IMPACTO CIENTÍFICO EDITORA

INNOVATION ECOSYSTEMS: A COMPARATIVE ANALYSIS OF THE MAPPING OF ACTORS BY SEBRAE IN PIAUÍ AND THE MIT IECOSYSTEMS MODEL

ECOSSISTEMAS DE INOVAÇÃO: UMA ANÁLISE COMPARATIVA DO MAPEAMENTO DOS ATORES PELO SEBRAE NO PI E O MODELO MIT IECOSYSTEMS

ECOSISTEMAS DE INNOVACIÓN: UN ANÁLISIS COMPARATIVO DEL MAPEO DE ACTORES DEL SEBRAE EN PIAUÍ Y EL MODELO IECOSYSTEMS DEL MIT

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ABSTRACT

Innovation ecosystems have emerged as important elements for driving economic and social development in different regions. A precise understanding of the actors and actions that constitute these ecosystems is essential to guide effective policies and strategies for

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promoting innovation and entrepreneurship. This research aims to analyze the congruence between the actors in the local innovation ecosystem mapped by Sebrae Piauí and the MIT iEcosystems model. To this end, specific objectives were also carried out, such as identifying new actors in the state's local innovation ecosystem and evaluating the scope and representativeness of the actors mapped by Sebrae Piauí in relation to the components identified in the MIT iEcosystems model. It was concluded that the congruence between the elements and inputs of the iEcosystems methodology and the actors mapped by Sebrae is, in general, strong, with each element finding an appropriate counterpart among the actors from Sebrae. However, there are some gaps, especially in the specific details of governance and some more granular aspects of innovation and entrepreneurship that could be the subject of deeper analysis.

Keywords: Innovation Ecosystems. Innovation. Iecosystems Methodology. ELI Sebrae Methodology.

RESUMO

Os ecossistemas de inovação têm emergido como elementos importantes para impulsionar odesenvolvimento econômico e social em diferentes regiões. A compreensão precisa dos atorese ações que constituem esses ecossistemas é essencial para orientar políticas e estratégias eficazes de promoção da inovação e do empreendedorismo. Esta pesquisa tem como objetivo geral analisar a congruência entre os atores do ecossistema local de inovação mapeados pelo Sebrae Piauí e o modelo MIT *iEcosystems*. Para tanto, foram realizados também objetivosespecíficos, tais como, identificar novos atores no ecossistema local de inovação do estado,avaliar a abrangência e a representatividade dos atores mapeados pelo Sebrae Piauí em relaçãoaos componentes identificados no modelo MIT *iEcosystems*. Concluiu-se que a congruênciaentre os elementos e inputs da metodologia iEcosystems e os atores mapeados pelo Sebrae é,em geral, forte, com cada elemento encontrando um correspondente apropriado entre os atoresdo Sebrae. Existem, porém, algumas lacunas, especialmente no detalhamento específico degovernança e alguns aspectos mais granulares de inovação e empreendedorismo que podem serobjeto de análise mais profunda.

Palavras-chave: Ecossistemas de Inovação. Inovação. Metodologia Iecosystems. Metodologia ELI Sebrae.

RESUMEN

Los ecosistemas de innovación se han convertido en elementos importantes para impulsar el desarrollo económico y social en diferentes regiones. Una comprensión precisa de los actores y las acciones que constituyen estos ecosistemas es esencial para orientar políticas y estrategias eficaces de promoción de la innovación y el emprendimiento. Esta investigación tiene como objetivo analizar la congruencia entre los actores del ecosistema local de innovación mapeado por Sebrae Piauí y el modelo iEcosystems del MIT. Para ello, también se llevaron a cabo objetivos específicos, como la identificación de nuevos actores en el ecosistema local de innovación del estado y la evaluación del alcance y la representatividad de los actores mapeados por Sebrae Piauí en relación con los componentes identificados en el modelo iEcosystems del MIT. Se concluyó que la congruencia entre los elementos e insumos de la metodología iEcosystems y los actores mapeados por Sebrae es, en general, sólida, y cada elemento encuentra una contraparte adecuada entre los actores de Sebrae. Sin embargo, existen algunas lagunas, especialmente en los detalles específicos de la

gobernanza y algunos aspectos más granulares de la innovación y el emprendimiento que podrían ser objeto de un análisis más profundo.

