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Business incubators in Brazil: realities and challenges

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RESUMO

Objetivo - Este artigo tem como objetivo descrever cinco incubadoras de empresas no Brasil através do contexto da Hélice Tríplice, suas realidades e seus desafios.
Estrutura teórica – A discussão de incubadoras de empresas, Hélice Tríplice e o uso de Tecnologias de Informação e Comunicação em incubadoras são as principais lentes teóricas que suportam a pesquisa.
Design/método/abordagem - Foram realizados cinco estudos de caso em incubadoras das Regiões Nordeste e Sudeste do Brasil. O artigo tem abordagem qualitativa e coleta de dados por meio de entrevistas semiestruturadas. Para analisar os resultados, realizou-se uma comparação entre a teoria e os achados da pesquisa de campo.
Resultados - Os resultados mostraram que a maioria das incubadoras estão em universidades públicas, a maioria tem foco em tecnologia, e algumas possuem diversidade (social e cultural). Alguns parceiros internos e externos os ajudam com apoio financeiro. Um dos desafios (talvez o mais importante) é um conjunto de limitações porque alguns docentes não conseguem compreender a utilização do conhecimento acadêmico para a consultoria**.**
Originalidade/valor – A contribuição principal é apresentar a realidade dessas incubadoras, os resultados empíricos, adicionando uma nova perspectiva a essa discussão**.**
Palavras-chave: Incubadoras de empresas; Desafios; Hélice Tríplice; Tecnologia da Informação e Comunicação.

ABSTRACT

Purpose - *The purpose of this paper is to describe five business incubators in Brazil through the Triple Helix model, their realities and challenges.*
Theoretical framework *– A discussion of Business incubators, Triple Helix and the use of Information and Communication Technologies in incubators are the main lenses used to support the research.*
Design/methodology/approach *– For this purpose, five case studies of incubators in the Northern and Southern Regions of Brazil were used. The paper uses a qualitative approach and collects data through semi-structured interviews. To analyze the results, the theory was compared to the findings from the field research.*
Findings - *The results showed that most incubators are in public universities, the majority focus on technology, and some are diverse (social and cultural). Some internal and external partners help them with financial support. One of the challenges (maybe the most important) is a set of constraints because some lecturers cannot understand how to use academic knowledge in consultancy.*
Research, Practical & Social implications – *The differences found between incubator categories are in the results that lead to this business model being more complex than it is in reality. The presentation of different incubator realities and challenges focusing on the discussion of 'selling' knowledge, the use of public resources by private enterprises, are the practical and social implications.*
Originality/value - *The main contribution is to show the reality of these incubators, the empirical results, adding a new perspective to the discussion.*
Keywords - B*usiness incubators; Challenges; Triple Helix; Information and Communication Technology.*

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1. INTRODUCTION

The study of Triple Helix requires a model which complements the institutional perspective with a focus on interactive operations at the system level, involving actors and agencies, adjusting their positions given institutional constraints and opportunities (LEYDESDORFF; ETZKOWITZ, 1996). Government, universities, and companies promote a partnership among themselves but receive the impacts from problems such as financial, communication, rules, and laws. For this purpose, these members of Triple Helix need information and communication technologies (ICT) to connect them, improving their collaborations, through incubators, which are the chain between these agents.

Incubators are a form of enterprise that houses many enterprises with several departments (incubatees), following a strategic approach towards its business, which affects the kind of firms it houses, support systems that it renders, and the performance of incubatees and the incubator (WASDANI *et al.,* 2022, p. 2). The incubators have members working in teams, using ICT to help their interactions. This information exchanged between incubator members (management, assistants, entrepreneurs, and others) creates a healthy environment for this business. According to Cooper et al. (2012), the success of these exchanges is in the incubator environment, where successful networking can sometimes make the difference between financial success and failure. Besides, knowledge sharing is effective on business incubators' performance in supporting start-ups (ZIBARZANI; ROZAN, 2017).

In Brazil, entrepreneurship is one solution to address labor unemployment problems and to create new business opportunities (SILVA *et al.*, 2018), leading researchers to invest in discussions related to this business model. In recent research findings, the authors show that entrepreneurial ecosystems discussion is still an under-researched phenomenon where conceptual studies dominate recent research. There is a need for more empirical research on the phenomenon (KANSHEBA *et al.,* 2020). This paper contributes to address this gap by describing five business incubators in Brazil through the context of the Triple Helix in this country, their realities, and their challenges. The paper has five sections: the first, the introduction; the second, with the literature review; the third, the methodology; the fourth, the analysis of issues from field research; and the fifth, the conclusions.

2. THEORETICAL FOUNDATION

2. 1 Business Incubators (BI): concepts

The definition of the incubator's focus must consider the local circumstances of the incubator and the region's strategic objectives, considering vocation, weaknesses, local potential, the leading institution, and entrepreneurial culture. Therefore, their results are related to:

- Their focus definition;
- Their integration into the community;
- Their capacity to obtain fundings;
- Their contribution to develop the entrepreneurialism in their regions;
- Their capacity to attract innovative and sustainable projects (ANPROTEC, 2016).

For Bøllingtoft (2012) and Aernoudt (2004), the term business incubators has a broad meaning, which covers heterogeneous realities, and one size fits all. This last author created an expression 'bottom-up business incubator' to differentiate incubators, which do not have any relationship and resources from public or private sectors. Bøllingtoft (2012, p.304) pointed out some roles of Business Incubator (BI) based on other authors and finished the discussion using this argument: "in between are the non-profit development corporation incubators and the academic incubators". According to Bøllingtoft (2012, p.306), "the facilities, services, and opportunities offered by different incubators are often connected to their specific mission and goal". This definition and this idea are the basis of this paper.

According to Aernoudt (2004), InfoDev Incubator Support Center (2015), National Association of Entities Promoting Innovative Enterprises (ANPROTEC, 2002, 2016), and Raupp (2011; 2012) there are different types of BI, depending on their focus and projects, the region and the institution that is supporting it. These types are summarized such as:

- Traditional incubator (where enterprises produce apparel, package, electronics, and plastics products);
- Technology incubator (where the raw material is the technology and the products have high added value);
- Mixed incubator (the incubator supports enterprises with the two profiles mentioned before) (ANPROTEC, 2002; RAUPP, 2011; 2012).

