

Views and Propositions on Guarulhos Innovation System

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Abstract

Aware of technological innovation as a source of sustainability, the city of Guarulhos endeavors to organize an innovation system. In order to do so, is necessary to evaluate the existing initiatives and efforts, such as the Company Incubator and Technological Park, entering, thus, the need to map the economy, the academy and the scientific and technical development, showing the characteristics of the city. After studies placing the Technological Park as the most promising innovation model to Guarulhos, that was the question that governed the technical mapping “it will articulate the different sectors of economy and academic to develop an instrument anchor and to develop the local authority on basis of innovation?” From the consolidated results of the current study, the favorable numbers and the bottlenecks to be removed were identified, allowing deeper analysis regarding the Technological Park like critical part of the innovation system of the city.

Keywords: Guarulhos, Mapping, Technological Park, Innovation System.

1. Introduction

The environment for technological innovation is constantly changing (Meneses & Quadros, 2009). The most plausible solution is to invest in 'innovative' efforts, encouraging the development of higher value-added activities, accelerating the growth curve (Carvalho & Kupfer, 2007). Aware of this scenario as a source of sustainability, the city of Guarulhos endeavors to organize an innovation system. In order to do so, it is necessary to measure the existing initiatives and efforts, such as the Incubator and Technological Park, entering, thus, the need to map the economy, the academy and the scientific and technical development in order to highlight the characteristics of the city.

After studies placing the Technological Park as the most promising innovation model for Guarulhos¹ (Zouain and Plonski, 2008) and considering the approach of national innovation system, which stands organizations, institutions, and the process of articulation as constituents, the paper aimed to answer "how to articulate the different sectors of the economy - public and academic - and to produce tools for the city development based on innovation?".

From the consolidated results of the current study, favorable elements, the bottlenecks to be eliminated, and the potential for alignment between the academy and the production were identified, enabling deeper analysis regarding the Technological Park as a critical part of the innovation system of the city.

¹ Project Development of a conceptual model of environmental innovation for the city of Guarulhos. PMG / PGT-USP

Regarding Guarulhos, it is known for its industrial and economic diversity, with strength and national recognition in industry, services and trade sectors. However, its greatest strength is in the industry, which has great productive capacity in various sectors.

In another sphere, it is observed that the academy still needs to grow and adapt to the movements of the local economy, being necessary to develop a scientific and technological basis, committed to the growth of labor-skilled work force.

Based on these principles, this paper presents data on Guarulhos and directs them to an analysis determining the active demand for the technological park, suggesting a response to mainstream educational institutions and businesses, allowing companies in the region to innovate more on their processes and products.

The paper is divided into six parts, starting with the theoretical framework and methodology. Continuing the paper, the economics aspects of the city are presented, where the industry innovation and characteristics, the services, Guarulhos Incubator and profile of city workers are exposed. Then, the academic profile of Guarulhos, with figures for teacher qualification and the courses offered in the city as presented. The fifth part of the paper answers the question "how to articulate the various sectors of the economy, public and academic and develop tools for the city based on innovation?" As a final step in tackling the paper, it shows considerations about the study.

2. Theoretical

The city of Guarulhos, given its importance, needs further studies on its socioeconomic profile. However, in recent years, it is possible to find some studies relating to innovations happening in the city, as an example, Guarulhos Technological Incubator, in addition to studies and mapping done by the Center of the Technological Park of Guarulhos.

The mappingⁱⁱ (Damião, Aguiar and Rabelo, 2011) identified the profile of Guarulhos Innovation System. It was observed, and it is composed of companies from several sectors and sizes, educational institutions, mostly private ones, with recent entry of public institutions, and large state and federal governments' incentives and municipal support to the initiatives as Incubator and Technological Park. From this overview, the concept of Guarulhos technological city.

Earlier literature also lacks a comprehensive exploration of the possible relationships between the innovative activities and the problems faced by innovation system. An innovation system involves people, knowledge, technology, infrastructure, creation and learning cultures which it work and which new ideas they are experimenting with (Cassiolato, Lastres and Maciel, 2003). Each regional or national innovation system evolves its own set of laws, regulations and cultures. (Edquist, 2005, 2008). The innovation system concept developed for Guarulhos is based on studies of Borrás and Lundvall (2005). This study argues that the major objectives of innovation policy are economic growth and international competitiveness. It also seeks to solve sustainability issues related to pollution, energy, urban planning and social indicators, and, at the same time, focusing in the creation of economic wealth. This policy covers a wide range of initiatives and it is necessary to structure this complex reality.

In essence, the introduction of the technological park into innovation system can provide significant benefits including to enhance the different actors of the city of Guarulhos and promote economic development, contributing not only to requalify its industry, but for socioeconomic development with influence in the region.