Palabras clave: Ecosistemas de Innovación. Innovación. Metodología iEcosistemas. Metodología ELI Sebrae.

1 INTRODUCTION

Innovation Ecosystems have emerged as elements to boost economic and social development in different regions. An accurate understanding of the actors and actions that constitute these ecosystems is necessary to guide effective policies and strategies to promote innovation and entrepreneurship.

In recent years, several surveys have shown the growing discussion on the subject. A survey by the newspaper Exame, carried out in 2023 by FIEC (Federation of Industries of the State of Ceará), revealed that the state of Piauí occupies the 21st position in the ranking of the most innovative states in Brazil (Martins, 2023). The index is calculated based on 12 indicators separated by "capabilities", the name the researchers gave to the state's innovation potential, and "results", how innovative the federation unit really is.

In this context, a study conducted by Sebrae appears as a significant initiative to map the actors and innovation programs in the state, in order to understand the dynamics of the local ecosystem. However, questions arise about the extent and adequacy of this mapping, given the complexity and diversity of the innovation environment, as well as the different methodologies of ecosystem analysis. In view of the concepts and theories about Innovation Ecosystems, the following reflection is made: can the study carried out by Sebrae contemplate the actors and actions of the state's ecosystem in a different method of analysis?

Actors in innovation ecosystems play diverse roles ranging from providing financial resources and mentoring to networking and accessing specialized infrastructure. Companies, universities, government institutions, investors, entrepreneurs, and local communities are some of the key actors collaborating to create an environment conducive to innovation.

At the same time, a methodology called iEcosystems, created by MIT, studies elements of a local innovation ecosystem, highlighting foundational institutions, innovation capacity, entrepreneurship capacity, comparative capacity, and impact as crucial points in this analysis. Based on the question previously made, this research intends to analyze the congruence between the actors of the local innovation ecosystem mapped by Sebrae Piauí and the MIT iEcosystems model. To this end, specific objectives will also be carried out, such as: identifying new actors in the state's local innovation ecosystem and evaluating the scope and representativeness of the actors mapped by Sebrae Piauí in relation to the components identified in the MIT iEcosystems model.

The MIT iEcosystems model offers a robust framework for identifying and analyzing the critical components of innovation ecosystems. In addition, aligning the mapping carried out by Sebrae Piauí to this model can reveal gaps and opportunities, improving the understanding and development of the local ecosystem. In addition, the research

methodology of the work involves documentary and bibliographic research with content analysis.

Finally, it is understood that the results of this research can contribute significantly to the improvement of strategies to foster innovation and entrepreneurship in the state of Piauí, with the purpose of serving as a complement to the mapping carried out by Sebrae and contributing to the enrichment of theoretical knowledge about innovation ecosystems in the state. In addition, the present research fills a gap in the understanding of the local innovation ecosystem, providing other perspectives for the formulation of more effective public policies and specific support programs for the identified actors.

2 THEORETICAL FRAMEWORK

The innovation can be understood in various ways and with different aspects, due to the multifaceted nature. In view of this, The Oslo Manual (OECD, 2018, p. 20) defines that "an innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)".

In 2005, the Handbook was updated to cover product innovation, process innovation, and a combination of both. This categorization allows for a more detailed analysis of innovative activities in organizations.

Christoph Freeman (1987), in turn, introduced a typology that incorporates incremental, radical innovations, changes in the technological system, and changes in the techno-economic paradigm (technological revolution).

Furthermore, Rieg and Alves Filho (2003) highlight that business innovation arises from technological advances in processes and products, which are commercially profitable and result from the technological investment of companies.

On the other hand, Johannessen, Olsen and Lumpkin (2001) suggest that innovation can be evaluated in six different areas. They include new products, new services, new production methods, opening up to new markets, new sources of supply, and new ways of organizing.

In view of the above, Drucker (1989) describes innovation as a business resource to seize opportunities and establish distinction. In addition, the author highlights the unpredictable nature of technological innovation, a process marked by uncertainties and with no guarantee of success.