Sansone *et al.* (2020) and Hirschmann *et al. (*2021) explore another type of incubator, the social ones, adding to business and mixed. This type supports social enterprises (SEs) in their early business stages to foster and develop their hybrid objectives (HIRSCHMANN *et al.*, 2021, p. 1095). Grimaldi and Grandi (2005) who studied incubators in Latin countries select four types of incubators: Business Innovation Centres (BICs), University Business Incubators (UBIs), Independent Private Incubators (IPIs), and Corporate Private Incubators (CPIs). Becker and Gassmann (2006) give another kind of categorization. For these authors, we can divide in type (non-core and core) and source of technology (internal and external). Some of these incubators are public, and some are private. One of the greatest adaptations of business incubators came through universities especially public sector universities.

In general, incubators supply the entrepreneurs services that include infrastructure (including physical space), access to a professional network of mentors (or coaches) and an intensive support of a consultant team to help with managerial and legal challenges, creating community, which fosters collaboration and mutual support for entrepreneurs as they address start-up challenges; and it signals legitimacy to external stakeholders, which facilitates access to resources (MIRANDA; BORGES, 2019; NICHOLLS-NIXON, 2022). Grimaldi and Grandi (2005, p.112) identify the main objective of public incubators: “reduce the costs of doing business by offering a set of services ranging from the provision of space, infrastructures and facilities to more elaborate services, as well as by offering access to technical and managerial expertise, assistance in business plan development, etc”. For these authors, incubators need revenue because they are the main source of resources cosidering that they demand public funding from local, national, and international agencies.

Allahar and Brathwaite (2016) stated that universities adopt relatively early models of BI, such as a strategy to encourage business start-ups and promote innovation in the teaching curriculum. Considering university as a place where local economies could find a support for its growth, some authors understand UBIs as institution which provides support and services to develop novice entrepreneurs and their businesses (REDONDO; CAMARERO, 2022). Mian (1996) named business incubators in universities as University Technology Business Incubator (UTBI), and in his paper he studied some incubators in different universities in USA. The author identified services offered by UTBIs that are like services offered by BI.

When Grimaldi and Grandi (2005) wrote about private incubators, they were referring to Independent Private Incubators (IPIs) and Corporate Private Incubators (CPIs). These

incubators support themselves in a financial way charging service fees and taking a percentage of revenues from incubated companies or events in incubators. They contribute to entrepreneurs providing pre-seed, seed, and other early investments, which were traditionally offered by angels and early-stage venture capitalists.

Some authors named some incubators as Technology-Based Enterprise Incubators (TBEI), which provide supplementary training for entrepreneurs in terms of technical and managerial aspects (DE OLIVEIRA *et al*., 2011). As technology-based enterprises (TBEs) are more promising than non-technology firms, there is a strong case for their incubation and promotion, though TBEs use incubators not as support providers for idea incubation but to control costs incurred to develop and implement their ideas, thus defying the objective of incubation (WASDANI *et al.*, 2022, p. 2). Even though, this categorization is common, in this paper we will consider all of them as Business Incubators (BI). Table 1 presents the services offered by different categories of incubators to entrepreneurs:

Table 1 - Services offered by different kinds of incubators.

Category	**Authors**	**Services**
Business Innovation Centres (BICs)	Grimaldi and Grandi (2005:112)	basic services
University Technology Business Incubator (UTBI)	Zeng and Callaghan (2016); Redondo and Camarero (2022)	typical incubator services: basic services and rent breaks
	Allahar and Brathwaite (2016) Mian (1996)	university related services: basic services, university image conveyance, library services, labs/workshops and equipment, related R&D activity, technology transfer programs
Independent Private Incubators (IPIs) Corporate Private Incubators (CPIs)	Grimaldi and Grandi (2005, p. 113)	pre-seed, seed and other early investments

Source: The authors, 2022.

2.2 Brazilian business incubators: S&T&I System

According to Zouain and Silveira (2006), many Brazilian universities have sought to promote technology-based entrepreneurship by some specific programs and business incubators. These programs have financial support, facilities and services offered by Brazilian

agencies (Brazilian Support Service for Micro and Small Enterprises - SEBRAE; Financier of Studies and Projects - FINEP; National Institute of Indus Property - INPI), universities, city halls, and others. The authors assume that there are positive impacts on incubation programs in Brazil developing the enterprises, regional and local economies.

Brazilian universities are also creating Technology Innovation Centers (NITs) to assist researchers in patent application processes, protecting their intellectual property rights, and eliminating the gap between academia and private sector. These centers promote higher integration between universities and private firms, which was one of the objectives of the Innovation Act. Engelman and Fracasso (2013) and Raupp and Beuren (2011) point out another function of incubators in Brazil: to develop an international insertion for enterprises which are in these structures, attract international capital, create technology interchange, management, financial, and infrastructure support. Besides, partnerships allowed by co-creation and co-working nevironment supplied by incubators give access to valuable knowledge that can lead to better results and competitive advantage for the organizations involved (DE FARIA *et al*., 2019). These initiatives led the BI to overcome some challenges, such as:

- The use of laboratories in public universities;
- Attention from the government;
- Resources provided by a private entity;
- Partnerships with companies.

Some institutions created some programs, and all of them are external partners who support BIs in their activities with funding, space, training, and technologies, as Table 2 shows. All these institutions are external partners supporting BIs with funding, space, training, and technologies.

Table 2 - Brazilian Institutions and Programs to support incubators

Institution	Program
Ministry of Science, Tehnology and Innovations (MCTI)	National Program for Incubators Support
FINEP	Innovation Project
MCTI and National Council of Scientific and Technical Development (CNPq)	Program of Human Resources Training to Strategy Activities
Association to Promote Brazilian Software Excellence, MCTI	SOFTEX Program
SEBRAE	SEBRAEtech
FINEP and SEBRAE	Program to Support Micro and Small Enterprises
Rio de Janeiro Federal University - UFRJ and Eldorado Institute	Program of Technological Training
Brazil Entrepreneur Program	Minister of Development, Industry, and External Trade

Source: The authors, 2022.

