ARE TECHNOLOGY BUSINESS INCUBATORS FULFILLING THEIR OBJECTIVES? A STUDY OF THE TBI'S PERFORMANCE LOCATED IN BRAZIL

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ABSTRACT

Technology business incubators (TBI) are considered an alternative for promoting entrepreneurship, innovation, employment and income generation, the maintenance of companies and consequently, local and regional development. However, despite the high number of incubators and investment made, the initiatives to assess the results of incubators are limited; little is known about the success of these in supporting the creation and development of new businesses. Within this context, this research analyzed the performance of technology business incubators located in Brazil, in a model of effective perspective and in its contribuitions to the region that the incubator is located. According to the proposed objectives, this research is of an exploratory, descriptive and analytical nature, in a descriptive statistical approach that used a survey as a research strategy, obtaining a sample of 97 incubators researched, in a universe of 112 technology business incubators. Through the data analysis, it can be concluded, according to the presented results of the searched criteria in the TBI's , that these are beneath the fulfillment of the objectives that they propose so that they are not contributing effectively to the local and regional development. Thus, it is suggested that the TBI's managers reflect on the real reasons why the researched organizations are not achieving the purposes that justify their existence.

Keywords: Technology business incubators (TBI); Evaluation; Results; Performance; Brazil.

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AS INCUBADORAS DE EMPRESAS DE BASE TECNOLÓGICA ESTÃO CUMPRINDO SEUS OBJETIVOS? UM ESTUDO DO DESEMPENHO DAS IEBT´S BRASILEIRAS

RESUMO

As incubadoras de empresas de base tecnológica são consideradas uma alternativa para o fomento ao empreendedorismo, à inovação, à geração de emprego e renda, à manutenção das empresas e consequentemente, ao desenvolvimento local e regional. Porém, apesar do elevado número de incubadoras e do investimento nestas, as iniciativas de avaliação dos resultados das incubadoras são limitados; pouco se sabe sobre o sucesso destas no propósito de apoiar a criação e o desenvolvimento de novos negócios. Dentro desse contexto, esta pesquisa analisou o desempenho das incubadoras de empresas de base tecnológica (IEBT´s) situadas no Brasil, numa perspectiva de efetividade do modelo da incubadora e nas contribuições para a região em que a incubadora está instalada. Em função dos objetivos propostos esta pesquisa é de natureza exploratório-descritiva e analítica, numa abordagem estatístico descritiva que utilizou *survey* como estratégia de pesquisa, obtendo-se uma amostra de 97 incubadoras pesquisadas, em um universo de 112 incubadoras de empresas de base tecnológica. Por meio da análise dos dados pode-se concluir, de acordo com os resultados apresentados dos critérios pesquisados nas IEBT´s, que estas estão aquém do cumprimento dos objetivos a que se propõem, de modo que não estão contribuindo, de maneira efetiva, para o desenvolvimento local e regional. Desta forma sugere-se que os gestores das IEBT´s reflitam sobre os reais motivos pelos quais as organizações pesquisadas não estão alcançando os propósitos que justificam a sua existência.

Palavras Chave: Incubadoras de empresas de base tecnológica (IEBT´s). Avaliação. Resultados. Desempenho. Brasil.

INTRODUCTION

In the initial phases of implantation of a micro or small enterprise (MSE) it is recommended that they seek support; one of the options being the so-called business incubators, entities destined to support the initial stage of nascent enterprises (REBELATO, et al., 2010; GALON, ENSSLIN, ENNSLIN, 2011). Ortiguara et al. (2011) corroborate with the aforementioned authors when they affirm that business incubators have become ubiquitous in many countries and are seen as important for the promotion of business generation and development in Brazil and in the world.

Thus, incubators can be considered as an alternative for the promotion of entrepreneurship, innovation, generation of employment and income, support for startups and, consequently, for local and regional development.

Considering the investment in incubators carried out by governments, universities, research institutions, municipal agencies and other stakeholders, a question has been raised about what society receives in return for these investments. This highlights the need for a greater attention to the evaluation of incubators.

Aiming to contribute with new lights to these issues regarding the degree to which incubators fulfill their institutional role, and that they contribute to the local and regional development and the success of new technology based companies (NTBCs), this research aimed to analyze the performance of technology business incubators (TBI) located in Brazil. In a model of

effective perspective and in its contributions to the region that the incubator is located.

Technology Business Incubators (TBI)

Technological innovation can be considered as an essential element for stimulating development and for expanding the competitiveness of companies, regions or countries. The Brazilian Institute of Geography and Statistics (IBGE, for its Portuguese acronym, 2015), through its Research on Innovation (PINTEC), using 2014 as a base year, defines technological innovation as the introduction of a new or considerably improved good or service in the market, at least for the company, or as the introduction of a process that is new or substantially improved, at least for the company. There are a variety of concepts related to technological innovation, but what can be concluded is that the production of knowledge and its materialization are fundamental to economic development.

