, in which we gathered information about the subject in question within the context of technology parks located in the Northeast region of Brazil. Such information served as the foundation of this article.

In order to achieve the objective of this study, we developed a research methodology in which the dimensions, variables, and its respective indicators were used as measurement tools. Regarding this, Lakatos and Marconi (2001) assert that a variable can be considered as: a classification or a measurement; a quantity that varies; an operational concept that contains or represents values; aspects, properties or factors that can be discerned and measured in a study subject.

Hence, for the development of this article, we have taken into consideration only one independent dimension (main component) to approach the essential questions that this study tries to answer, with their correspondent variables and indicators that explain the data variation, and facilitate the interpretation and simplification of the final analysis, according to the Chart 01 below:

SIZE: TECHNOLOGY PARK Economic development is complex and designed to promote local technological knowledge-based economies through the integration of scientific and technological research, with technology intensive companies and government organizations.	
VARIABLES	**INDICATORS**
Economic development and Local Development	• Support services to management of technology park; • Region's performance and profile; • City and region image ability; • Infrastructure support to local development; • Support local financial, industrial, services and hinged to the S&T Park; • Identification and characterization of innovative activities and opportunities.

Chart 01: Variables investigated. Source: Author's (2009/2010).

The research technique employed in this work, according to the objectives, involved the following steps: data gathering through the application of a questionnaire, interview, data quantification, and processing and analysis of the collected data.

We gathered the primary information by applying a structured questionnaire with one main approache – economic development. To analyze them in this study, the instrument was divided in two parts:

Part 1: Characterization of the technology park;

Part 2: Economic development and local development;

Part 3: Innovative activities.

For the execution of the research, the data was organized, selected, and put aside in similar groups according to the desired objectives of each research variable, in order to facilitate the examination and interpretation of the results.

In general, the data analysis is a process that involves many procedures and statistical analysis that requires data interpretation. This interpretation aims to establish the connection between the obtained results and other results from theories or previous studies (GIL, 2006).

3 Results presentation and analysis

This topic demonstrates the results of the research, applying the techniques specified in the methodology section, with inferences based on the primary and secondary data, alongside the research form, semi-structured interviews, and inventory of the obtained results with its respective theoretical references. For better comprehension, this chapter is divided into two topics: the first describes the technology parks, and the second presents the potentialities for the local economic and innovative development, focusing on the items addressed in the questionnaire, and in the semi-structured interview.

3.1 Description of the technology parks

To describe the technology parks in this investigation, general information was obtained from the semi-structured interview, as well as from the material offered by the administrators of each organization.

3.1.1 NUTEC

NUTEC, that began its activities in 1979 tied to the Department of Science, Technology, and Superior Education (SECITECE), has the following mission: "To seek technological solutions for a sustainable industrial development that benefits society".

3.1.2 PORTO DIGITAL

Porto Digital is the result of an environment of innovation consolidated in Pernambuco in the last decades with coordinated efforts of the university, the productive sector, and the government, intending to put the Information and Communication Technology industry in the economic core of the State of Pernambuco.

3.1.3 PARQTEL

ParqTel was created over ten years ago by the Pernambuco government to assemble technology-based enterprises of electrical and electronic sectors.

3.1.4 PaqTcPB

"Promoting the innovative entrepreneurship within the State of Paraíba, supporting the creation and the progress of technology-based companies and social enterprises, through the appropriation of knowledge and technologies generated in the R&D organizations, and the insertion of products, services, and processes in the market.

3.1.5 SergipeTec Sergipe Parque Tecnológico

Its mission is to promote entrepreneurship, seeking innovation, competitiveness, and generation of knowledge, work and income for the State.

3.2 Potentialities for the local economic and innovative development

The information about technology parks economic and local development was divided in regional profile and innovative activities. About this, Zouain e Plonski (2006) say that this indicates the technology parks contribution to regional development, stimulating the local economic activity by creating and rapidly developing companies, increasing commercial and exportation activities based on products and services of high aggregated value, and generating job opportunities and income for qualified professionals.