2.3 Triple Helix and business incubators

There are innovative entrepreneurship support infrastructures (IESI) by public policies, which include incubators, technology centers, and universities (ROIG-TIERNO *et al.*, 2015), which are among the instruments that governments deploy to strengthen entrepreneurship and innovation (OECD, 2011). These infrastructures act as intermediaries (AARON *et al.*, 2013), providing services to improve the results from innovative activities in the fields of knowledge and technology creation and acquisition. Public infrastructures also prepare companies to produce and commercialize their products or services (ROIG-TIERNO *et al.*, 2015).

In this case, universities are responsible for creating and transferring knowledge through education and collaboration with businesses that fall into this group of infrastructures (ROIG-TIERNO *et al.*, 2015). Audretsch (2014) reinforces this idea when he assumes that the existence of a knowledge filter suggests that investments alone in research at universities are not sufficient in facilitating the spillovers that are required to generate innovative activity and economic growth. Thus, commercialization and knowledge transfer to society become the third mission of universities apart from two previous teachings and research (BAYCAN; STOUGH, 2013).

This commercialization of knowledge by universities leads them to another purpose, named as an "entrepreneurial university" which can be viewed as "a university that has developed a comprehensive internal system for the commercialization and commodification of its knowledge" (JACOB *et al.*, 2003, p. 1556). This structure is in a researcher-governed system that distinguishes between four types of governance structures: the market structure, the Technology Transfer Office (TTO) structure, the wholly-owned start-up firm structure, and the partially owned start-up firm structure. TTO is one of the most common structures in a university, where enterprises expect that there is a commercialization of research knowledge (BENGTSSON *et al.*, 2009). Even though this initiative from universities by TTO is necessary, Jamil *et al.* (2015, p.226) stated that "a financial framework suitable for commercialization tools such as technology parks and university incubators needs to be institutionalized. The participation of various financial hubs should be recognized and triggered to enhance the efficacy of technology parks and university incubators for expanded research commercialization".

In Latin America these 'hubs' are insufficient to support world-class clusters in S&T industries, the creation and/or expansion of research universities and the implementation of the academic commercialization model is one of the most promising strategies available to policymakers attempting to upgrade its innovation systems (SARGENT; MATTHEWS, 2014).

To help incubators in their management and network, Anprotec and SEBRAE (ANPROTEC, 2002) created the Cerne model, implemented in more than 100 incubators, but just 21 Brazilian incubators are certified in different levels of model (ANPROTEC, 2022). The model proposes a generic process to be implemented by an incubator, and practices (how) to be executed by the incubator to contribute to the local innovation system. For this purpose, the model was structured into three lays incubator, process, and the company. It was proposed to be a maturity model, which will create innovative companies, and has four levels of maturity: company, incubator, partnership network, and international action (ANPROTEC, 2022). Even though Anprotec and SEBRAE support the incubators with the Cerne model, as we see above, some of these incubators did not implement it.

Mansano and Pereira (2016) argued that promoting a culture of technology innovation is vital and not confined to R&D considerations, but includes investment policies, education, market dynamics, and strategic public-private partnerships. Further, universities must be seen

as part of the innovation system and promoters of innovative projects, giving managerial knowledge to entrepreneurs, because they have solely technical expertise related to their incubation proposal.

Generally, sponsorship and funding of BI came mainly from governments through scholarships for BIs' managers, for example, and financial support is received from the private sector. In Brazil, BIs are funded through federal government programs such as the National Incubation Support Program (PNI) and a collection of government, industry, and incubator associations like Anprotec (ALLAHAR; BRATHWAITE, 2015). In Brazil, incubators have different sources of funds (scholarships, investments, equipment, conferences' registration, etc), from different institutions, such as the National Bank for Social and Economic Development (BNDES), the State institutions for research (FAPERJ, FAPESP, FAPEMIG, etc), and FINEP.

2.4 Regulation and laws in Brazil

For the success of research-innovation relationship, some laws were created. In the USA, the Bayh-Dole Act allows universities to negotiate the innovations appeared in their campi and spread to society, because before this Act, the knowledge was strictly for the federal government (AUDRETSCH, 2014). While the US was discussing Bayh-Dole Act in congress, Brazil has, from an evolutionary perspective, the specificities of such a system, which should be analyzed in terms of niche creation and niche management within a global economy (LEYDESDORFF; ETZKOWITZ, 1996). In Brazil, the Lei da Inovação (translated to 'Innovation Federal Law') authorizes incubation within Scientific and Technological Institutions, allowing companies to use their laboratories, equipment, tools, materials, and facilities. As a return, these Institutions that serve as incubators are granted with a patent licensing and transfering the technologies developed in their facilities. Besides, the institution receives part of the revenue related to what it developed (BRASIL, 2016).

While the Lei da Inovação turns its attention to developing the incubator role of Scientific and Technological Institutions, the so-called Lei do Bem (translated to 'Good Law'), foreseen in the Innovation Federal Law, focuses on enterprises. The law provides tax incentives for companies that support and develop research activities, development, and technological innovation. The implementation and operation of technology-based incubators

by private companies are leveraged and essential to make a company eligible to receive the incentive, which makes the Lei do Bem a source of support for the incubation practice (Associação Nacional de Pesquisa e Desenvolvimento das Empresas Inovadoras [ANPEI], 2016).

The Lei da Informática (translated to 'Informatic Law') grants tax incentives to companies in the technology sector, specifically for firms involved with business related to hardware and automation that are proven to invest in Research and Development, which also benefits technology Incubators. These tax incentives involve the reduction of the Tax on Industrialized Products (IPI) for enabled /encouraged products. Similarly to the Lei do Bem, implementing and operating technology-based incubators are practices that allow a company to be eligible to receive the incentive granted by the government, what, as a consequence, serves as a source of motivation to the incubation activity by companies from the hardware and automation sectors (MDIC, 2020).

On January 11th, 2016, the President of Brazil approved Law 13.243, article 4, the Legal Marco of Science, Technology, and Innovation (STI). In this law, a university is considered an STI institution, sharing, in a period, by a contract, with or without payment, laboratories, equipment, and materials with other STIs or private enterprises, since they are working under technology innovation in an incubator, preserving their activities. The third resolution is related to the STI allowing the use of its intellectual capital in research projects, development, and innovation activities and actions. In addition, STIs, even public, can receive financial resources.