3. Methodology

Given the need for further development on the subject, a methodological case study template was applied (Yin, 2001), which is a research strategy that represents a way of investigating a topic empirically by following a set of pre-specified procedures, namely: documents, files, interviews, direct observation, participant observation and physical artifacts analysis.

ⁱⁱ Report of the documentation of the accreditation São Paulo System Technology Parks (SPTec). AGENDE / PMG

Indicators of value added, GDP (Gross Domestic Product), patents, business and human resource access and management of databases (IBGE / RAIS / SEADE / PMG / INPI) were collected as a structure to economic data. Companies that invest in innovation to its plants were surveyed by socioeconomic, technological, scientific, environmental and local infrastructure platforms and priority activities to be benefited. To reach the results on the development of technical and higher education, primary research interviews and structured questionnaires, field observation visits to educational institutions, and use of INEP database were made.

4. Economic Characteristics

According to the SEADE (State System of Data Analysis) classification, the city of Guarulhos is characterized as a multi-sector city, i.e., it has a highly complex productive structure, and a constant growing services sector. Despite all the diversity in Guarulhos, there are segments that demonstrate stronger economic influence, as for the pharmaceutical, metal-mechanic and logistics segments, being selected as priority activities for Guarulhos Technological Park.

The pharmaceutical sector, alone, has the highest value added tax (VAT) industryⁱⁱⁱ, with the amount of R\$ 2,828,340,134 - for the year of 2009. However, taking into account the metal-mechanic, where companies are grouped machinery and equipment, vehicles and transport equipment, metals and metal products, value added tax reaches R\$ 5,067,798,503. The service sector, which fits logistics, has a VAT of R\$ 4,571,845,250. These indicators show that the industries have a production with higher added value and/or contribute more than the service sector. Also, it must be considered that the service sector has little impact in VAT, because it does not include services under municipal tax, because they are not subject to ICMS (State Value Added Tax on Services and circulations Goods), but to the ISS (Municipal Service Tax) - as municipal public transport, consulting, construction, among others. Regarding Value Added^{iv} (inputs - costs), the participation in the service sector is of 67.66% in the city.

The city of Guarulhos is a strong player in the national economy, placed as the 8th largest city in the country by the GDP criteria, and also for its strategic location, located in Greater São Paulo, the most dense and rich metropolitan area in South America .

The Gross Domestic Product (GDP) of the municipality follows a steady trajectory; the cumulative percentage of participation is 28.72% (Graph 1). This behavior clearly shows that Guarulhos entered a sustainable growth path, based on its industry and the growth of the services sector.

Referring to these economic data, three platforms were created for initial research on developing technological park, being:

- i. Platform of life: encompasses the areas of biotechnology, medicine and pharmacy;
- ii. Platform mobility: logistics and information technology;
- iii. Structural Platform: metal-mechanics, electronics, new materials and nanotechnology.

Analyzing AGENDE (Damião et al., 2011), using the tax incentive laws as source (*Lei do Bem*: 11.196/05), government funding (FINEP), and companies in the city, it was found that innovation is present in the pharmaceutical, chemical, auto parts, food and clothing articles companies, with investments that can be only seen in large companies and start-ups as the Incubator companies, all of that technology-based.

The most significant investments are in companies of high and medium-high tech. A portion of innovative companies enjoys tax incentive laws and funding agencies to finance their processes and innovative products. However, a considerable amount of them makes use of its own resources to innovate, or do not know the methods of investment for innovation and do not innovate due to the high costs of these processes.

One way to measure innovation in a particular location is by the number of patents generated by that locality. Using the index of patents from the National Institute of Industrial Property - INPI as meter, it was found that the numbers of Guarulhos follow a positive trend, despite some fluctuations.

ⁱⁱⁱ Series of industry value added tax - SEADE. Economy - Information Municipalities of São Paulo.

^{iv} Gross Domestic Product of Municipalities – IBGE (Brazilian Institute of Geography and Statistics). Gross Value Added Services. 2009 Ref.

In 2005, 35 requests were made patent; in 2006, that number jumped to 65, resulting in a variation of 85.71%. During the study period - 2005 to 2010 - it was verified that after this leap, requests maintained an average of 63.67 patents, with a peak in 2008, where 89 patents were applied (Graph 2). In addition to the patents as a form of intellectual property protection, other means of protection were also considered, such as the brand, which is the most used mean to protect property intellectual and industrial secrets in Brazil according to PINTEC (Research Innovation) 2008 IBGE (Brazilian Institute of Geography and Statistics), a common practice in important sectors producing intermediate economies.

4.1. Guarulhos technological incubator

Considering the economic results, the city of Guarulhos, responds by placing second in the state of São Paulo, with a strong industry and wide range of services. To maintain and sustain this reality, it is necessary to develop strategies that allow maintaining their vocations and seeking innovative ways to grow. In this context, we designed a model of innovation system that includes various activities and assets. In this design, innovative entrepreneurship is encouraged by emerging technology businesses, in which the entrepreneur must employ significant efforts, through technical expertise to develop his product or process.