The regional profile is presented in two degrees of comprehension with regard to the level of agreement of the technology parks researched. On one side, we have answers about the profiles of companies, institutions, and conglomerates able of generating knowledge, technology, and information in connection with the technology parks disseminated in the region; and, on the other hand, there are answers about the existing conditions for local economic development, with the presence of favorable conditions for the companies installed in the technology parks.

About the profiles of companies, institutions, and conglomerates, we can see, according to Table 1, that most of the technology parks, including NUTEC, Porto Digital, PaqTcPB, and SergipeTec, agree that, in the region where they're inserted, there are companies in the same field of the technology parks, diversity in the region's industrial structure, possibility of institutional support from alliance networks favoring the parks, institutions able to stimulate the flow of knowledge and technology between the parts involved, agglomeration of companies involved with the technology offered by the research institutions, and work force with medium and superior education in the area.

Table 1: Region Profile

	Degree of Agreement	
Region Profile	**Average**	**Classification**
There is presence of peer group in the park's operational actions	4	Agree
There is diversity of industrial structure in the region (presence of companies from different segments)	4	Agree
There are local presence of large companies	3	Neither Agree Nor Disagree
There is presence of innovative companies that produce products and technological services of high added value locally	5	Totally agree
There is the possibility of institutional support networks alliances in the park's favor	4	Agree
There are institutions that can stimulate and manage the flow of knowledge and technology between research institutions, companies and markets	4	Agree
There are low transaction costs in the region	3	Neither Agree Nor Disagree
There are cluster of firms directly involved with technology provided by research institutions	4	Agree
There is availability of local skilled labor (higher level)	4	Agree
There is availability of local skilled labor (middle level)	4	Agree
Average	**3**	**Neither Agree Nor Disagree**

Source: Direct Research, 2009/2010.

This degree of agreement is evidenced specifically by each technology park. NUTEC tells that it is the result of an environment that stimulates the creation and development of companies and products, specially the knowledge innovative and intensive ones. This environment offers to emerging companies and research teams elements such as physical area and infrastructure, companies in the same field, and services to support and create synergy within and outside the enterprises. It also potentializes the process of creating, attracting, and fortifying local and regional innovative companies, particularly developing those economical sectors with growth vocation and potential.

Porto Digital, that has the mission of becoming one of the main actors in Pernambuco's economy, says that the regional profile of the companies, institutions, and conglomerates increases the technology information pole interaction with other productive sectors of the State, strengthening the competitive edge of the companies installed in the technology park. In this sense, it is considered a valuable asset for the State, with the potential to contribute to the development of the efficiency patterns and competitiveness levels of all economic sectors, because of ICTs transversal characteristic. As such, Porto Digital aims to promote the exchange of knowledge and information/communication technology innovation solutions generated in the environment for other productive chains in the State of Pernambuco, with the intention of promoting integration between productive chains, guaranteeing their condensation, as well as the ICT's itself.

PaqTcPB tells us that it is a non-profit organization that seeks to achieve scientific and technologic development, and to promote innovative entrepreneurship in Paraíba. It was by promoting the articulation between partners, and between the many knowledge chains and productive activities, that the institution has searched for new ways of attracting and fixating competencies in the State. That is, each year new business projects are accompanied, which augments their chances of growing with the technical and managerial support accessible to each company.

SergipeTec says that, according to this assertive, it attracts technology-based companies aiming to establish them in the park, through activities of divulging and promoting; stimulates the entrepreneurship of technology base in the State, favoring the creation and development of new companies, according to the incubator model; and promotes the integration of the scientific community with companies and market, aiming to create a complete cycle for developing technology-based products and services.

Allied to this resulted, there's the technology parks agreement that there is work power with medium and superior education levels in the region. In this sense, NUTEC, Porto Digital, PaqTcPB, and SergipeTec all possess the same opinion, that it is necessary to have professionals that fulfill the market's demands and are up-to-date with the tools and methodologies necessary to optimizing the productive processes of technology-based companies.

It is important to stress that ParqTel disagreed with all this information about the profile of companies, institutions, and conglomerates, justifying that it is currently, according to its manager, an unfinished/interrupted project, because, among other factors, of changes in the State's government orientation in the administrative term.