2.5 Information and communication technologies and Triple Helix

Information and communication technologies (ICT) allow access to information through telecommunications, so the term is similar to IT but is also concerned with communication technologies such as the internet, wireless networks, cell phones, voice over internet protocol, video conferencing, social networking sites such as Facebook, and other communication media (ALZAGHAL; MUKHTAR, 2017, p. 538).

The foundational premise of a technology incubator is the valorization of the techno-entrepreneur for whom the incubator is offered as a repository of experience, a network of relations, and a nurturing environment within which to explore his/her innovation potential

(KAWLRA, 2013). This premise is possible to apply for a business incubator, where networks are critical to its success and particularly relevant to innovation because networks, innovative initiatives, communications strategies, and marketing are key concepts in promoting innovative businesses (CORREIA *et al.*, 2015). Gonçalves and Freire (2007, p.19) presented some challenges in the communication of information process. They focused on one Brazilian incubator, but before that, they listed some barriers to this communication in technological places, such as:

- Laboratories: problems in communicate with the community, especially with state and federal governments);

- Users Group: limited data about science and technology, frequently the data is not oriented to the users, irregular dissemination of information;

- Public: lack of information about opportunities and absence of comprehension about the benefits of technologies.

Miranda and Borges (2019) state out that is critical to incubators to develop both highly skilled teams of consultants and social environment that facilitates communication. The use of ICT tools supports this communication and is very important for any organization wishing to increase competitiveness, save a lot of time and money, and improve the effectiveness of decision-making (ALZAGHAL; MUKHTAR, 2017).

3. METHODOLOGICAL PROCEDURES

Here, in this paper, four public incubators and one private incubator (Southern and Northern Regions in Brazil) are the multiple case studies research method in a qualitative approach. The literature review supported the questions, defining constructs to design the theory-building research (EISENHARDT, 1989). To collect data, the authors used three kinds of source of qualitative information interviews, observation (one researcher asked and typed the answers, while another one observed the interviewees reactions), documents (folders and websites of incubators), and semi-structured interviews (EISENHARDT, 1989; CRESWELL, 2013).

The questionnaire has open questions, and the initial visits to the research sites included a series of questions. They are the basis to understand the organization's background, ST&I [Science, Technology, and Innovation System, the incubator structure such

as TTO and others], focus, internal and external partners, project areas, benefits, and communication (challenges and ICTs). The authors asked more questions about one or two of the projects (enterprises) to understand objectives and goals, the type of incubator, how long the project has been in action, details about the team members, and relationships with other agents of TH.

After the initial interviews, the authors identified five projects/incubators to study in more detail. The interviewees asked to preserve the identities of the incubators, so we used letters to identify them (IA, IB, IC, ID, and IE). The sample strategy is snowball, where the researcher identifies cases of interest from people who know people who know what cases are information-rich (Miles and Huberman, 1994, p. 28).

The interviews spent one hour and a half and were done in person before the pandemic time. The interviewees' profiles are in Table 3:

Table 3 - Interviewees' profiles

Aspects	IA	IB	IC	ID	IE
Academic background	Economist	Chemist	Journalist	Designer	Business/Management
Role at the university	Innovation Agency Director	Innovation Center Coordinator	Professor	Technician	Technician
Role at the incubator	Director	Coordinator	Manager	Coordinator	Coordinator

Source: The authors, 2022.

Immediately following each interview, an author transcript them and analyzed each one with the literature review. Then, the authors compared the incubators to check the differences according to their characteristics detailed in the next section. This comparison is close to a cross-case analysis (CRESWELL, 2013). After creating a preliminary synthesis of the findings, we reviewed open questions and insights with key stakeholders and incorporate their feedback into our final analysis, comparing the theory with field results.

4. RESULTS AND DISCUSSIONS

4.1 Discussion: presenting the case studies

Incubator A (IA) is a part of a Federal University since 2009 and focuses on technology transfer, knowledge generation, and service provision. Today, the communication between the IA staff is mostly via e-mails, through distribution lists.

The Incubator (IB) has been part of Federal University B since 2006. Besides working with the incubated companies, the IB regulates junior companies of different undergraduate majors at the university, supporting their students. The IB is part of the Center for Technological Innovation and Entrepreneurship of the university (which includes Intellectual Property and technology transfer - NITE), whose coordinator is also the incubator coordinator. Besides, IB pertains to the Dean of Research and Graduate.

The incubator C (IC) was founded in 1997, supported by different institutions (funds, foundations, private companies, a bank, and an international university). It is under the supervision of the Vice Dean of Development at the university. Until 2001 every project was focused on the technology area. After this year, the IC began to act in the creative economic sector, and in 2005 had the first projects in the social sector. The incubator has three different kinds of actions: incubating, spreading the entrepreneurship culture, and teaching (courses).

The incubator D (ID) pertains a unity in a public university since 1994 and participates in the generation of 85 companies. The entrepreneurs are, in the majority, students who had their Master and Ph.D. certificates in this university, in Engineering major (25%). The university has a technology park inside one of its campi, where the Engineering departments and the incubator are. There is a possibility of integration among the companies in the ID and the others inside the technology park. Even though there is this integration (between ID and technology park), the Research and Development (R&D) decisions are outside the park. The companies in ID have a global market, but they are still operating in local ones.

The ID focuses on the energy, Petroleum and gas, environmental activities, information technology, biotechnology, materials, and robotics, presenting a technology basis. The focus was on the consultancy in software because of space constraints, but in 2012 a new building was launched that allows the creation of prototypes, attracting robotic and

biotechnology companies. Even though the ID is close to the Life Science Center, its focus is still on the Engineering.

The incubator E (IE) was founded on November 14th, 1997, and regulated on September 17th, 2010, launching its first call in 2011 and incubating its first enterprise in 2012. It has a mission to motivate and support entrepreneurs in the processes or generation, consolidation, and growth of micro, small, and medium enterprises in the Northern, promoting regional sustainable development. The IE is on a State University campus, and it is under the Vice dean. The main aspects of these incubators are in Table 4:

Table 4 - Comparison between incubators.

