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USINESS INCUBATORS AS SUPPORT MECHANISMS FOR THE ECONOMIC DEVELOPMENT: CASE OF MARINGÁ'S TECHNOLOGY INCUBATOR

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ABSTRACT

In an environment where competition is increasingly fierce, it is essential to create an innovation system, that ranges from basic research to the transfer of developments for the companies and the whole society. To verify this process, the most of the works are using the record number of patents as a proxy, given the difficulty of measuring new products, services and process for the market. Based in incubators of technology-based enterprises, in this article this problem was overcome, by measuring their products, services and processes. Thus, we developed this work with the main objective to assess whether there is interaction between the resident enterprises in technological incubator of Maringá, external companies and university. The methodology includes a literature review on the subject, the development of variables related to incubator's characteristics, the application of a questionnaire to the companies linked to Technological Incubator of Maringá, in order to verify the new products, services and process related to research that hit the market. The results point indicates the need for facilitating the process of innovation and interaction with university and industry by developed innovations.

Keywords: Innovation, Technological Business Incubator, Technology-based enterprises, Technology Transfer, Literature Review, Patents.

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INTRODUCTION

Since the seventies, continual changes in economic dynamics have set a socioeconomic development model characterized by a dynamic and highly competitive environment in which micro and small enterprises (SMEs) have an important role in this scenario (Machlup, 1962), Porat and Rubin (1977), Perez (1983, 1988, 2002), Drucker (1986, 1993), Dornelas (2001), Bessant, J. & Tidd J (2009) and Fayet (2010).

The internationalization of the economy has been accelerated by the technological development of production, making them more efficient and productive, and traditional factors of production are giving way to a new paradigm characterized by flexibility, resource mobilization and quality management.

There is a consensus among the literature that is essential to invest in developing new technologies in order to contribute to sustainable economic development, one of the biggest challenges to transform knowledge into products and services, systematically promoting a culture of technological innovation in the society. In this sense, technological innovation is not only a process within the research and development (R&D), but a large cluster of related issues including investment policies, education and market, strategic partnerships involving the public-private space.

The articles refers to some of the different aspects that make up the economic development based on technological innovation, such as technology transfer, the process of innovation, the interaction between university, government and the productive sector and mechanisms used by universities such as business incubators. This theme was chosen because a difficulty of interaction between academia and companies is still observed, and so the objective is to assess whether there is importance in studying the mechanisms as business incubators in order to facilitate the transfer of technology and innovation.

Thus, **this article addressed a theoretical and conceptual review that discusses the economic development generated by innovation, technology transfer and the triple helix and business incubators.** The objective was to assess whether there was an interaction between the resident enterprises in Technological Incubator of Maringá, academia and outside companies, and the specific objectives were to observe if the transfer of technology and innovation is occurring, as well as the products market share. The methodology includes a literature review on the subject, the development of variables related to incubator's characteristics and the analysis.

In this sense, the article has been divided into five sections: the first is an introduction; the second is a

literature review on economic development related to innovation, and about business incubators how a mechanism of technology transfer; the third is dedicated to the development of method used; and, the fourth section is the presentation of results and finally the main conclusions.

Economic development generated by technological innovation

Innovation has become the key to sustainable economic development, and is increasingly associated with efficiency and competitiveness gains. From the perspective of Schumpeter (1936), who is considered one of the largest theme references in Economics, innovation starts in the agent's necessity of change, which according to the author, "the producer who, as a rule, begins economic change, and consumers, if necessary, for it is 'educated', they are, so to speak, taught to want new things, or things that differ in some ways from those who have the habit of consuming". According to the author (1985), innovation is distinguished from the invention, as this is the discovery of opportunity and the first is the exploitation of a lucrative opportunity.

For Drucker (1986), innovation is to assign new capabilities for existing resources in the company, generating wealth. Educational institutions are paramount in the development of new technologies because they act as a mechanism to facilitate the technology transfer, which, in turn, are affirmed as a crucial element for economic development and progress, both for developed countries or in development. The author states that successful entrepreneurs try to create value and make contributions, but still, they are not content to just improve what already exists, they seek to create value and achieve new and different satisfactions or create a new and more productive configuration through the combination of existing resources. Therefore, it has to be systematic innovation and to seek deliberately and in an organized manner the changes.