Guarulhos Incubator was born with the aim of stimulating innovative entrepreneurship and today has become a key asset for the local innovation system, providing knowledge transfer, tools, resources and management technologies to bring the business market.

Meanwhile, representative bodies such as the SEBRAE-SP (support service to micro and small companies) successfully offer support to initiatives Technology Based Incubators, providing resources for the administrative structure of the businesses and their product and / or process.

The incentives are due to the fact that the technology-based incubators play a key role in the success of innovative businesses (developed by incubated companies) that lack initial bases to develop a competitive market structure.

Of course, support for businesses must be carefully structured and conditioned by the development of entrepreneurial skills, with control conditions that are flexible and practices prescribed by specialists in business development.

In this aspect, the lifecycle approach is essential, since it has as goal to empower each stage of the incubation period. Not advocating, therefore, a unique approach without differentiation for companies, instead, an approach that allows prescribing skills in terms of the set of knowledge (know), skills (know-how) and attitudes.

Within the context of Guarulhos Innovation System, the incubation of technology companies is a key asset. Thus, the AGENDE (institution in charge of incubator administration) technical team carried out studies with the goal of establishing a satisfactory answer to this demand. The Ready to Live Program - PPV is structuring a system to manage the entire process of incubation of companies, being based on lifecycle approach, maturity models and management skills, as possessing the skills necessary to establish goals for each phase of the period incubation and their level of maturity.

Considered the embryo of Guarulhos Technological Park, the Incubator has created more than 200 jobs in the region. It currently has 24 companies, divided into residents and nonresidents.

4.2. Guarulhos innovation system

About Guarulhos Innovation System (Figure 1), it can be considered as incipient, because the articulation is not systemic. In the other hand, there is a great potential since is configured by large companies that develop innovations, with a consolidated facility characterized by educational institutions, recent uprising of private and public institutions and strong support of the Government in innovative initiatives such as the Technological Incubator and Technological Park projects.

4.3. Human resources

Using RAIS (Annual Social Information Report), 2010, as reference, and the relationship between degree of skill and technology intensity as a criteria, the profile of Guarulhos professionals was defined. The profile of workers is overwhelmingly - more than 70% of total employees in 2010 – technical (Graph 3).

There is also the low number of highly qualified professionals (masters and doctors), represented by only 0.1% of all workers. These professionals are concentrated in segments of low and medium-low technology intensity, the latter being related to public administration professionals and teachers of graduate and postgraduate courses.

The highly qualified professionals of high-tech companies are allocated to economic sectors: pharmaceuticals, electronics and appliances for measuring, testing and control, and doctors are present only in the pharmaceutical sector. In the medium-high technology intensity, most masters are linked to the sector of parts for motor vehicles and doctors are in chemical companies.

5. Overview of Technical and Higher Education

In the city of Guarulhos there are 12 institutions of higher and technical education belonging to public and private spheres, being 2 Universities, 1 University Center, 1 Federal Institute, 6 colleges and 2 technical schools. These institutions have been studied in regards to evolution of ownership of teachers and courses offered. *EACH – USP Leste* (University of São Paulo – East Campus), was also considered in this study for its proximity, contributing to the scientific scenario.

Regarding ownership, significant improvements were seen in relation to the migration of graduates and specialists teachers to master teachers and doctors.

In graph 4, you can see the total number of teachers in educational institutions around Guarulhos and by degree of specialization. Below (Graph 5), there is the list of doctor teachers, comparing the number of doctors with and without the *EACH-USP Leste*.

In this case, there is a significant drop in the number of doctors compared to the previous graph. However, the high demand of students in the city and surrounding area allows for greater investment in quality education in the region, contributing to the gradual increase of this scenario, a fact that is already happening.

In Figure 6, there is a proportional comparison of graduate teachers, specialists, masters and PhDs teaching in Higher Education Institutions of Guarulhos (HEI) and weighted by the number of surrounding residents. That item is important to note that a lower absolute number indicates higher concentration of professionals.

The total population of Guarulhos, according to the last Census of IBGE, is 1,222,357 inhabitants, which is the number used as reference for the preparation of the graph.

The graph shows closeness in the number of Master Teachers and PhDs in the region of Guarulhos, making a very important aspect that reflects directly on the quality of educational institutions in the region.

In Figure 7, a comparison of the number of inhabitants by PhDs professors is made with and without the *EACH-USP Leste*. There is a high drop compared to the two numbers. However, Guarulhos is a municipality that intends to rapidly expand science and technology, a fact that provides a favorable environment for the creation and expansion of higher education. Developments in the scientific and technical densification of the city will increasingly increase the number of highly qualified professionals in the municipality HEI, leading to gradual improvement of this situation.