Aspects	IA	IB	IC
ST&I (Science, Technology, and Innovation) System			
Incubators' focus	Technological and social	Technological, cultural, and social	Technology, cultural, and social
TH constrains	-	Lack of support from the city hall	The knowledge property inside the university
The Incubator			
Structure	Inside Innovation Agency	Inside NITE	Vice Dean of Development
Focus	Service and software	Services and products (interest)	Services
External partners	FAPs, CNPq	FAPs, CNPq, CAPES, SEBRAE, Foundation of the university's School of Engineering	Foundations, CNPq, CAPES, SEBRAE, Companies, Associations, University on Chile
Internal partners	University, Students and Director	Students, coordinator, manager, and incubated entrepreneurs	International Relationship Dept., entrepreneurs, coordinator, departments
Project areas	Social, life sciences, technology	Cultural, social, technology	Cultural, Social, technology
Benefits	Supporting small businesses	Local and regional development Creating a local culture of entrepreneurship Bonding university and the community	Make a bridge between the university and the market, development of entrepreneurship capacity, reduces the risks of entrance in the market
Communication/ ICT			
Challenges	Communication in general	Internal - communication with "traditional" faculty members External - convince the mayor of the importance of the incubator, attract business resources for	The use of shared files (space in the server), time management, different graduations, different levels of commitment

		the IB	
ICTs used	E-mail, distribution lists, and Facebook	One Drive, Dropbox and Facebook	Facebook, Twitter, Instagram, YouTube, meetings' platforms, Facebook, WhatsApp, Google agenda

Table 4 - (be continue).

Aspects	ID	IE
ST&I (Science, Technology, and Innovation) System		
Incubators' focus	Technology	Biotechnology and renewable energies
TH constrains	Visibility of incubators	Interaction with companies and State Government
The Incubator		
Structure	Innovation and Technology Directory of Engineering School	Subordinated by the Dean office, has a parallel function with Technology Innovation Center
Focus	Services and products	Services and products
External partners	Innovation Agency, State Foundation, FINEP, CNPq, ANPROTEC, Communication Dept of technology park	State Government, the State Foundation of Research, State Incubators Net, REDENIT, and SEBRAE
Internal partners	The Engineering coordination graduation programs, Innovation Agency, manager, technicians, and enterprises	Dean and vice dean, Unity of Research in Transfer of Biotechnology and Innovation, NIT, Institute of Studies, Research, and Projects, laboratories
Project areas	Technology and health/life science	Biotechnology and renewable energies
Benefits	Visibility to the city and to State as innovators entities, and to the university as an entrepreneur	Changes in the researchers' profile, development of innovation products, employment and income, spread the university brand, and return to the society what it gave by its taxes to the university, make the bridge between market and university
Communication/ ICT		
Challenges	Language and culture of university is different of companies, different languages (to interact with multinational companies in the park)	Sharing laboratory and some resources of university with a company; some entrepreneurs do not understand their role in the incubator, and director of one unity/center demands a control over the incubator that his position does not have
ICTs used	Website, e-mail, Facebook, meetings' platforms, LinkedIn, blog, Dropbox	E-mail, WhatsApp, Facebook, Twitter and its website

Source: The authors, 2022.

4.2 Analysis of case studies

Based on the interviews and the aspects summarized in Table 4 and according to the literature (ANPROTEC, 2002; RAUPP, 2011; 2012; AERNOUDT, 2004; INFODEV INCUBATOR SUPPORT CENTER, 2015; SANSONE *et al*., 2020), IA, ID, and IE are technology incubators. On the other hand, IB and IC have mixed/social profiles because they incubate enterprises with technology, cultural and social projects.

The classification of public and private incubators is not easy for the sample. Even though the majority is on a public university campus (IA, IB, ID, IE), they are not - as Mian (1996) named - business incubators in universities (UTBI). Some incubators are closer to the BIC concept because they classify themselves as a center of entrepreneurship. IA is a UBI, IB pertains to the Innovation and Entrepreneurship Center, but according to the director and the IB site, it is a Business Innovation Centers (BIC) (GRIMALDI; GRANDI, 2005, P.111; ALLAHAR; BRATHWAITE, 2016). IC is in a private university, has private source of resources, being classified as a Corporate Private Incubator (CPIs). ID is a BIC and is in the technology park, which is on the university campus. IE is on a public university campus and belongs to this institution because it is a center legally linked to the university where it is located, under the vice dean's control, so it is a BIC.

All of them offer different kinds of services, as the authors pointed. IA, IB, and ID select the best alternatives of funds and other opportunities for financial resources to enterprises. In the past, IB had some professors supervising the entrepreneurs. IC offers courses, such as one about Business plans, IPO, and managing enterprises. ID gives support to entrepreneurs, helping them with Intellectual Property, with a psychologist, supervising them, and IE gives traditional support (MIAN, 1996; TOTTERMAN; STEN, 2005; ABETTI, 2004; MARTINS *et al*., 2006).

Grimaldi and Grandi (2005, p.113) wrote about private incubators, and they are referring to IPIs and CPIs. The IC is one of the CPI cases and contributes to entrepreneurs providing pre-seed, seed, and other early investments. In addition, IC offers supervision on business models, coaching by staff, recruiting mechanisms, instant infrastructure, networks with key strategic actors and experts in business, and provision of technology to accelerate product development or support.

Brazilian universities are also creating Technology Innovation Centers (NITs) to help them link innovation initiatives (projects, proposals, companies, financial resources, institutions, and to promote TH). IA, IB, IC, and ID connect these initiatives in an Innovation Center (agency). IE built a network in the State where it is to connect all resources and ideas to innovation purposes.

The creation of these centers can help incubators and their staff to connect entrepreneurs with universities, mainly after Legal Marco of STI, in 2016 (ENGELMAN; FRACASSO, 2013; RAUPP; BEUREN, 2011). Some respondents presented their problems with this relationship between incubators, universities, and government (the majority is public and federal, so they depend on federal laws to share their resources). In IA, in the past was extremely hard to see the incubator as an agent to promote innovation and entrepreneurship inside the university where it is. Some faculty members did not approve the use of public space by a private company. Nowadays, the university administration is trying to promote this connection between the university and incubator and its enterprises. For IB, the Innovation Law helps them to encourage the use of university laboratories by incubated companies, though it is still a challenge. This point of view reduces the possibility to establish partnerships between professors, students, research groups, and the IB. IC has problems with knowledge selling, some employees do not see this as a function of the university, in this TH 'network', though it is private. In ID, the university does not see the enterprise incubated as a customer. IE has some problems in this case, with some professors, in the countryside (another campus).