Lalkaka (1997) argues that three interconnected forces can influence the economic environment, characterized by the development of the technology market, entrepreneurship and the competitive spirit. Also according to the author, the importance of the development and application of technology is reflected in the experience of developed countries, including those with a strong technology base that have been established as a prerequisite for the growth of the industry. According to Pierry (2011), the wealth of a society is related to the ability to generate the same training and empowerment

of people. Thus, it is important to note that the technological development of the trajectory starts from basic research to get to the productive sector. Technological innovation is responsible for breaking and improves production techniques, which might generate greater competitiveness, improving machinery and equipment, increasing the productivity of labor and the growth of output and employment. According to Castro (2006), knowledge has been a central role in economic development, becoming the main factor in the process of innovation and increased competitiveness.

Thus, innovation is also synonymous of development, new business generated from new ideas and generating competitive advantage. The authors also point out the importance of innovation management, the necessity of manage the innovation process, which basically focuses on generating new ideas, selecting the best and implement them in an active way, ensuring they are successful (Bessant; Tidd, 2009). The innovation process, according to the OECD (2005), begins from the company's objectives and will be influenced positively or negatively by a number of factors.

In this sense, the concept of innovation can be defined from a life cycle that includes three phases: (1) the invention, being a "concept or a design, a sketch or a model of a new product, process, service, or even a considerable improvement of existing ones"; (2) innovation, defined as "the process by which an idea or invention is translated into the economy" and (3) use, that is the introduction of the product or service in the economy, until it passed by other (Valeriano, 1998, p.29).

According to Oslo Manual (OECD, 2005), until recently innovation processes were not sufficiently understood, which was held based on evidence that innovation can be a dominant factor in economic growth on a national and international level, and with regard to companies, the Research and Development (R & D) is seen as the factor with the greatest capacity to absorb and use new knowledge of all kinds, not only technological (OECD, 2005). For Bell and Pavitt (cited in CNI, 2010), "Innovation is a learning organizational process".

According to Ribeiro (2001), in general, innovation corresponds to the "introduction of new knowledge or new combinations of existing knowledge. Since technological innovation refers to new products and / or processes of production and product improvements or upgrades and / or existing processes." Joseph Schumpeter argues that innovation creates a disruption in the economic system, within industries, revolutionizing the productive structures and creating sources of differentiation for companies (Kupfer, 2002 cited Schumpeter, 1912).

To measure the effect of innovation in the economy it is necessary to evaluate quantitatively various related issues. One is the technological invention, measured by

the record of number of invention patents. To describe the innovation process, several indexes were created, but due to asymmetric information (the indexes were made using proxies) indexes have been created composed of several indicators, as discussed in Furtado & Queiroz (2013). The construction of these innovation indicators is divided between the input indicators and output indicators. Input indicators, according to the authors, correspond to the costs in research and development.

According to OECD (2005), these activities cover basic research, applied research and experimental development. The product indicators are difficult to measure because of the reference to the products and services in development and developed. The only indicator that shows if there is innovation is the deposit and registration of a patent. On the other hand, although aware of the difficulty of measure the innovative products and services that reach market sector especially belong to the relationship with the research, that was done, giving a novelty character for research.

Many students and academies already engage in decidedly entrepreneurial action, building innovative ideas and inventions of their own laboratories or as incubators, inviting companies into the universities, generating innovation and the development cycle. Within the industrial sector, innovation is important as it allows the industry to access new markets, increase revenues, perform and improve partnerships, acquire new knowledge and even add more value to their brands. Bringing the level of analysis, innovation enables the increase in the level of employment and income, promoting economic growth and development. Therefore, technological innovation and technology transfer are crucial for economic development, as they bring competitive gains, improve productivity, employment and therefore generate wealth for the economy.

Business incubator as mechanisms to stimulate innovation

From the 1970's the international literature started to deal systematically with business incubators as part of the technology infrastructure with a focus on creating jobs, revitalizing economically depressed areas and as a mechanism of interaction between universities and companies. Already from 1980, with widespread understanding of the process of technological innovation, the objectives of business incubators widened, making them as key mechanisms of technological infrastructure for the dissemination of innovative activities in the productive sector known as economy knowledge (Vedovello; Figueiredo 2005).

According to several studies, the consensus is that incubators are part of the innovation system, characterized as the promoters of innovative projects.