Technology business incubators are among the institutional/business mechanisms and arrangements used to encourage the culture of innovation, entrepreneurship and the formation of new technology-based companies, that, according to the Ministry of Science, Technology and Innovation - MCTI/Anprotec (2012), are seen as "innovation habitats", suitable to provide administrative support and technological assistance to innovative micro and small enterprises. Therefore, in a scenario in which knowledge, efficiency, and agility in the innovation process are admittedly the decisive elements for the competitiveness of economies, the incubation process is essential for innovation to take place in a timely manner in order to meet the demands of the market (MCT, 2000) and thus increase the country's competitive capacity.

Phillips (2002) presents three characteristics that distinguish technological incubators from other types of incubators: (1) they are focused only on companies based on new technologies; (2) they provide support, such as access to advanced technology laboratories, equipment

and other technical and research resources, as well as to universities' teaching staff, students, and libraries; (3) they are linked to universities and research institutions, facilitating technology transfer and marketing. In this way, the TBI are structures oriented to the development of new competitive technology based businesses that can contribute to the country's GDP and development.

Colombo and Delmastro (2002) point out that the establishment of this type of incubator aims at dealing with market failures, that is, when the market cannot allocate resources efficiently by itself (Arrow, 1962), regarding knowledge and other inputs of the innovation process, such as technical and managerial services, physical infrastructure and access to external funding that negatively influence the formation of new technology based companies and their post-entry performance.

Aernoudt (2004) reinforces this idea by stating that technology business incubators have the mission of overcoming the bottlenecks of the economy imposed on entrepreneurship, with the main objective of inducing entrepreneurial behavior by stimulating innovation and creating technology startups (COLOMBO e DELMASTRO, 2002; LALKAKA, 2006). Hence, technology business incubators are expected to play a relevant role in reducing more pronounced market failures.

An issue that has concerned researchers is the identification of factors that may explain the success of technology incubators. Barrow (2001) states that the success of a technology incubator stems from a combination of seven components: clear objectives, the incubator coordinator's profile, provision of services, shared resources, physical space, access to funding, and project selection.

The most cited objectives of TBI, as reviewed in the bibliography about the topic (Anprotec, 2016a; Barbero et al, 2012; Bezerra, 2007; Lalkaka, 2006; Dornelas, 2002; MCT, 2000; Baêta, 1999), are listed below:
a) Generate employment and income for

the region/country;

b) Support the entrepreneurship of technology based companies;

c) Train new businessmen;

d) Encourage academics in the creation of their own businesses;

e) Reduce the mortality rate of micro and small technology based enterprises;

f) Transform knowledge into innovative products and/or services with added value;

g) Provide the necessary conditions to incubated companies to prepare and strengthen themselves for the market;

h) Promote integration between universities, research centers, companies and the community;

i) Give support and aid the development process of innovative enterprises;

j) Disseminate the transfer of knowledge generated in the institution;

k) Promote the integration of startups with national and international consolidated companies;

l) Provide methods and solutions for the creation, development, and improvement of innovative technology based enterprises regarding technological, managerial, marketing and human resources aspects.

m) Capture and retain talents in the region;

n) Expand the supply of technology-intensive products;

o) Support the introduction of new products, processes and services in the market;

p) Facilitate access to technologies;

q) Influence the technological culture of the region where it is installed.

As it can be seen, the review of the goals to be achieved by the TIB pointed out a diversity of reasons, which may be associated with the different nature of these organizations concerning organizational model, institutional links, region of influence, level of organizational maturity, among others.

Evaluation of incubator´s performance

Ramalheiro et al. (2013) comment that the business incubator movement in Brazil was originated in the 80's, expanding in the following decades. There, it received the condition of public policy to support innovation and local development, to the point of moving considerable values from public resources. With the public policy status, it became necessary to use instruments and measures to control and evaluate the effectiveness of the incubators' results in the execution of their functions and their social and economic responsibilities. Despite the high number of incubators and investment in them, initiatives to evaluate incubator results are limited; little is known about their success in supporting the creation and development of new businesses. Even if there are success stories and public policies supporting business incubators, there are also incubators that may not be successful in supporting entrepreneurs. As a consequence, there is a growing debate about the effectiveness of incubators and the real need to invest public resources in these organizations (TAVOLETTI, 2013). Thus, the control and evaluation of an incubator are essential, because besides offering information to improve management, it also serves to identify the degree to which its objectives are being achieved.

Griffin (2007) defines the action of controlling as the monitoring and adjustment of the organization's activities, so that the performance remains within previously established acceptable limits. It can also be conceptualized as the monitoring or measurement of something, in order to compare results obtained with those predicted and taking the appropriate corrective measures (LACOMBE and HEILBORN, 2003).

The control of an organization, as Griffin (2007) states, is necessary for the following purposes: a) seek the achievement of organizational goals; b) adapt to environmental changes; c) avoid repetition of errors and correct faults; d) deal with the complexity of the business; e) minimize costs; f) improve processes; g) increase/maintain market share; h) greater autonomy in decision making and i) ensure the safety of the business.