Regarding the area of knowledge of the higher and technical courses in Guarulhos, they are distributed as follows (table 1):

As can be seen, it is evident that most courses are in social area. However, one should take into account the health sector of Guarulhos develops considerable amount of theses and research, along with the field of Geosciences. Also, the knowledge areas that concentrate more research groups in the city with funding support agencies are human, health sciences and earth studies.

However, the reformulation of the Innovation System aims to increase the number of courses in Engineering and Exact Sciences in the city, forming a harmonic balance between courses offered and thus meet the demands of companies in the region. The creation of Guarulhos Technological Park is also a factor that will contribute to the acceleration of this process, so the demand for professionals in these fields of knowledge tends to increase as a result of the Park, which will create new jobs that require this type of training.

In 2010, the city of Guarulhos offered 255 courses of specialization, namely technical level, graduate, specialist, master's and doctorate in response to the demand from local and surrounding counties, such as Santa Isabel, Mairiporã, São Paulo, among others .

The number of courses offered in Guarulhos by degree of specialization in 2010 shows the following order (Graph 8):

There are a large number of undergraduate courses offered by the institutions of Guarulhos. However, the creation of Guarulhos Technological Park and recasting the local innovation system will enable an increase in demand for specialized courses *Lato Sensu* (Latin for in broad sense) and *Stricto Sensu* (Latin for in narrow sense). There are prospects for creating advanced university campus within the park, which will contribute to a significant improvement of this profile.

Below, following table shows the relationship of student's enrollments and graduates of undergraduate HEIs Guarulhos divided by area of knowledge (table 2):

As can be seen, the courses related to the field of Applied Social Sciences are the most attractive to students, and we cannot fail to observe the area is that offers more courses in the region, as seen in Table 1.

This scenario, like the others, also tends to revert to the reformulation of the Innovation System and the creation of the city of Guarulhos Technological Park, as they are directly influenced by their actions, which aim, among other things, the specialization of manpowered labor in certain areas and the creation of new jobs that eventually attract the attention of future professionals in these areas in question. (Etzkowitz, and, Andrew, 1998).

6. How to Articulate Different Economic and Academic Sectors Into Creating Tools to Enhance the Municipality Development Based on Innovation?

In previous studies and analyzes (Damião, 2009; FAPESP, 2008) it has been proven that in regions with great economic power, as Guarulhos, technological parks should be the main tool of the local innovation system. Acting as an anchor of the system, the park will allow for interaction with local industry, making them attractive for redevelopment of the technical and scientific basis.

Guarulhos Technological Park Project is the main public policy directed to the municipality innovation and to their conception were evaluated three aspects, namely:

- i. Academic: through qualifying educational institutions already established in the city, so as to search for new institutions;
- ii. Business: through the pursuit of innovation to industry and services;
- iii. Government: by supplying high impact tools with respect to the urbanization and quality of life.

Through this interaction between the various sectors of the economy, government and academia were developed some prospects for the future, as aspects of territorial intelligence, cooperation, support entrepreneurship, thickening the base of science and technology, international integration, among others. Going into the specifics, cooperation between universities, public power and companies will result in a new special envisioning that shelters research, development and innovation.

The technological park will be an important economic driver and provide, for mixed use, - from companies to commercial premises and residential blocks - increased focus on specialized services for entrepreneurs and startups, improving the environment of cooperation by both established companies and also the commitment of universities and research centers in those relationships, idealized environments with concern for quality of life, culture and entertainment.

The technological park will be completely urban and its location will be integrated with universities. There will be partnership with them to varying degrees, with the sharing of knowledge and research groups. From the point of view of social interest, the technological park will be beneficial because it will be offering specialized courses, recovering degraded public area, centers of social intelligence, increase of jobs and qualified real estate appreciation in the area.

6.1. AGENDE's academic center

Instrument of coordination between the actors of Guarulhos, the AGENDE's academic center has the formalization of technical cooperation agreements as one of its attributes, between AGENDE and higher education institutions, aiming to integrate programs and projects in the areas of research and development, management technology and innovation. The agreements also enable the participation of teachers in the Technical Committee of Guarulhos Technological Incubator, in studies of the technological park of the city and the development of joint projects of preincubation in colleges. AGENDE's academic center provides all technical support to teachers and students of institutions cooperated in innovative entrepreneurship projects and academic work within the Incubator and Guarulhos Technological Park.

As a main process of articulation, AGENDE's academic center promotes closeness and interaction between Government, Private Sector, Civil Society and Academies, developing entrepreneurial activities focused innovation. Included in these processes, there are activities that seek solutions that bring benefits to society as well as structure of government demands to be assisted by innovative projects.