According to “Glossário Dinâmico de Termos na área de Tecnópolis, Parques Tecnológicos e Incubadoras de Empresas” published by Anprotec (2002), there are three settings for a business incubator:

(a) Nuclear Agent generation and consolidation of micro and small enterprises;

(b) Mechanism that encourages the creation and development of micro and small enterprises, technology-based companies or light manufacturing, through the further training of the entrepreneur in the technical and managerial aspects;

(c) Facilitator of entrepreneurship process and technological innovation for micro and small businesses.

The PNI –National Program to Technology Incubator, cited by MCT (2000) lists the following objectives for a business incubator: businessman-entrepreneur training; stimulation of the relationship between researchers and entrepreneurs; creation of an entrepreneurial culture; job creation; support the introduction of new products, processes and services in the market; promoting aggregation of knowledge and the incorporation of technologies in SMEs; reduction of new SME mortality rate; and consolidation of SME with potential for growth and interaction between SME and institutions to develop technological activities.

According to Plonski (2010) cited by Bittencourt et al (2014), the concept of business incubators should be consolidated as strategic, institutional and operational platforms to work together with their partners - organized society, universities and government - the priorities for developing the regions and the country, through the promotion of innovative entrepreneurship.

According to the same author, business incubators can play a role as an organization, systematic large-scale, successful innovative projects and act as a guideline for the implementation of programs whose foundations are based on the strategy to enlarge its service capacity, while it is enhanced the quality of results.

According to NBIA - National Business Incubation Association (NBIA, 2015), which represents the incubator movement of US, incubators catalyze the process of starting and developing a new venture, providing entrepreneurs with the necessary expertise to manage their companies, establishing networks of contacts and tools that will make their projects achieve success. Also according to NBIA, a business incubator should offer at least the following services:

- Enable the entrepreneur to develop a network of contacts, always encouraged by the incubator manager.

- Provide technical and managerial assistance to incubated by experts working in the incubator itself or by trained professionals from the community.

- Assist the entrepreneur to get funding for their project, from the preparation of the business plan to the negotiation with investors.

- Provide a range of services to incubated and also those companies affiliated to the incubator, but non-residents (Rice, 1992 apud Dornelas, 2002).

To Aranha (2002), the business incubators linked to universities "are hybrid environments where the scientific and business dimensions are." These incubators act as a link between academic knowledge and business activities.

Thus, incubators promote university-industry interaction acting as technology and knowledge transfer channels, promoting science, technology and innovation coming to society in the form of processes, products and services.

In this sense, there is consensus that innovation does not arise spontaneously, there must be investment in research and development to occur. Today, in the neo-Schumpeterian studies, innovation is the result of interaction between universities, government and private companies, known as triple helix. The technology business incubator (TBI) are environments that include companies whose products, processes or services are generated from search applied results which technology is high added value, are a type of incubator that focuses on promotion of enterprises and technology-based start-ups (MCT, 2001).

A TBI includes: “Enterprises in areas of computer science, biotechnology, chemical, precision mechanics and new materials. It is distinguished by housing developments exclusively derived from scientific research” (Lahorgue 2004, p. 84).

To authors as Dietrich, Harley and Langbein (2010), there is no single model for a technology incubator or an incubation process of technology-based enterprises. The authors define the term technological base as a set of technologies and activities not only high-tech.

As for the start-ups, TBIs are defined as companies structured for individuals who are legalizing as legal entities. In this sense, TBIs are environments that support for companies installed where the companies technology-based put the products in the market and do not develop technologies, so the TBIs should not be confused with applied research centers.

The environment where a TBI is implemented is regarded as a region inserted at the heart of start-ups, job growth, technology transfer and innovation and can be seen in **Figure 1**.