Hackett and Dilts (2004) argue that attempting to measure the impacts of incubators

is as important as it is challenging. Measuring is important because most incubators operate with public funds and must be held accountable for the results associated with the usage of these funds. Measurement is a challenge because the entire range of data needed to implement technology based projects that directly address the question "if incubation had not been done would there be any difference in the survival rate of new ventures?" is not readily available. The importance of evaluating incubators lies in the fact that it indicates the main points where incubation programs should be remodeled or improved (CHAN and LAU, 2005). It can be concluded that evaluation of the incubators must take place periodically for a better improvement of their organizational processes, and therefore their results; but it is not an easy systematics, due to the difficulty in establishing the criteria to be evaluated, besides the difficulty of obtaining the data from the established questions.

Most studies on evaluating business incubators suffer from two major flaws. First, it is not possible to define precisely what constitutes success, and second, even when studies succeed, they are unable to measure success by using factors that determine the outcome of incubation (DEE, et al, 2001). For Aaboen, Lindelöf and Löfsten (2008), incubator evaluations have been a topic of discussion since the beginning of their existence due to the fact that there was no consensus on how to determine the good performance of the incubators. Rogova (2014) explains that the problem of assessing the effectiveness of business incubators has not been solved in a systematic way. One of the reasons to be considered may be the diversity of institutional models and contexts in which incubators operate.

For Tibola (2005), methodologies for self-assessment of business incubators have been established, but according to the evaluation purpose, indicators can be included or extracted so that the performance measure may be investigated based on the objectives of each organization.

According to Tang et al (2011), although the critical success factors approach provides a way to evaluate the effectiveness of TBI, some elements of success may be critical in some cases, but may not be decisive in other cases. For example, entrepreneur training and a network of relationships play critical roles in the operation of European technology incubators, while company funding and management functions are considered important for the performance of TBI in the United States.

What can be observed is that incubator evaluation models used in one country are not always applicable in another country. In this way, a classification that has been established by surveys conducted in other countries cannot be followed blindly, because policies introduced in different countries can lead to different results (BARBERO et al., 2012). This leads to the conclusion that regardless of the incubator evaluation model being used, it must be adapted to the type of incubator, to the specificities of the country, region, and institution that maintains the incubator to be evaluated.

Criteria for the evaluation of incubators

Considering that a significant portion of technology business incubators are nonprofit entities, the financial techniques generally used to evaluate business are not very useful. Financial indexes, such as net present value, internal rate of return, discounted cash flow, etc., do not make sense since each incubator usually has an annual budget to cover costs of its administrative activities and support to entrepreneurs. However, it is difficult for a non-profit incubator to generate enough revenue to be self-sustaining, always needing additional resources from outside institutions and public agencies. Evaluating an incubator from an exclusively financial point of view would mean to say that it is a non-viable business, since it makes a lot less than it spends (DORNELAS, 2002).

Dee et al. (2011) reinforce this statement, commenting that since many incubators are non-profit, a financial or microeconomic analysis

becomes meaningless. And even those incubators identified as private often have the backing of public resources for their programs. It is concluded that a microeconomic analysis of financial indicators is not recommended, so its use should only be done with caution, or it may be feasible in conjunction with other indicators.

In evaluating business incubation programs, it is common to use several criteria, among which: incubated companies, jobs created, taxes generated, revenues earned, exports, capital increase and survival rate of firms (ROGOVA, 2014). In an attempt to improve this assessment, Bergek and Normann (2008) suggested that business incubators should be evaluated according to their own characteristics. Phan, Siegel and Wright (2005) and Dee et al. (2011) believe that there is no standard methodology for measuring incubator's performance, which makes comparisons between studies more challenging. Some of the benefits of incubation are also intangible. As a result, all measures of success are open to a certain degree of criticism and there is no consensus on which is the most appropriate.

Previous studies on incubator evaluation have addressed the issue of incubator efficacy from a multiplicity of perspectives. In particular, most researches focus on the effectiveness of individual incubators and science parks, on a group of incubators and science parks (for example, within a country), or on specific types of incubators and science parks. What has been neglected in previous evaluation efforts are comparisons within a specific population of

incubators (SCHWARTZ, GOTHNER, 2009). Based on these authors, a gap can be identified in the researches regarding the evaluation of incubators, offering an opportunity for potential studies in this area.

Theodorakopoulos, Kakabadse, McGowan (2014), Bergek and Normann (2008) remark that researchers have used several indicators to evaluate the effectiveness of business incubation. The aforementioned authors cite the following studies: Allen and McCluskey (1990) studying 127 business incubators used three indicators: occupation, jobs created and graduated companies.

Phillips (2002), in addition to the criteria used by Allen and McCluskey (1990), adopted three more indicators that were revenue per tenant, number of patent applications per company and number of discontinued companies. Mian (1996) added management policies and their effectiveness as well as tenant support services. Subsequently, Chan and Lau (2005) established nine indicators: advantages of resource pooling, resource sharing, consulting services, positive effects of a better public image, network advantages, clustering effects, geographic proximity, cost subsidies and financial support.

Theodorakopoulos, Kakabadse and McGowan (2014) summarized the main dimensions used in the international literature for the evaluation of incubators, which is presented in Table 1.