With the approach of the city actors, through AGENDE's academic center, there are discussions about plans and projects to the thickening of the scientific-technical base of the city and hence the emergence of actions aimed at encouraging an environment conducive to innovation and sustainable development of the region.

These actions are based in knowledge, where the concentration and the emergence of innovative ideas gain contour with the involved experts support, and later expanded to other sectors of society.

Based on this, the following figure represents the actions included in the process of articulation of the municipality (figure 2):

As we can see, there is a synergy between all stakeholders in the innovation system of the city, with the AGENDE's academic center as his great articulator. This process allows the discussion of issues of common interest, and creates actions to improve the scientific and technical base of the municipality.

This entire process tends to become more intense with the creation of Guarulhos Technological Park, with closer and better articulation of those involved in strengthening and developing the local economy based on innovation.

7. Considerations

To speed up the innovation curve, it is essential to short the distance in the relationship between the university and business, as the various benefits such as the qualification of the demands of companies and direct application of scientific knowledge, among others.

Considering the need to stimulate innovation system, it is necessary to access the basal knowledge of the local environment and used it as a parameter in the development planning. Thus, one of the instruments was mapping economic, academic, scientific and technical aspects, in which was possible to better understand what bases are grounded in the city's economy and how academy behaves with increasing demand for knowledge-intensive labor. The survey also allowed us to analyze the dynamics of economic development of Guarulhos, showing its economic greatness with positive numbers in relation to GDP and value added. However, it is evident in this and in other studies already made the city's gap between the academic and local businesses.

Based on the results of this study, conclude that the implementation of a core organizer is part of the structuring process in the city, acting as a link between all sectors of the economy, promoting the approach and interaction of its actors and seeking together with the others involved, new tools for the densification of the technical-scientific basis of Guarulhos and its development based on innovation.

The joint preliminary structure allows a favorable environment for the Technological Incubator and Technological Park of the city, regarded as the ideal instrument to leverage the positive and address the shortcomings of the city, bringing the local economy to a new level, aligned with a new approach based on the dynamics of knowledge. Guarulhos Technological Park will also favor the company in other aspects, improving the level of higher education in the city, creating new job opportunities, requalifying manpower and, thus, contributing to increasing income with a greater amount of skilled workers, thus following a cyclic economic development.

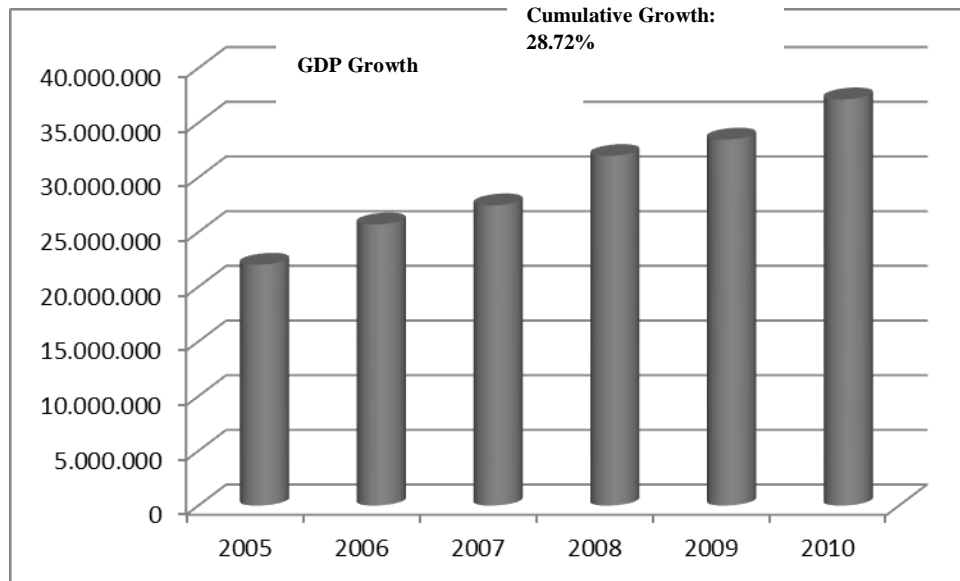
In this way, Guarulhos intends to stimulate higher education and the creation of courses that meet the demands of local production, developing the knowledge economy, thus providing an environment conducive to innovation and innovative entrepreneurship.