Oliveira (2003) and Joyal (2002) say that this result about the profile of companies, institutions, and agglomerations, as well as the existence of qualified work force, brings up the main characteristic of the technology parks administration, which is stimulating the formation of new companies in cutting-edge sectors, and the attraction of companies specialized in advanced technologies; revitalizing traditional regional industrial sectors by incorporating the region and new technologies; promoting the business vocation and qualified work of the region; and favoring the region's technological independence by internally generating new advancements and technologic applications.

Add to this the statement from Buarque (2002), who says that the promotion of the local development must be structured in at least three pillars: society organization, which contributes to forming the local social capital (i.e., the local society's organization and cooperation capacity) combined with the formation of institutional spaces for negotiating and administrating; value aggregation in the productive chain, with the articulation and augmentation of the economic activities competitiveness with local advantages, and

the restructuration and modernization of the local public sector as a way of decentralizing the decisions and elevating the efficiency and efficacy of the local public management. All this associated with some form of distribution of social assets, particularly knowledge, expressed by education and technologic capacitance. Therefore, changes are a result of these three processes, and the resultant synergy in the social sphere makes the local development in a solid and consistent fashion possible.

About the existing conditions for the local economic development, we can see that, according to Table 1, there's general neutrality, i.e., the technology parks do not agree nor disagree about the presence of large enterprises, with the exception of Porto Digital, that says that the region is mostly composed by small and medium companies. However, multinationals such as Motorola, IBM, and Microsoft are also present in the region with their regional offices (Motorola and Samsung actually have partnership agreements with C.E.S.A.R for developing softwares for mobile phones). And there are low transaction costs in the region.

With this result, we can see that, with few exceptions, the regional profile with regard to the existing conditions for the local economic development leaves much to be desired in the technology parks researched, as well as in their installed companies, independently of the positive performances shown. Thus, Brazil's Northeast region as a whole, in which the technology parks are installed, makes it impossible for a general satisfactory result regarding the regional profile of the parks researched.

This can be verified with the statement of Galvão and Vergolino (2009) about the Northeast region. They assert that, throughout the 1990s, the effects of the commercial opening for the Brazilian regional development have been very distinct. In the Northeast, with the possibility of importation, the introduction of new technologies in intensive work force industries, and the production of better quality products, were necessary conditions to avoid more and more the technological distance from the Central-South regions of Brazil. However, we must say that the Northeast region is still relatively behind when compared to the South and Southeast regions of Brazil, despite of the differentiated growth experienced in some expansion areas. This regional inequality is resultant of the different productive structures of each region, and the processes by which they are integrated to the national and international markets. The way in which this process occurs reflects in the Brut Intern Product (BIP) division between Brazil's regions, which can bring huge difficulties for the States performances in trying to diminish regional differences.

Hence, Sicsú and Lima (2009) asseverate that it is important to strategically reflect about the possible emergence of a new development pattern with innovation and value aggregation, reducing the distance that still separates the Northeast region from the national average. In this sense, the S&T dimension and innovation are indispensable, and must play a central role in the development process alongside a number of other strategic factors.

As a result, the consolidation of the Northeast region in a structured segment of science, and specially technology, can give support to strategic sectors of the economy and be a great attractive of new segments for the regional production and service provision sceneries, which consists in a great opportunity to promote the dialogue between private initiative and public power in order to develop the region. To be exact, captivating the interest in acting in projects that generate revenue and are perfectly integrated with the urban planning (infrastructure of transportation, telecommunications, commerce, industry, housing, and services in general) for the regions in which they are inserted.

It's in this context that the technology parks constitute an important alternative for the local economic and innovative development, since, according to the results seen so far, they reunited conditions to identify regional economic potentialities and contribute to the technologic innovation, where innovative companies or knowledge intense ones can be delimitated or, according to more innovative tendencies, widespread in the region.