Table 1 - Main indicators used for the evaluation of incubators in the international literature

Key Sucess Factors	Indicative Literature
Incubatee Selection	Smilor and Gill (1986); Merrifield (1987); Kuratko and LaFollete (1987);
Policy	Lumpkin and Ireland (1988); Autio and Klofsten (1998); Colombo and
	Delmastro (2002); Wiggins and Gibson (2003); Hackett and Dilts (2004;
	2008); Peters, Rice and Sundararajan (2004); Lalkaka (2006); Buys and
	Mbewana (2007); Aerts, Matthyssens and Vandenbempt (2007);
	Bergek and Norrman (2008); infoDev (2009); OECD (2010); UKBI (2004,
	2009, 2012); Dee, Livesey and Gill (2011); Lewis, Harper-Anderson and
	Molnar (2011); Khalid, Gilbert and Huq (2012)
Exit/ Graduation Policy	Allen (1985); Campbell (1989); Markley and McNamara (1994); Mian

	(1996); EC (2002); Hacket and Dilts (2004, 2008); Rothaermel and
	Thursby (2005); Lalkaka (2006); Bergek and Norrman (2008); UKBI
	(2004, 2009, 2012); Patton, Warren and Bream (2009); infoDev (2009);
	OECD (2010); Dee. Livesey and Gill (2011); Al-Mubaraki and Wong
	(2011); Lewis, Harper-Anderson and Molnar (2011); Al-Mubaraki and
	Schrodi (2012)
Shared Office Space	Allen (1985); Hisrich and Smilor (1988); Mian (1997); European
and Resources	Commission (2002); Rice (2002); Chan and Lau (2005); Dettwiler,
	Lindelöf and Löfsten (2006); infoDev (2009); OECD (2010); UKBI (2004,
	2009, 2012); Dee, Livesey and Gill (2011); Lewis, Harper-Anderson and
	Molnar (2011); Khalid, Gilbert and Huq (2012)
Incubator Manager	Fry (1987); Allen and Bazan (1990); Udell (1990); Lichtenstein (1992);
Competences and	Autio and Klofsten (1998); Sherman (1999); Duff (2000); Rice (2002);
Relationship with	Lalkaka (2002); Hannon (2005); Hackett and Dilts (2004, 2008); Dee,
Incubatees	Livesey and Gill (2011)
Support Services	Campbell, Kendrick and Samuelson (1985); Allen (1985); Smilor and
	Gill (1986); Kuratko and LaFollette (1987); Lichtenstein (1992); Rice
Management know	(1993); Mian (1997); Lee, Kim and Chun (1999); Lalkaka and Shaffer
how	(1999); Hannon and Chaplin (2001); Hansen, Chesbrough and Nohria
	(2000); Barrow (2001); Rice (2002); European Commission (2002);
Advice on regulations	Hannon and Chaplin (2003); Wiggins and Gibson (2003); Cammarata
	(2003); Hoang and Antoncic (2003); Hackett and Dilts (2004); Lee and
Technology & RD	Osteryoung (2004); Peters, Rice and Sundararajan (2004); Chan and
support	Lau (2005); Phan, Siegel and Wright (2005); Rothschild and Darr (2005);
	Bollingtoft and Ulhoi (2005); Dettwiler, Lindelöf and Lofsten (2006);
Networking (internal &	Suk and Mooweon (2006); Lalkaka (2006); Buys and Mbewana (2007);
external)	Knopp (2007); McAdam and McAdam (2008); Bergek and Norrman
	(2008); Patton, Warren and Bream (2009); infoDev (2009); UKBI (2009,
Acess to funding	2012); Connell and Probert (2010); OECD (2010); Xu (2010); Dee,
	Livesey, Gill and Minshall (2011); Lewis, Harper-Anderson and Molnar
	(2011); Adlesïc and Slavec (2012); Al-Mubaraki and Schrödi (2012);
	Ebbers (2013)
Monitoring	Smilor and Gill (1986); Mian (1997); European Commission (2002);
Performance	Wiggins and Gibson (2003); Hackett and Dilts (2004, 2008);
	Abetti (2004); Lalkaka (2006); UKBI (2009, 2012); Al-Mubaraqui and
	Wong (2011); Dee, Livesey, Gill and Minshall (2011); Khalid, Gilbert
	and Huq (2012)

Source: Theodorakopoulos, Kakabadse and McGowan (2014).

Lalkaka (1997) presented ten results to be reached by the incubation process, which could be used to evaluate the performance of the incubators.

a) Best-performing incubators can be identified by measuring the number of incubated enterprises and discontinued incubated enterprises;

b) Number of jobs generated in incubated companies per year of work, from the last three years;

c) Economic activity and jobs created by graduated enterprises, measured by working time and added value in sales, from the last six years;

d) Public investments values for the

establishment of incubators and their development measured annually;

e) Commercialization of the researches/projects developed in incubated companies, measured in number of projects and economic activity (years of work, accumulated total revenue);

f) Tenant evaluation surveys, measured by response rate and specific activities;

g) Sustainability of the incubator, evaluated by revenue and its operating cost;

h) Taxes and other social contributions of the incubator, tenants and graduated companies, measured by property, income, employment and other taxes to these organizations;

i) Development of capacities and changes in mindset, greater culture of research - links with industry and development of entrepreneurship, measured by public opinion surveys, number of collaborative research contracts with industry and universities (value, number of teachers and personnel involved);

j) Changes in public policies to increase aid to private enterprises, measured by the number of government projects and financial commitment to their design and implementation.