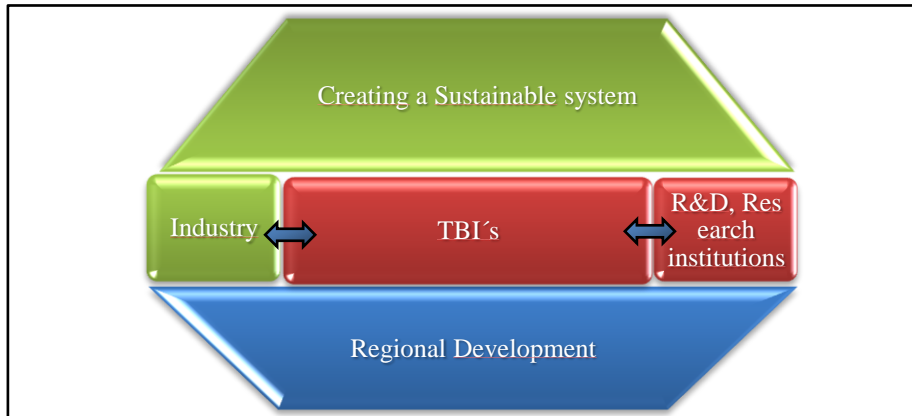


Figure 1. Incubators enterprises at the core of a sustainable system innovation and development
Source: Elaborated by the authors based on Dietrich, Harley and Langbein (2010).

According to Figure 1, the TBI may be recognized as an effective tool of technology transfer between universities and industry, promoting science, technology and innovation, facilitating the performance of the incubated companies and promoting greater contact with formal and informal networks legal, economic or technological of information. Generally, these incubators are directed to correct local economic development issues by improving the entrepreneurial base.

To consolidate this environment, technology transfer has become a key factor for economic development, and has not only attracted the attention of academics, but also government officials and businessmen. Bessant & Rush (1993 cited in France, 2001) defines technology transfer as a set of processes and activities in which technology is passed from one user to another, incorporated in new processes and products, or in ways of disembodied knowledge, skills and rights legal. Thus, the technology transfer process can be understood as the passage of intellectual property, where the result of applied research and experimental development carried out by an educational institution / research or business

and which are transferred to the industrial and commercial sector. The exchange of information among these agents are where new technological innovations and new ideas meet each other. Phillips (2002) studied the mechanisms of TBIs technology transfer and formulated two criteria to identify them: 1) verify that the primary sponsor of the incubator was an university; 2) verify that the objectives or the initial guidelines of the incubator were the transfer of technology or marketing research. According to the author, the three most important goals for this type of incubator are: a) economic development and local job opportunities; b) the commercialization of research; c) the transfer of technology.

When the TBI is the mechanism for the transfer of technology, the interaction between university, government and the productive sector is a topic that can be based on Henry Etzkowitz studies (2000), one of the authors who has excelled in the production of theme. According to the author, triple helix is the model where each environment is influenced by the other.

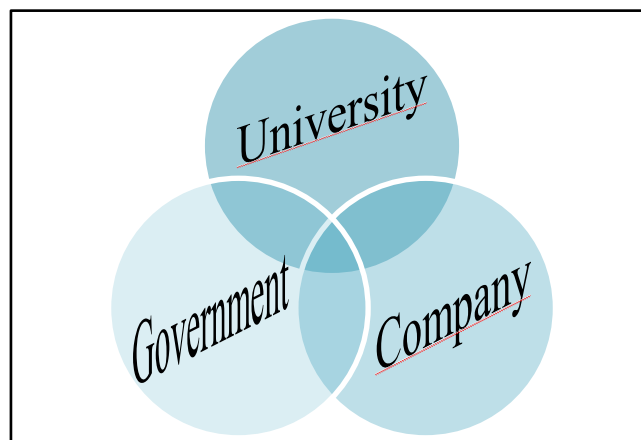


Figure 2. Triple Helix - Interaction between University, Companies and Government
Source: Elaborated by the authors based on Etzkowitz and Leydesdorff (2009).

In **Figure 2** there is a model of interaction between the three spheres, which according to Marques (2007), each institution has its powers. The production companies are part with the knowledge of market and demand for new creations. The universities hold knowledge awaiting use and development of opportunities for new experiences. Within universities there are experiments that can escape the expected result. This requires resources available for investments in research, as have risk and long-term return. The government would be part of this tripod, providing support for political or financial framework for the viability of these projects.

In summary, the business incubator environment acts as a technological infrastructure playing an important role in the innovation scenario. Through its infrastructure is possible to combine political and social agents channeling efforts and resources with the primary objective of generating companies, promoting sustainable and competitive economic development of the region and contributing for the innovation process. Given this scenario, business incubators are important supporters of new, small and medium enterprises, because that way the incubated companies can innovate and achieve the success of the enterprise, contributing to economic development.