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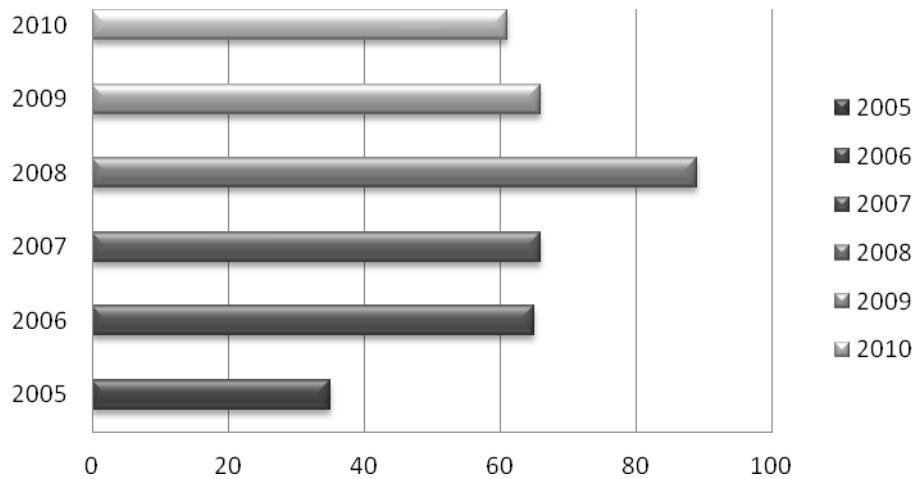
Tables and Graphs

Graph 1: GDP and growth accumulate



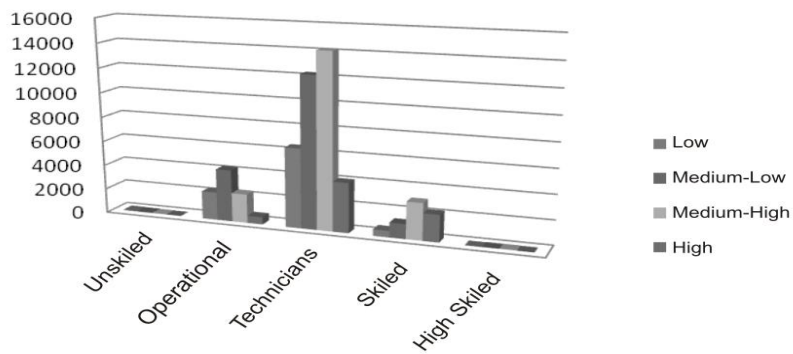
Source: IBGE / Gross Domestic Product of Municipalities