The benefits described by the respondents are similar to the literature review, mainly in the IE (ZOUAIN; SILVEIRA, 2006; MARTINS et al. 2006; TOTTERMAN; STEN, 2005; ABETTI, 2004). The creation of an entrepreneurship culture in the university is a benefit that interviewees mentioned, too (MANSANO; PEREIRA, 2016).

There are innovative entrepreneurship support infrastructures (IESI), which support incubators and enterprises located there, as cited above (ROING-TIERNO et al., 2015; OECD, 2011; AARON *et al.,* 2013; EUROPEAN COMMISSION ENTERPRISE DIRECTORATE-GENERAL, 2002). These agents are the external partners, which are in common for all incubators in this research, such as the National Council of Scientific and Technology Development (CNPq) and State Research Support Foundations (FAPs). Besides, IB and IC have National Coordination of Superior Level Human Resources (CAPES), and IB,

IC, and IE have external support from SEBRAE. Anprotec supports, according to the interviewees, ID and other institutions not well-known in the ST&I system (Table 2). Most of these institutions were cited above and given to the incubators and enterprises funds, scholarships, and training.

The external partners are agents to increase the performance of incubators and the external partners are agents to increase the performance of incubators and the enterprises, but other public infrastructures also prepare these enterprises to produce and commercialize their products or services (ROING-TIERNO *et al*., 2015). Laws as Lei da Inovação, Lei do Bem, Lei da Informática, Marco Legal, the creation of TTO, lead the universities to be responsible in creating, transferring, and commercializing knowledge (BENGTSSON *et al*., 2009; ROING-TIERNO et al., 2015; AUDRETSCH, 2014; BAYCAN; STOUGH, 2013; JACOB *et al*., 2003; JAMIL *et al*., 2015; ANPEI, 2016). These actions connect incubators and universities to other agents of Triple Helix, as organizations and government, though is not a local initiative, but a global one (LEYDESDORFF; ETZKOWITZ, 1996). Nowadays, the "entrepreneurial university" has been having not just a concept, but a strategy adopted by some universities, guiding and teaching incubators, improving their skills and creating tasks (supporting the entrepreneurs). The universities and other governmental agents (State and Federal) are part of National System of ST&I, which offer investment policies, education, market dynamics, and strategic public-private partnerships (JACOB *et al*., 2003; MARTINS *et al*., 2006; TOTTERMAN; STEN, 2005; ABETTI, 2004; MANSANO; PEREIRA, 2016). All incubators in this study recognize the importance of laws and management skills in the universities to incubators. In addition, they have internal partners, as shown in Table 2.

The incubators present different communication challenges as internal (IA, IB and IE) related to consultancy, the payment by incubators for the use of facilities in universities, the intellectual property, though it is the third mission of universities as see in Baycan and Stough (2013). According to IB interviewee, the external challenge is to convince the mayor that the incubator attracts business resources for itself. IC has a technical problem as sharing files in its server, which has less memory than the incubator needs. Besides, the incubator has managerial issues, such as different levels of commitment and points of views to solve the same problem. ID pointed that the communication between university and companies occurs using different languages and cultures. IE adds problems with entrepreneurs and the Engineering School Director because he does not know his role in incubator. These

challenges about communication cause problems in their networks, which are especially important to these incubators (KAWLRA, 2013; CORREIA *et al.*, 2015; MIRANDA; BORGES, 2019).

The incubators teams need ICT to connect them, to work better. As Gonçalves and Freire (2007) presented, these incubators have some challenges in communication of information process. Anprotec joins the incubators in a system, by the Cerne model, what is a way to create a cluster, as Nemova *et al.* (2015) studied. All incubators' members communicate between themselves internally and externally by e-mail and Facebook, and the IC uses more ICT tools than others do. IA was looking for a Customer Relationship Management (CRM) to improve its communication processes, which can lead it to a strategic plan. IB pointed out that its major challenge in this subject is the communication with traditional professors at the university. ID uses ICTs daily, and its challenge is to choose the most important news to publish by its communication sector. IE has a communication challenge related to technical constraints (network and telecommunication) in university campus. All incubators used a managerial software to support the Cerne model and their management.

The Triple Helix constrains are the lack of support from the City Hall (IB), the knowledge property inside the university (IA, IB, IE), the visibility of incubators (ID), the relationship between enterprises in incubator and the State Government (IE).

5. CONCLUSION

The culture of universities in Brazil has changed, mainly after the set of laws and initiatives from the government and incubators. In the sample investigated, there is a limitation in the universities, the understanding of the knowledge selling. This behavior is unproductive because it creates a barrier against knowledge and innovation. On the other hand, laws and Marco Legal support the development of entrepreneurship culture in the universities.

The innovative entrepreneurship support infrastructures (IESI) contribute to the goals of incubators and entrepreneurs. They are not only financial support, but they are external and internal partners that offer a place, training, mentoring, and coaching for entrepreneurs, not only to perform when they are in the incubator but after, to compete at the same level as other

companies in the market. Therefore, the Cerne model is strategy support, which gives a pattern and a guide to developing the functions of the incubators. Besides, because some incubators have some challenges in exchanging information, the Cerne model and Anprotec connect them.

In general, the incubators did not present problems with communication between their member and the entrepreneurs. On the other hand, Triple Helix has some challenges for this sample, such as the lack of support from the city hall. State and federal governments do not give all support – mainly financial, but they allow the incubators to work, giving some financial resources and approving laws to develop the innovation process.

References

AARON, C.; GLAESER, E. L.; KERR, W. R. Clusters of entrepreneurship and Innovation. **NBER Working Paper Series, Working Paper**, v. 19013, p. 1-37, 2013.