Methodological approach

The methodology was consisted of two stages: in the first stage was developed the survey variables from the full set of features Technological Incubator of Maringá. This qualitative research aims to verify the dynamic between reality and the subject in an attempt to relate models to practice (Chizzotti 1991). Then an intentional non-probabilistic sampling was carried out, in which the researchers were interested in the opinion of certain elements of the population and are not necessarily representative of this Marconi and Lakatos (2002). Thus, the use of a qualitative approach in the first stage allows

the orientation of research relating to the dynamics of real world and the subjectivity of the study subject, based on the collection of data and information that allowed the evaluation of the data and conclusions.

This way, we used a primary data collected from the development of a performance monitoring questionnaire of the enterprises linked to Technological Incubator of Maringá, between January and July 2014, which was applied to eighteen enterprises. The questions were related to the number of employees, amount of investment, the number of products developed and in development, the market coverage of the products, the number of patents and the type of interaction with the academic endeavors of the past two years.

The companies in this study are characterized by developing products and services for which the technology is a high added value. Also, are distributed in different areas such as biotechnology; mechanical and mechatronics; nanotechnology; new materials; safety and health at work; information and communication technology (ICT); textiles and design, being the ICT sector the most representative.

Results

Companies established in the Technological Incubator of Maringá are inserted in a space to develop their activities and have support, services and facilities where they probably would not find elsewhere. In this sense, part of it goes to the development of products or services, because there is a reduction of costs in the incubation environment. These set of enterprises in the first half of 2014 involved 85 employees between partners, employees, interns and fellows, of which many are students and recent graduates. Even so, many of these companies are called spin-off, a term used to describe a company that emerged from some relationship to research sector, such as universities, institutions or research centers (public or private).

Table 1. Characteristics of resident enterprises in Technological Incubator of Maringá

Variables	Mean	Standard error	Minimum	Maximum
Incubation Time (months)	18.5	12.287	4	48
Employees	4.1	2.37	2	10
Revenues (R\$)	17,477	41,676.75	0	180,000

Products in the marketplace	1.16	1.2	0	4
Products development	2.11	1.45	0	5
Number of clients	21.16	60.4	0	260

Source: Authors

Note: Sample of 18 companies.

According to **Table 1**, the companies linked to the Technology Incubator of Maringá had mean incubation time of 18 months, being the enterprises with longer incubation those related to nanotechnology, new materials, biotechnology, mechanical and mechatronics, and the less incubation time the enterprises related to IT areas. The number of enterprises that have no products on the market as well as those who have not had a turnover in the period, in a total of 7 companies, and these were in the installation stage. Together, the enterprises amounted to 453 customers, and the marketplace for their products were mostly in the State.

The percentage of customers of all companies are spread over 3% of regional customers, 67% state and 30% national. By providing innovative and technological edge features, products become attractive and competitive, and so are able to enter markets beyond the regional.

The results showed that the incubated companies had developed and putted in the market 21 products and these ones were already developing other 38, as shown in Figure 3. The characteristic of these products is a result of targeted investments in research and development (R&D), the interaction between companies and academia, which creates an enabling environment for innovation.

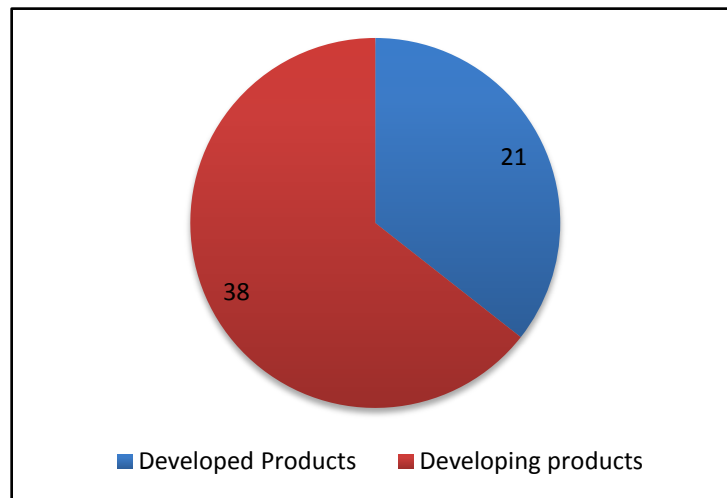


Figure 3 – Number of Developed and Developing products

Source: Elaborated by the authors

Another important finding was that 50% of incubated companies had some formal link with the academic world, either through partnership with universities, institutions or research center and researchers, however, even companies that do not have this type of interaction, indirectly it can be considered that this occurs because its employees are used the knowledge acquired during the under graduation or post graduation.