Innovative activities in incubated and/or installed companies in the technology parks are identified in degrees of importance of internal and external R&D activity, acquisition of other external knowledge, software acquisition, acquisition of machinery and equipment, and introduction of technology innovations in the market, according to Table 2 that follows:

Table 2: Innovative activities

	Technology Park	
Innovative activities	n	%
Importance of internal P & D through business incubated and / or installed so far held		
High	4	80
Average	1	20
Importance of acquiring external R&D through business incubated and/or installed so far held		
High	2	40
Average	3	60
Importance of acquiring external knowledge through of the incubated companies and / or installed, held so far		
High	2	40
Average	3	60
Importance of acquiring software through business incubated and / or installed, held so far		
High	2	40
Average	2	40
Low	1	20
Importance of acquiring machinery and equipment through the incubated and / or installed, held so far		
High	4	80
Average	1	20
Importance of the introduction of technological innovations in the market through business incubation and / or installed to date		
High	4	80
Average	1	20

Source: Direct Research, 2009/2010.

About the importance of internal and external R&D activity, the biggest emphasis is in the internal activity, according to Table 2, with most technology parks, among them NUTEC, Porto Digital, PaqTcPB, and SergipeTec, agreeing that the importance of these activities is high for the development of innovative activities in the incubated and/or installed companies. And the external activity has medium importance among the incubated and/or installed companies of NUTEC, ParqTel, and SegipeTec. It is important to point out that the technology parks administrators were asked to give a description of the internal and external P&D activities, but this item was not answered because of limitations in obtaining more detailed information from incubated and/or installed companies, despite the fact that their commitment to giving biannual general data about their programs, projects and activities' performances.

This result highlights what Kim and Nelson (2005), and Ortt and Smits (2006) affirm about two models of technologic innovation: linear and interactive, introducing knowledge as a dynamic and inter-current element in all phases of the process, and considering that technology innovation in incubated and/or installed companies in the technology parks are not related only to invention, production, and commerce, but to a continuous social process involving activities of management, coordination, apprenticeship, negotiation, investigation of the users' needs, acquisition of competences, managing the development of new products, financial management, etc. Tidd, Bessant, and Pavitt (2008) complement saying that, in practice, innovation constitutes a process of parity and adjustment that sometimes takes the pulled form, and sometimes, the pushed one, and requires, thus, a successful innovation, i.e., an interaction between internal and external R&D activities.

ParqTel considers medium the importance of the internal and external R&D activity, because, according to its administrator, since the park does not have incubated companies, innovative activities are developed by each company individually and in isolation; despite that, its companies incorporate the R&D process as a tool for obtaining innovative and commercially competitive products and processes. And in the external

R&D activity, they have a partnership deal with Porto Digital for developing technologies in the urban mobility area, with the automobile chip.

According to this reasoning, in conformity with external R&D activity, the acquisition of other external knowledge has a medium degree of importance among the incubated and/or installed companies at NUTEC, ParqTel, and SegipeTec, as we can see in Table 2. This way, according to Takashi and Takashi (2007), new ideas, products, and processes converted in innovative activity can emerge from challenges, natural or provoked, of the organizations internal and external environment, and must be canalized properly, so that they result in the improvement of methods, routines, and organization, i.e., the essence of fast processes in technology development (BIANCHI, *et al.* 2010).

About the importance of software acquisition, Table 2 shows that Porto Digital and PaqTcPB consider high the importance of this acquisition, ParqTel and SergipeTec consider it medium, and only NUTEC attributes a low degree of importance to it. This result is justified by the incubated and/or installed companies' preoccupation in observing software consumer market tendencies, perceiving the receptivity of products and services offered, and identifying innovation opportunities, as well as concerning about adjusting to the performance area of the park in which it is inserted. According to the administrators of Porto Digital and PaqTcPB, that consider high the importance of software acquisition, we can highlight among the ICT segments the production of management softwares, solutions for financial and health systems, games, security sector softwares, administration systems for traffic and transportation, software usability, and integrated solutions for portal development, extranets and intranets.

About the importance of acquisition of machinery and equipments, according to Table 2, most technology parks, among them NUTEC, Porto Digital, PaqTcPB, and SergipeTec, affirm that the acquisition of machinery and equipments is high for the development of innovative activities in incubated and/or installed companies, proportionating a functional and well-equipped environment. In this sense, the innovation process is also determined by the ability of coordinating these technical resources, with the objective of supporting the generation of new ideas to improve products and processes, and creating new knowledge. ParqTel does not share this opinion, because, according to its administrator, the importance of this acquisition is medium, since the installed companies already possess the machinery and equipments necessary for the execution of their activities, and it is not necessary more investments in this aspect.