Graph 2: Patent Applications in Guarulhos



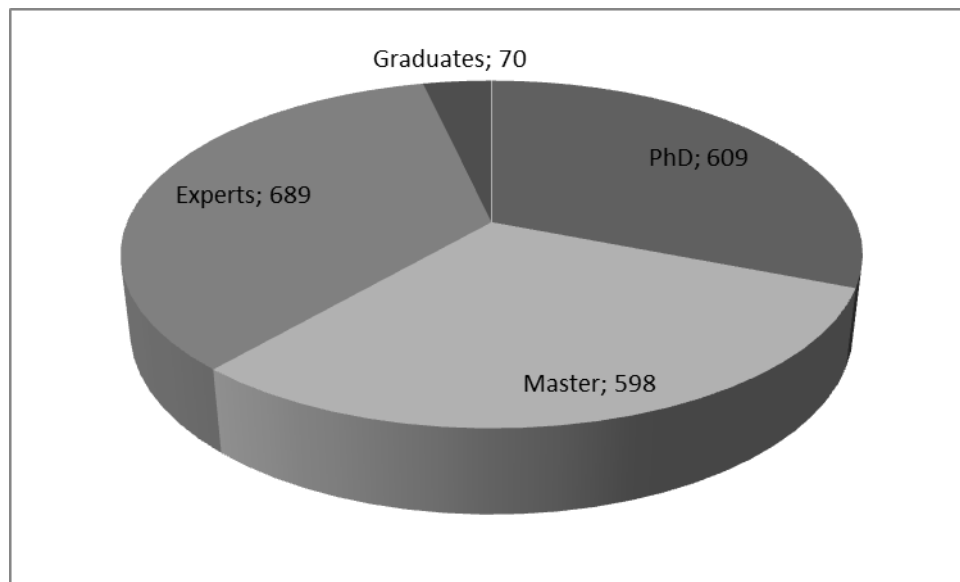
Source: INPI/ Prepared by the authors

Graph 3: Number of workers by technological intensity

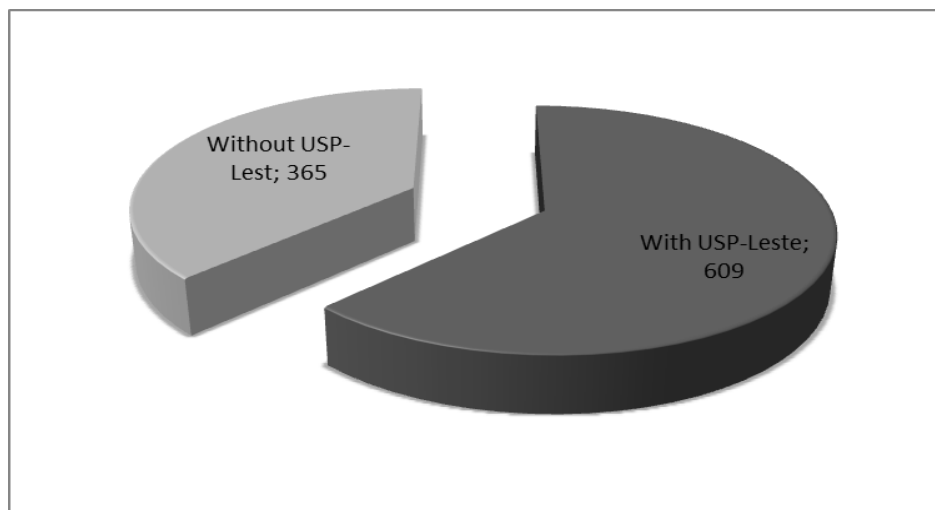


Source: RAIS 2010/ Prepared by the authors

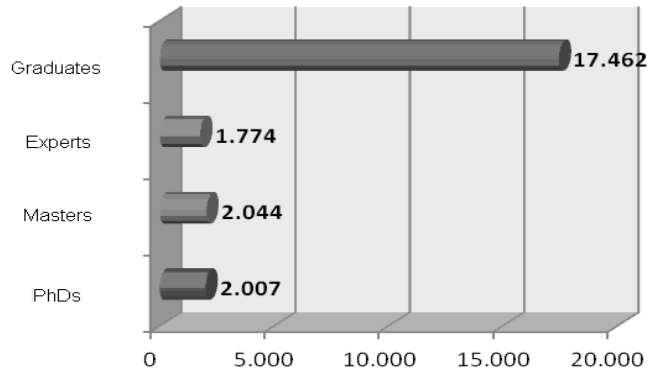
Graph 4: Titration of Teachers of Educational Institutes of Guarulhos in 2010 Including EACH-USP-Leste



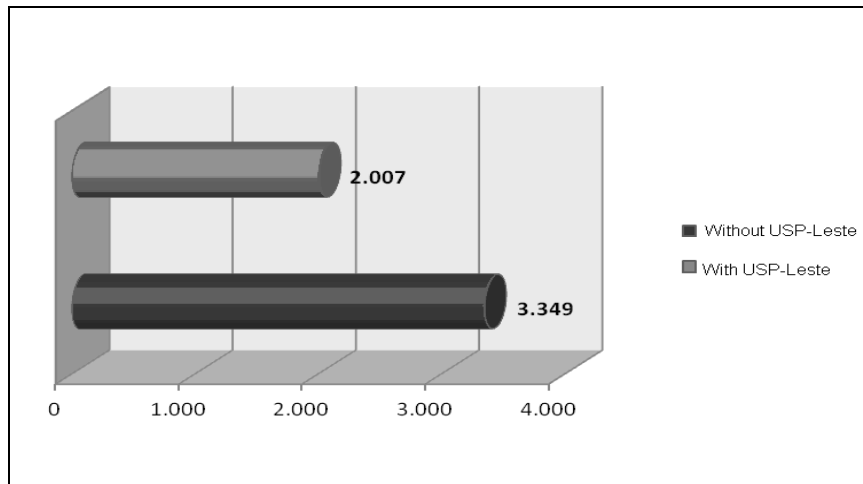
Graph 5: Number of Ph.D. professors in 2010 (With and Without USP- Leste)



Graph 6: Relationship of Teachers by Inhabitants in 2010 Considering EACH-USP Leste



Graph 7: Comparison of Ph.D. professors For Inhabitants in 2010



Graph 8: Relationship Course (Level) in 2010

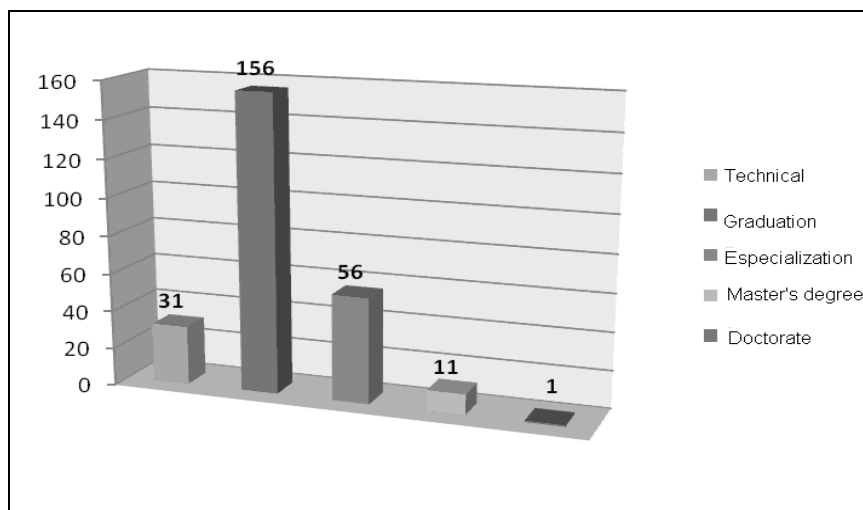


Table 1: Amount of courses offered in percentage

Courses	
Area	Amount (%)
Biological	4
Engineering	7
Exact Sciences	9
Human Sciences	14
Literature	3
Health	18
Social Sciences	45