In this investigation, the results of technology business incubators were recognized in the following criteria: a) resident incubated companies, b) discontinued resident incubated companies, c) non-resident incubated companies, d) discontinued non-resident incubated companies, e) total number of employees in incubated companies, f) products generated, g) occupation capacity of the incubator in number of resident companies, h) occupation capacity of the incubator in number of non-resident companies, i) number of graduated companies and j) number of deposits of registers and patents.

The respondent of the questionnaire (incubator manager) pointed out, in numbers, the results of each of these ten TBI topics, in the last three years (2014, 2015 and 2016).

Table 1 and its references related to the evaluation criteria of the incubators presented in

this topic, served as a basis to the set of question's elaboration used in the data collect, in this research.

Methods

This research is of a descriptive statistical nature and used survey as a strategy in technology business incubators located in Brazil. It was identified that there are 112 (one hundred and twelve) Brazilian TBI according to searches carried out on the website of the National Association of Entities Promoting Innovative Enterprises - Anprotec (2016b), in state and regional incubator networks, in municipal and state organs, and also in reports from the Ministry of Science Technology and Innovation (MCTI - for its Portuguese acronym). The study sample was non-probabilistic by adhesion: non-probabilistic because sample selection did not follow any previous procedure to be characterized as statistically representative of the population (HAIR JR et al., 2005) and by adhesion because the composition of the sample was only by the respondents who, from their own intention, decided to answer the questionnaire from the invitation they received.

The research was applied through a structured and self-administered questionnaire that investigated, together with the managers, the results achieved by these institutions, as well as their relationships. The questionnaires were sent to the incubators, beginning on May 3rd, 2017, and closing on June 5th, 2017. The last questionnaires answered were received on June 6th, 2017. The survey resulted in 97 valid questionnaires answered, which corresponds to 86.61% of the researched population, highlighting the representativeness of the sample in relation to the researched universe.

Moreover, the representativeness can also be visualized from the commonly used sampling calculations, considering a 99% confidence level (above the standard 95% used in the surveys in the area of Administration) and as for the margin of error of 5%, for a population of 112 incubators, a sample of 96 incubators would have to be obtained.

Results and discussion

The first aspect is the number of resident incubated companies from 2014 to 2016. So, in this regard, it was possible to observe that some of the surveyed incubators indicated that they did not have resident incubated companies, some of them for one or two years, but others during the three years surveyed, as it is the case of six incubators that recently started their activities, which justifies the absence of incubated companies. It was verified that 83 incubators had resident incubated companies, in the years 2014, 2015 and 2016.

The sampled incubators had an average of approximately 9 resident incubated companies in each of the three years surveyed; nearly 70% of incubators in the sample had less than the average number of incubated companies and around 30% had more than 9 incubated companies. Among these, two of the incubators investigated were highlighted by the high number of incubated companies, in relation to the other incubators in the sample. The first incubator had more than 40 companies incubated in each of the three years, presenting growth over the years.

The second incubator had more than 30 companies incubated in 2014 and 2015 and more than 50 in 2016. On the growth in number of incubated companies, it was verified that this is not a constant, with few exceptions that were observed in four incubators. On the other hand, a reduction of incubated companies was also observed in four other incubators.

Regarding the number of discontinued resident incubated companies, it was verified that of the 83 incubators that had resident incubated in the three years surveyed, 22 TBI (26.5%) reported that there was no discontinuation of resident incubated in any of these years. There were TBI that did not have discontinuation of resident incubated in one or two of the years surveyed. It can also be identified that in 2015 and 2016 there was a higher incidence of discontinuity of resident incubated. Such situation may be due to the

scenario of economic crisis that Brazil has been facing with the recession, high inflation, fiscal adjustment, reduction of investment in some areas, etc.

There were TBI that presented a higher dropout rate of resident incubated in some of the years surveyed, and there was no increase in the number of companies incubated in these incubators. In this situation, seven incubators may be cited. One of the TBI had an increase in the abandonment of resident incubated companies, but there was an increase in the number of resident incubated companies in 68%.

According to Jabbour and Fonseca (2006), an incubator's ability to retain companies during the incubation period is one of the reasons for its existence as an organization. Thus, it is necessary that the TBI check the tenants' rate of evasion; and in case of a high level of withdrawal, it is necessary to identify where the faults are so they can be corrected.

As regards to the number of non-resident incubated companies, it was observed that 42 TBI (46.2%) did not perform external incubation in any of the 3 years and 34 incubators (37.4%) performed external incubation in all the years surveyed; the incubators surveyed had an average of approximately 2 non-resident incubated companies in each of the three years.