About the importance of the introduction of technologic innovations in the market, most technology parks, among them NUTEC, Porto Digital, PaqTcPB, and SergipeTec, attributed a high degree of importance to introducing new technologies in the market by the incubated and/or installed companies; only ParqTel informed that this importance is medium, according to Table 2. This result has two justifications: the first one is from the point of view of the park itself, that admits in its environment essentially technology-based companies; and the second one, from the perspective of the incubated and/or installed companies themselves, in which the dynamic of the technologic innovation process depends, according to Ferguson and Olofsson (2004), and Hindle and Yencken (2004), more on the knowledge learning processes tied to interactions between organizations and agents, allowing the generation, reproduction and retro-feeding of learning processes and their conversion into innovative activities.

Generally speaking, this result is verified according to the assertion of Tid, Bessant, and Pavitt (2008) about technologic innovation. According to them, the success in introducing technology innovations by incubated and/or installed companies at technology parks consists in its management, which consists in the perception of internal and external environment, strategic selection of potential innovations to be developed, use of resources available for the innovation to be developed and implemented, and reflection as a way of contributing to the apprenticeship through the experience. Chiaroni, Chiesa, and Frattini (2010) also say that it is in the introduction of technologic innovations in the market that companies will discover the business models more suited for commercializing the technology. In other words, it is the practice of establishing relations with the external environment that one commercially identifies the innovation opportunities.

4 Conclusion

Technology parks are innovative environments. As such, instruments implanted in development and developing countries make regional and national economies more dynamic, adding knowledge and technology innovation to them. In this research scenery, we noticed that all five studied parks promote the innovation, competitiveness, and business capacitance growth culture, based on the transference of knowledge and technology via interaction among its actors in the environment in which they are inserted.

Generally speaking, the research results show that there are potentialities for the local economic and innovative development of the studied technology parks. This result is based in two groups of specific questions (characterization of the technology parks and local and economic development). The whole analysis performed in this article ensures that the objective was reached throughout the research, in which we demonstrated the potentialities for the local economic and innovative development. In this sense, we noticed, based on Zouain (2003), that the five technology parks researched have the following common traits:

a) They are initiatives placed in physical areas in which innovative and knowledge-intensive companies are located;

b) They help to integrate innovation incentive public policies in their incubated and/or installed companies, contributing to the growth of competitiveness in the regions where they are inserted;

c) They propel the creation of innovative companies, intensive in knowledge and new technologies, usually derived from research and educational institutions located nearby;

d) They promote the interaction of these companies with educational institutes, research and technologic development centers, and organizations that deal with information;

e) They contribute to the economic development of the region in which they are inserted, making the local economic activity more dynamic with the formation and fast growth of companies, and more commercial activities based on products and services with high segregated value;

f) They help to divulge a new entrepreneur and innovative culture in the region, through a scientific and technologic base for support, in which the systematic dissemination of knowledge is facilitated by formal or informal administrative structures.

Hence, it is noticeable that the five technology parks studied are important environments, propitious to the innovation that promotes economic and innovative development in the region in which they are inserted. And, despite having some limitations, they guarantee support and have basic conditions for the emergence of enterprises based in new technologies that, as such, must make possible many connections with the involved actors in order to contribute to the development of the technology park as whole.

Although this study proportionates an analysis of the potentialities for the local economic and innovative development of technology parks located in the Northeast region, results found do not generalize the current situation of the operating Brazilian technology parks, nor generalize questions concerning the local economic and innovative development of these enterprises, because, apart from studying just five cases, the research was restricted to the Northeast region, which, according to what has been said before, is the least favored with regard to the consolidation of innovation habitats if compared to the South and Southeast regions of the country. However, this study brings important contributions in the legal, socio-economical, and institutional spheres to the study of the technology parks operating in the Northeast region, since until now no specific research had been produced about all these enterprises.

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