ABETTI, P. A. Government-supported incubators in the Helsinki region, Finland: infrastructure, results, and best practices. **The Journal of Technology Transfer**, v. 29, n. 1, p. 19-40, 2004.

AERNOUDT, R. Incubators: tool for entrepreneurship? **Small business economics**, v. 23, n. 2, p. 127-135, 2004.

ALLAHAR, H.; BRATHWAITE, C. Business incubation as an instrument of innovation: the experience of South America and the Caribbean. **International Journal of Innovation: IJI Journal**, v. 4, n. 2, p. 71-85, 2016.

ALZAGHAL, Q. K.; MUKHTAR, M. Factors affecting the success of incubators and the moderating role of information and communication technologi**es. International Journal on Advanced Science, Engineering and Information Technology**, v. 7, n. 2, p. 538-545, 2017.

ASSOCIAÇÃO NACIONAL DE ENTIDADES PROMOTORAS DE EMPREENDIMENTOS INOVADORES (Anprotec). **Incubadoras certificadas**. Available at: https://anprotec.org.br/cerne/incubadoras-certificadas/ Access on October 21st, 2022.

ASSOCIAÇÃO NACIONAL DE ENTIDADES PROMOTORAS DE EMPREENDIMENTOS INOVADORES (Anprotec). **Estudo de impacto econômico: segmento de incubadoras de empresas do Brasil**, Associação Nacional de Entidades Promotoras de Empreendimentos Inovadores. – Brasília, DF, Brazil, ANPROTEC: SEBRAE, 2016, 26 p.

ASSOCIAÇÃO NACIONAL DE ENTIDADES PROMOTORAS DE EMPREENDIMENTOS INOVADORES (Anprotec). **Planejamento e implantação de incubadoras de empresas**. Brasília: ANPROTEC/ SEBRAE, 2002.

ASSOCIAÇÃO NACIONAL DE PESQUISA E DESENVOLVIMENTO DAS EMPRESAS INOVADORAS (ANPEI). **Lei do Bem. Leis de incentivo,** 2016. http://anpei.org.br/leis-de-incentivo/lei-do-bem/ Accessed November 02nd, 2020

AUDRETSCH, D. B. From the entrepreneurial university to the university for the entrepreneurial society. **The Journal of Technology Transfer**, v. 39, n. 3, p. 313-321, 2014.

BAYCAN, T.; STOUGH, R. R. Bridging knowledge to commercialization: the good, the bad, and the challenging. **The Annals of Regional Science**, v. 50, n. 2, p. 367-405, 2013.

BECKER, B.; GASSMANN, O. Gaining leverage effects from knowledge modes within corporate incubators. **R&D Management**, v. 36, n. 1, p. 1-16, 2006.

BENGTSSON, L.; NILSSON, A. S.; RICKNE, A. Why and how do researchers engage themselves in commercialization of research. In: INTERNATIONAL CONFERENCE ON ORGANIZATIONAL LEARNING, KNOWLEDGE AND CAPABILITIES, 2009, Amsterdam. **Proceedings…** Amsterdam, 2009.

BØLLINGTOFT, A. The bottom-up business incubator: Leverage to networking and cooperation practices in a self-generated, entrepreneurial-enabled environment. **Technovation**, v. 32, n. 5, p. 304-315, 2012.

BRASIL. Lei no. 13.243, de 11 de janeiro de 2016. Presidência da República. Secretaria-Geral. Subchefia para Assuntos Jurídicos, 2016. Available at http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2016/lei/l13243.htm. Access on October 10th, 2022.

COOPER, C. E.; HAMEL, S. A.; CONNAUGHTON, S. L. Motivations and obstacles to networking in a university business incubator. **The Journal of technology transfer**, v. 37, n. 4, p. 433-453, 2012.

CORREIA, T. J.; MATEUS, A.; LEONOR, S. Marketing communications model for innovation networks. **International Journal of Innovation**, v. 3, n. 2, p. 43-53, 2015.

CRESWELL, J. W. **Research Design**: Qualitative, Quantitative, and Mixed Methods Approaches. 4a. ed. Califórnia: SAGE, 2013.

DE FARIA, A. M.; JUNIOR, M. M. O.; BORINI, F. M. Public funding for innovation: The importance of individual resources of the entrepreneur and the relational resources of the firm. **Technology in society**, v. 59, p. 101159, 2019.

DE OLIVEIRA, R. S: LIMA, A.A. T. de F. de C., FERREIRA, M. A.; PEREIRA, N. R. Analysis of competences for innovation in technology-based enterprise incubators. **Latin American Business Review**, v. 12, n. 3, p. 187-207, 2011.

EISENHARDT, K. M. Building theories from case study research. **Academy of Management Review**, v. 14, n. 4, 532-550, 1989.

ENGELMAN, R.; FRACASSO, E. M. Contribuição das incubadoras tecnológicas na internacionalização das empresas incubadas. **Revista de Administração**, v. 48, n. 1, p. 165-178. https://dx.doi.org/10.5700/rausp1080

EUROPEAN COMISSION ENTERPRISE DIRECTORATE-GENERAL. **Benchmarking of business incubators**, Final Report. Centre for Strategy and Evaluation Service. 47p, 2002.

GRIMALDI, R.; GRANDI, A. Business incubators and new venture creation: an assessment of incubating models. **Technovation**, v. 25, n. 2, p.111-121, 2005.

GONÇALVES, M.; FREIRE, I. M. Processo de comunicação da informação em empresas de uma incubadora tecnológica. **Ciência da Informação**, v. 36, n. 2, p.16-26, 2007.

HIRSCHMANN, M.; MORITZ, A.; BLOCK, J. H. Motives, supporting activities, and selection criteria of social impact incubators: An experimental conjoint study. **Nonprofit and Voluntary Sector Quarterly**, v. 51, n. 5, p. 1095-1133, 2022.

INFODEV INCUBATOR SUPPORT CENTER. **Business Incubation Definitions and Principles** - trainee manual. Module 1. 2015. Available at http://www.infodev.org/infodev-files/m1_traineemanual_20101029.pdf. Accessed on November 11th, 2020.