There was a considerable gradual increase in the number of non-resident incubated companies in five technology business incubators during the three years surveyed. On the other hand, the reduction of external incubated companies can also be observed in six technology business incubators. A hypothesis that was raised was that these TBI could have reduced the number of non-resident incubated and increased the number of resident incubated, but when carrying out the verification, it was verified that such a fact did not occur.

Lahorge (2008) comments that the incubation of non-residents is one of the ways to increase the use of the incubator's expertise, reaching a greater number of companies offering

training, coaching, consulting and other services. External incubation is also a way of bringing benefits to resident incubated companies, as they can spark business opportunities and partnerships with non-resident companies that could otherwise go unnoticed.

The aforementioned author states that the incubation of non-resident companies inserts a greater understanding of the external environment in the management of a TBI, mainly for the incubators that are related to research centers and universities. It can be observed that the opportunities that may arise with the incubation of non-resident companies have not yet been perceived by the technology business incubators, since the data presented above, related to external incubation in the researched TBI, demonstrated a low index of use of this incubation mode.

In relation to the number of discontinued non-resident incubated companies, it was identified that from the 34 incubators that had non-resident incubated in the three years surveyed, 15 TBI (44.1%) reported that there was no discontinuation of non-resident incubated in any of these years. Some of the TBI had discontinuation of non-resident incubated in one or two years. It can also be identified that in the years of 2015 and 2016 there was a higher incidence of discontinuity of non-resident incubated, a fact that also occurred with resident incubated companies.

Regarding the discontinuity ratio of the incubated companies (residents + non-residents), there were 67 incubators in which the discontinuity of resident and external incubated companies occurred. Thirteen incubators were identified with a discontinuity proportion of incubated companies as of 30%. Six of these presented a discontinuity ratio in the order of 60% or more. A worrying example is one of the researched TBI that had 3 companies incubated in 2014 and 3 discontinued in 2014, and in 2015 and 2016 there were no companies incubated, being an incubator that carried out neither the pre-incubation nor the external incubation modality.

The total number of employees in the incubated companies, by incubator, presented an average of approximately 49 employees who were in the incubated companies in each of the three years, with 51 incubators from the sample (56%) having less than the average of employees in incubated companies and around 18.7% having more than 49 employees in incubated organizations. It could also be identified that 2016 was the year in which there was a greater increase in the number of employees.

Brazil has a total contingent of 166.3 million people at working age (IBGE, 2017) and it has an average of 11.5% of unemployment rate in the economically active population in 2016. The generation of new job opportunities, with the country in a scenario as presented, establishes an expectation in the performance of incubators. In 2014, there were a total of 3377 employees in the incubated companies, in 2015 they totaled 3707 and in 2016 there were 4351 employees working in incubated companies. Considering that the technology business incubators surveyed have an average of 3812 employees per year, it is observed that the TBI are not making a major contribution to the generation of employment, with a marginal contribution to short term job creation. But, according to Anprotec (2016b) and Lalkaka (2006), the increase in the number of jobs generated in companies occurs after graduation.

The number of products generated per incubator presented an average of approximately 8 products in each of the three years per incubator. Thirteen incubators had a generation of products above average. Six incubators could be distinguished by the high number of products generated, in relation to the other sampled incubators. It was also possible to observe a higher incidence in the generation of products with the incubators in 2016. It was also identified that there were several TBI that did not present values with respect to the products generated.

This fact is justified since 10 TBI answered with the number 0 in the three years, 25 incubators left the answer blank, 7 of the organizations informed that they did not know

the numbers because they did not have the control of this data and 1 incubator replied that it could not provide this data. This context reveals that the TBI are not aware of what happens to the incubated, since they do not follow up on certain data that are relevant to evaluate the evolution process of the incubated companies and also to verify if the technological incubators are fulfilling the objectives they propose to themselves.

Table 2 shows the occupation rate of the technology business incubators in the three years surveyed. Regarding the answers, in 2014 there were - 06 beginner incubators and 07 missing data, and a valid sample of 84 incubators; in 2015 - 06 beginner incubators and 06 missing data, and a valid sample of 85 incubators; in 2016 - 06 beginner incubators and 04 missing data, and a valid sample of 87 incubators.

On the occupancy rate of technology business incubators (table 2), it can be seen that in 2014 only 24 incubators (28.57%), that is, less

than 1/3 of the TBI had an occupancy that comprised between 81% and 100%; in 2015 - 26 incubators (30.59%) and in 2016 - 32 incubators (36.78%), showing a small improvement in the occupation level of the incubators, in this period of three years. With rates covering up to 70% of occupation of the TBI, in 2014, 2015 and 2016 there were respectively 45 (53.57%), 42 (49.41%) and 41 incubators (47,13%). These data expose the idle capacity of the TBI, leading to a series of assumptions, among which a possible exacerbated expansion in the occupation capacity of the technology business incubators; the existence of a gap between the incubator's supply and the demand of the entrepreneurs; the lack of an effective work of advertising the TBI to the community; the entrepreneurs' lack of preparation at the moment of elaborating the business plan; the ignorance of the entrepreneurs of the existence of technology business incubators as an aid to the initial stage of nascent companies; failures in the selection process of companies interested in incubation, etc.