Table 2: List of Enrolled and Graduates of the Academic Year 2010

Academic Year 2010	Enrolled	Graduates
Exact Sciences	3.476	1.725
Biological	463	139
Engineering	754	391
Social Sciences	17.461	3.240
Human Sciences	2.585	1.066
Language, literature and arts	2.114	1.448
Health Sciences	3.266	871
Agricultural Sciences	37	33



Figure 1: System Innovation in Guarulhos/ Prepared by the Authors

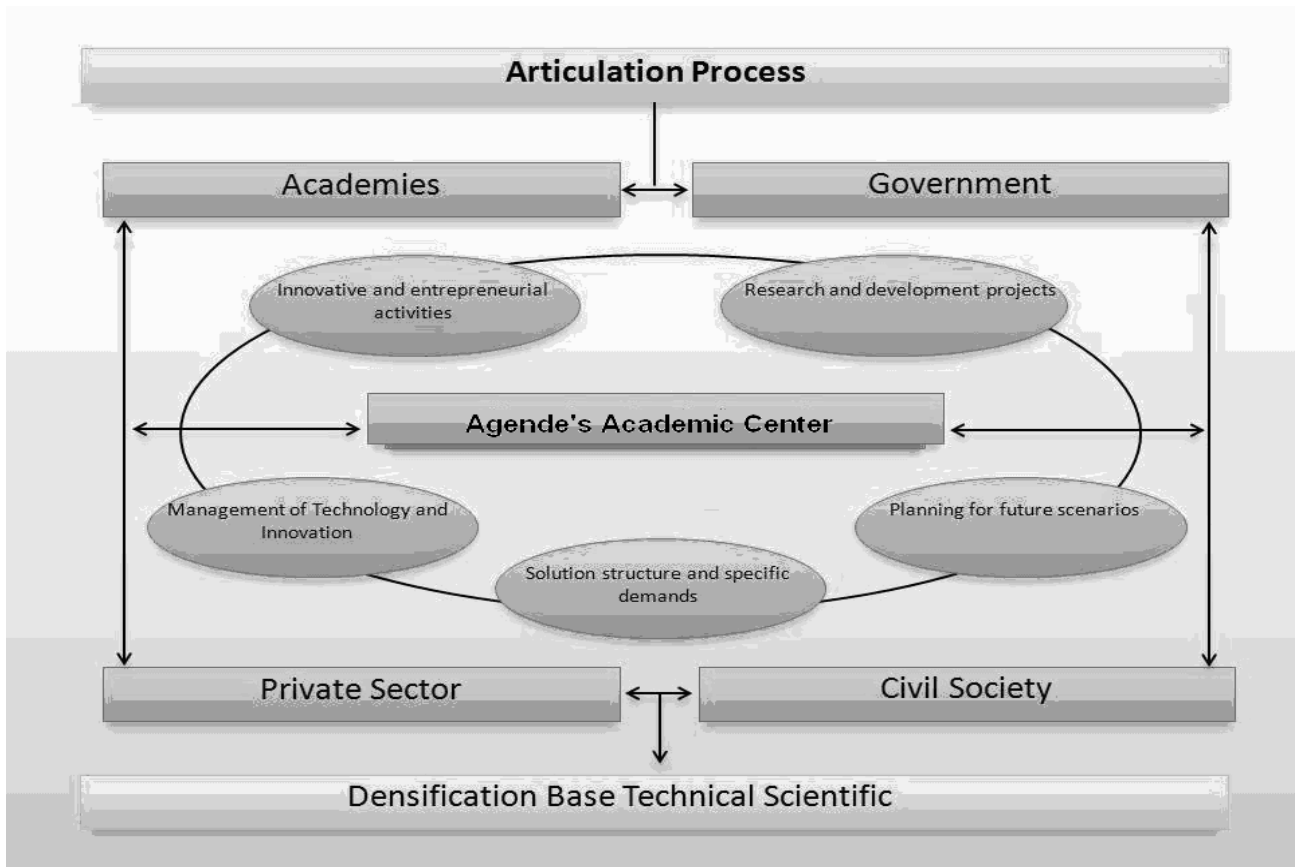


Figure 2: AGENDE Process of Articulation Core Academic