JACOB, M.; LUNDQVIST, M.; HELLSMARK, H. Entrepreneurial transformations in the Swedish University system: the case of Chalmers University of Technology. **Research Policy**, v. 32, n. 9, p.1555-1568, 2003

JAMIL, F.; ISMAIL, K.; MAHMOOD, N. A review of commercialization tools: University incubators and technology parks. **International Journal of Economics and Financial Issues**, v. 5, n. 1S, p.223-228, 2015.

KANSHEBA, J. M. P.; WALD, A. E. Entrepreneurial ecosystems: a systematic literature review and research agenda. **Journal of Small Business and Enterprise Development**, v. 27, n. 6, p. 943-964, 2020.

KAWLRA, A. ICT mediated development for whom? A reflexive ethnography of ICT, in Oakley, R., Yalamala, R. and Kasi, K. (Eds.), **Social exclusion in India: critical ethnographic discourse from the margins**. Annuaire Roumain d'Anthropologie, p. 40-51, 2013.

LEYDESDORFF, L.; ETZKOWITZ, H. Emergence of a triple helix of university-industry-government relations. **Science and Public Policy**, v. 23, n. 5, p. 279-286, 1996.

MANSANO, F. H.; PEREIRA, M. F. Business incubators as support mechanisms for the economic development: Case of Maringá's Technology Incubator. **International Journal of Innovation**, v. 4, n. 1, p.23-32, 2016.

MARTINS, G. S.; XAVIER, W. S.; LIMA, A. A. T. DE F. C.; OLIVEIRA, A. R. DE; GAVA, R. A interação universidade/empresa nas Incubadoras de Empresas de Base Tecnológica de Minas Gerais. In: SIMPÓSIO DE GESTÃO DA INOVAÇÃO TECNOLÓGICA, 24., 2006, Rio Grande do Sul, **Proceedings**... Rio Grande do Sul: ANPAD, 2006, p. 17-20.

MIAN, S. A. Assessing value-added contributions of university technology business incubators to tenant firms. **Research Policy**, v. 25, n. 3, p.325-335, 1996.

MILES, M. B.; HUBERMAN, A. M. **Qualitative data analysis**: an expanded sourcebook. 2nd ed., 1994. Los Angeles: SAGE.

MINISTÉRIO DA INDÚSTRIA, COMÉRCIO EXTERIOR E SERVIÇOS (MDIC). Lei de Informática, 2020. Available at http://www.mdic.gov.br/index.php/inovacao/lei-de-informatica Accessed on November 19th, 2020.

MIRANDA, M. G.; BORGES, R. Technology-based business incubators: An exploratory analysis of intra-organizational social networks. **Innovation & Management Review**, v. 16, n. 1, p. 36-54, 2019.

NEMOVA, D.; BAGAUTDINOV, R.; MUSHINSKIY, A. University-business Cooperation Based on Virtual Research Information Service**. Procedia Engineering,** v. 117, p.1115-1121, 2015.

NICHOLLS-NIXON, C. L.; VALLIERE, D.; SINGH, R. M.; CHAVOUSHI, Z. H. How incubation creates value for early-stage entrepreneurs: the People-Place nexus. **Entrepreneurship & Regional Development**, v. 34, n. 9-10, p. 1-22, 2022.

OECD. **Regions and Innovation Policy**. OECD Reviews of Regional Innovation, OECD Publishing, 2011.

RAUPP, F. M. Perfil das incubadoras de empresas brasileiras. In: Encontro Nacional de Engenharia de Produção, 32., 2012, Rio Grande do Sul. **Proceedings**... Rio Grande do Sul: ABEPRO, 2012. p. 1-12.

RAUPP, F. M.; BEUREN, I. M. Perfil do suporte oferecido pelas incubadoras brasileiras às empresas incubadas. **Revista Eletrônica de Administração**, v. 17, n. 2, p. 330-359, 2011.

RAUPP, F. M. Gestão de custos nas empresas incubadas em incubadoras brasileiras. **Revista Gestão Industrial**, v. 7, n. 2, p.155-171, 2011.

REDONDO, M.; CAMARERO, C. Building the first business relationships: incubatees in university business incubators (UBIs). **Entrepreneurship Research Journal**, v. 12, n. 4, p. 597 – 6271, 2022.

ROIG-TIERNO, N.; ALCÁZAR, J.; RIBEIRO-NAVARRETE, S. Use of infrastructures to support innovative entrepreneurship and business growth. **Journal of Business Research**, 2015, v. 68, n. 11, p. 2290-2294, 2015.

SANSONE, G.; ANDREOTTI, P.; COLOMBELLI, A.; LANDONI, P. Are social incubators different from other incubators? Evidence from Italy. **Technological Forecasting and Social Change**, v. 158, 120132, 2020.

SARGENT, J.; MATTHEWS, L. Latin American Universities and Technology Commercialization. **Latin American Business Review,** v. 15, n. 2, p. 167-190, 2014.

SILVA, M. C.; RAMPASSO, I. S., ANHOLON, R., ORDOÑEZ, R. E. C., QUELHAS, O. L. G.; DA SILVA, D. Critical success factors of Brazilian business incubators. **Latin American Business Review**, v. 19, n. 3-4, p. 197-217, 2018.

TOTTERMAN, H.; STEN, J. Start-ups: business incubation and social capital. **International Small Business Journal**, v. 23, n. 5, p.487-511, 2005.

WASDANI, K. P.; VIJAYGOPAL, A.; MANIMALA, M.J. Business Incubators: A Need-Heed Gap Analysis of Technology-based Enterprises. **Global Business Review**, p. 1-23, 2022.

ZENG, P.; CALLAGHAN, V. A cooperative approach to academic entrepreneurial initiatives. **International Journal of Innovation**, v. 4, n. 1, p. 13-22, 2016.

ZIBARZANI, M.; ROZAN, M. Z. A. The Role of Knowledge Sharing in Business Incubators Performance. In: **International Conference of Reliable Information and Communication Technology**. Springer, Cham, 2017. p. 719-727. https://doi-org.ez24.periodicos.capes.gov.br/10.1007/978-3-319-59427-9_74

ZOUAIN, D. M.; DA SILVEIRA, A. C. Aspectos estratégicos do modelo de gestão em incubadoras de empresas de base tecnológica, **Cadernos EBAPE.BR**, v. 4, n.3, p. 1-14, 2006.