Table 2: Researched incubators occupation rate

	2014		2015		2016	
ABSENT DATA	7		6		4	
BEGINNER INCUBATORS	6		6		6	
OCUPATION RATE	No.	%	No.	%	No	%
Up to 30%	13	15.48%	11	12.94%	8	9.19%
From 31% to 50%	17	20.23%	14	16.47%	19	21.84%
From 51% to 70%	15	17.86%	17	20.00%	14	16.10%
From 71% to 80%	12	14.29%	12	14.12%	8	9.19%
From 81% to 100%	24	28.57%	26	30.59%	32	36.78%
Above 100%	3	3.57%	5	5.88%	6	6.90%
SAMPLE	84	100.00%	85	100.00%	87	100.00%

Source: Made by the author (2017).

As relevant as TBI ability to maintain companies during the incubation phase, preventing them from disengaging from the program, is the competence to develop autonomous companies so that they can remain and compete in the market after graduation.

About the number of graduated companies 16 incubators had no graduated companies in

any of the three years. In this number, the six incubators that started their activities recently were not counted, which justifies the lack of graduated companies. It was verified that 36 TBI presented companies graduated in the three years and others presented companies graduated in one or two of the years researched. The sampled incubators had an average of approximately 2 graduated companies in each of

the three years, with about 53% of the sampled incubators having less than the average number of graduated companies. Among the TBI studied, two of them were distinguished by the high number of companies graduated in relation to the other surveyed incubators. The first incubator, totaling 50 companies graduated in the three years. The second incubator, adding 49 companies graduated in the three years surveyed.

The data demonstrate the low number of graduated firms as well as incubators that did not graduated companies in any of the three years. So, these results may be indicating that the TBI are not achieving their main proposed objectives.

The dissemination of Intellectual Property (IP) management amidst the entrepreneurs of the incubated companies is essential so that they can understand the importance of transforming everything that is susceptible of protection in assets to the organization, becoming sources of revenue and causing the development of the enterprise. Regarding the number of registrations and patents, it was observed that there were several TBI that did not indicate the number of registrations and patents made, a situation that also occurred in relation to the data of the products generated in the incubators, as previously mentioned.

So that 35 TBI responded with the number 0 in the three years, 22 incubators left the answer blank, and 1 incubator responded that it could not make this data available. Regarding the incubators that made deposits of registrations and patents in the three years, there were 14 in number. One of the incubators stood out, with a high number of registrations and patents made in 2014, totaling 24.

This scenario reveals that, in Brazil, in addition to TBI not carrying out monitoring in relation to certain data that are important for evaluating the process of evolution and innovation of incubated companies, it also shows that the protection of IP assets by incubated companies is low. As stated by Silva (2014), the main factors by which beginner companies do not protect IP assets are: a) difficulty in defining what can be protected; b) difficulty in preparing patents; c) difficulty in defining the software registration/copyright process; d) high costs of specialized IP services; e) bureaucracy and delay in the analysis of applications and f) ignorance of IP management.

The information presented shows how important it is that the TBI develop with incubated companies actions regarding the protection of knowledge and intellectual property, such as lectures, courses and training on the subject, as well as support in the process of registers and patents deposits.

In order to make the incubators' performance data comparable in the three years, a strategy to categorize the quantitative from the quintiles presented by the sample in each variable in its respective year was chosen, representing a performance "concept" or "grade". In this way, the six performance concepts or grades were divided into: Terrible (0); Very Bad (1); Bad (2); Good (3); Very Good (4); Excellent (5). It should be noted that the overall performance of the incubators in each of the years was the result of the average of the scores of the 10 variables included in the data collection instrument, according to data presented in Table 3.

Table 3 - Minimum, maximum and mean grade

Year	N°	Mínimum	Maximum	Mean	Standard deviation
2014	91	1.00	4.43	2.50	0.797
2015	93	1.00	4.67	2.60	0.803
2016	97	1.00	4.67	2.61	0.790

Source: Made by the author (2017).

It was found that 3 incubators reached grade 1, a very bad concept, but none had a zero mark (terrible). On the other hand, no incubator reached the maximum mark in all the questions so that it reached an average of 5 (Excellent). But in 2015 and 2016 one of the incubators averaged 4.67. In relation to the analysis of the incubators' performance, it was possible to categorize them from the Cluster Analysis in two clusters, named High Performance and Low Performance, as shown in Graph 1.

In the High Performance group there are 48 incubators (53%) and in the Low Performance group there are 43 incubators (47%). Six incubators did not enter the composition due to missing data. It stands out the high percentage of incubators with low performance. Chan and Lau (2005) pointed out the importance of evaluating the performance of incubators so that they identify the main points in which their organizational processes must be remodeled or improved.