As the technology-based companies characterized by being those that have the technical and scientific knowledge their principal feedstock production, the number of patents, information used in this innovation indices was 33% of all firms that submitted the application for registration as illustrated in **Figure 5**:

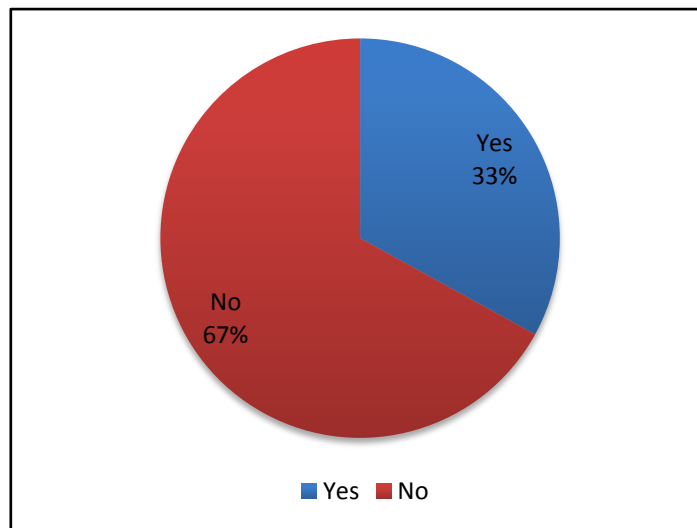


Figure 4 - Patent Order

Source: Elaborated by the authors

In addition, companies linked to Technological Incubator of Maringá have been covered by government financial resources for the implementation of projects for the development of new products or significantly improved products with technological innovation, especially for micro and small enterprises and to demonstrate market potential impact occurring so the effectiveness of the triple helix between government, universities and companies.

Thus it can be seen that on the one hand has a significant production of knowledge and technological solutions in Universities and Research Institutes, however, still lack mechanisms for the transfer of these to productive activity. On the other hand, we can observe that the incubators are very efficiently fulfilling this role. This role is being conducted mainly through the products and services related to the results of research that technology companies are offering on the market, as showed by the significant results. Yet it should be noted that the intensity of this process is increasing very significantly and there has been a general improvement in the competitiveness of traditional companies that are innovating by using new products and services, from the research. They are being made available on the market by incubated companies.

Conclusion

The creation of new technologies within universities and research institutions and possible partnerships with the productive sector are important for the development and growth of the country and contribute to increase competitiveness in developed countries. The technological innovation investment generates both new

products as well as the improvement of existing processes and products. For this, we need mechanisms such as business incubators, which are facilitating technology transfer process between academia and the productive sector, by being close to universities and research centers.

From the results obtained, it can be concluded that the incubators, such as technology-based, are environments that facilitate the knowledge transfer process. In the period analyzed, 38 products and services were being developed, the main feature being the technological differential. In addition, 21 products and services were already being sold, for an average of 21 clients spread throughout the country. In this sense, other companies now have access to such products and services arising from academia, and the knowledge from universities was transformed into products and services, has been marketed and distributed beyond the regional level.

Regarding the results of the work it can be noted that despite being restricted and yet so expressive, they have a very significant merit because there is almost nothing written that addresses this issue and these have been consistent enough to reach theoretical and practices conclusions. On the side of the theory new issues have been raised that must be addressed in relation to new methodologies related to forms of modeling and measurement of the process of technology transfer and innovation.

On the side of the practical application measures to facilitate the relationship of research to technology-based companies were proposed to foster the creation of new products, services and processes. Also in this sense, procedures have been suggested to develop a business center in the incubator to facilitate interaction with the

market. These facts highlight the importance of this paper in the academic area and generating practical contribution. Finally it is also worth highlighting the pioneering that this issue worked in this paper. It can be inferred that creating and supporting mechanisms as incubators can contribute to sustainable economic growth and life quality given to new products and

services. Finally, there was the importance of the technology business incubators such as enabling environments transfer process from basic research to the developments for companies and society, stimulating innovation in a systematic way and contributing to economic development.

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