Graph 1 - Performance grouping
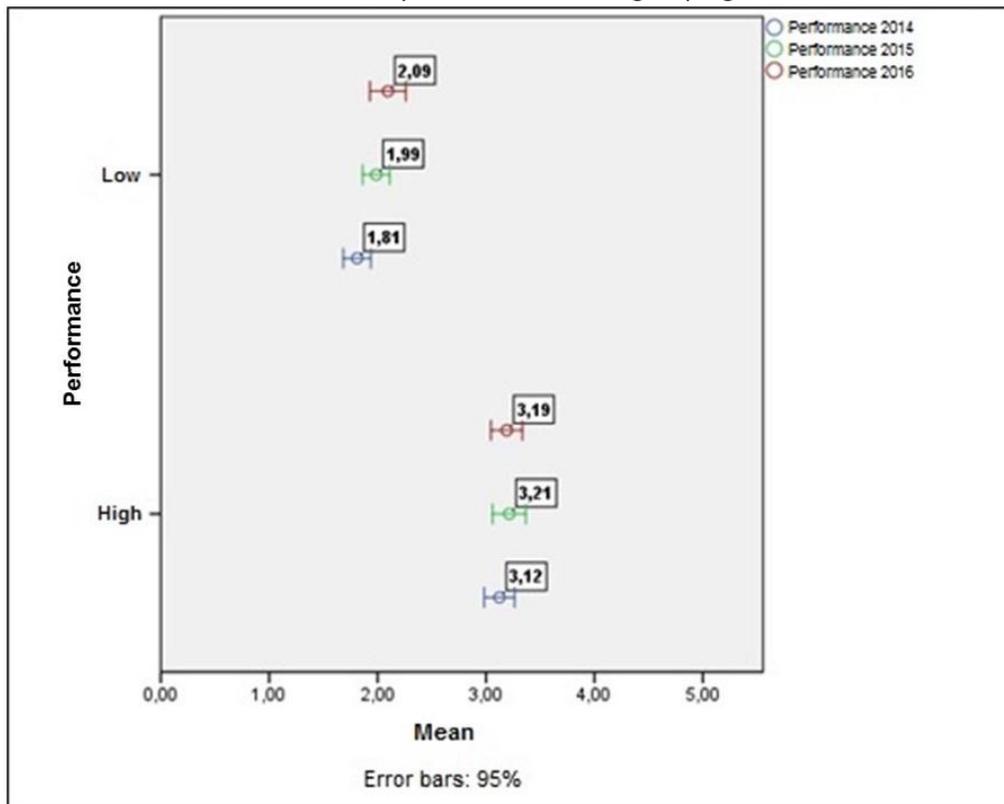
Source: Made by the author (2017).

In the group with high performance are the TBI with the best results. However, it can be seen, according to graph 1, that the mean in the years 2014, 2015 and 2016 are, respectively, 3.12 - 3.21 and 3.19 which corresponds to the concept good. In this way they demonstrate that they are capable of achieving their goals. However, there are several improvements to be developed to achieve the concept of excellent. In the low performance group are the TBI that need exclusive care so that they can remain in activity and with a possibility of reaching the goals for which they are intended.

Conclusions

Thereafter are comments on some criteria used to evaluate the performance of technology business incubators.

Regarding the number of resident incubated companies, the surveyed incubators had an average of approximately 9 incubated companies in each of the three years, with close to 70% of incubators in the sample having less than the average number of incubated companies and

around 30% having more than 9 incubated companies.

On the non-resident incubated companies, the data presented demonstrated a low usage index of this incubation modality. As regards to the number of employees in the incubated companies, the results showed that the TBI are not representing a great contribution to the generation of jobs.

Regarding the occupancy rate of the technology business incubators, the data showed an idle capacity of the TBI. On the number of graduated companies, it was observed the low number of graduations, besides incubators that did not graduate any companies in the three years surveyed. As to protection of IP assets by incubated companies, a low index was also identified in this question.

The results of the study show that of the TBI investigated, 53% are fulfilling the objectives that they proposed to themselves. However, there is a high percentage of technology business incubators that have been partially achieving their objectives, having a low number of incubated companies, a high level of incubator abandonment, a low index of graduated companies, a high idle capacity, low productivity in terms of deposits of registrations and patents; resulting in low employment and income generation and slow regional development.

It was observed in the questionnaire that there were criteria on the results of technology business incubators which were not answered by the TBI managers, such as: number of products generated, number of registries and patents, number of collaborators. This demonstrates the lack of perception on the importance of evaluating the incubator by some managers, since this action offers information to improve the management of the incubator, to evaluate the process of evolution of the incubated companies, besides identifying to what degree the objectives of the TBI are being achieved.

Thus, it is suggested that the manager and other TBI employees elaborate an evaluation model that meets the specificities of the incubator.

It can be concluded, through this research, according to the results presented by the researched TBI, that these are below the fulfillment of the objectives that they proposed to themselves, so that they are not contributing, in an effective way, to the local and regional development. Thereby, it is suggested that the TBI managers should reflect on the real reasons why the organizations researched are not achieving the purposes that justify their existence.

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