Finally, under the assumptions of other authors, it is possible to identify three fundamental pillars for innovation, namely: 1) Innovation as disruption (Schumpeter, 1988);

2) Innovation as implementation (OECD, 2005; Chesbrough, 2003; Barbieri, 2003); and 3) Innovation as a process (Tidd; Bessant, 1997; Tigre, 1998).

Innovation ecosystems represent the foundation for the advancement and sustainability of smart cities. They consist of a dynamic network of entities, such as research institutions, companies, government, and civil society, which constantly collaborate to stimulate innovation.

The notion of innovation ecosystems, although not a contemporary invention, has gained new perspectives in relation to its construction and improvement. However, it is the recent evolution in the understanding of how these ecosystems arise – often serendipitously – and how they can be effectively managed and enhanced that marks a significant transformation. Johns (2016) mentions that this change is paradigmatic when he cites the importance of a dynamic and adaptive approach on the part of the leaders of these ecosystems to foster and sustain innovation.

Innovation in the service sector is often viewed through the lens of the innovation ecosystem, a complex and interconnected network structure. Sawatani et al. (2007) highlight that these ecosystems not only include consumers and service providers, but also suppliers and the surrounding environment, all of which are interconnected by value streams that can be observed both on a conceptual level and in practical examples.

With a focus on how cities in Europe are developing strategies for using the internet to create "smart cities", Komninos, Pallot and Schaffers (2013) expand this vision by identifying innovation ecosystems as spaces where bottom-up and top-down initiatives converge in order to promote extended collaboration across communities.

Furthermore, Carioni (2018) supports the same point by arguing that, in order for smart cities to generate real benefits for citizens, it is essential that public managers recognize the importance of investing in innovation ecosystems and initiatives that establish a solid foundation for it, before implementing isolated solutions.

For this reason, IESE Business School's Cities in Motion Index (CIMI) (2019) serves as a globally recognized instrument for assessing cities' performance in nine crucial dimensions, including human capital, social cohesion, and technology.

3 METHODOLOGY

The research is exploratory in nature and, as for the objective, it is descriptive-comparative in nature. The approach is qualitative and the technical procedures include documentary and bibliographic research, with content analysis. The methodology adopted is based on a proposal by the Massachusetts Institute of Technology (MIT) in which the main

source of research is the work "A systematic MIT approach for assessing 'innovation-driven entrepreneurship' in Ecosystems", by Budden, Murray and Turskaya (2017).

The research sources also included documents, such as the "Manual of Methodology for Action, Management and Monitoring by Maturity Levels of Innovation Ecosystems" (2019), prepared by Sebrae in partnership with the Foundation for Reference Centers in Innovative Technologies (CERTI) and the e-book "Radar of the Innovation Ecosystem of Piauí", prepared by Sebrae Piauí, as well as reports on the activities of innovation actors and programs and related websites. In addition, secondary documents were consulted, such as the literature on innovation ecosystems and case studies on innovation ecosystems in other Brazilian states.

To perform the congruence analysis, the first step was to provide the general aspects of each methodology. First, an overview of Sebrae's ELI (Local Innovation Ecosystem) methodology, which resulted in the mapping of the actors by Sebrae Piauí, contemplating the main criteria for analyzing the mapping of ecosystems and the description of the identified actors; and, second, an overview of the MIT iEcosystems methodology, contemplating its conceptual basis and the most relevant aspects.

Soon after, the analysis of congruence between the actors mapped by Sebrae and the iEcosystems conceptual model was carried out through a comparative table. To identify new actors, the topics of each methodology were analyzed and searches on websites, portals and research of new actions and initiatives related conceptually. Finally, the scope and representativeness of the actors of Sebrae Piauí in relation to MIT was presented.

4 RESULTS AND DISCUSSIONS

In view of the study of the Local Innovation Ecosystem (ELI) methodology and the MIT iEcosystems methodology, similarities and divergences were noted. To arrive at the analysis of the congruence between the actors mapped by Sebrae Piauí and the Local Innovation Ecosystem (ELI) methodology, it is necessary to understand the particularities of each model.

4.1 SEBRAE LOCAL INNOVATION ECOSYSTEM (ELI) METHODOLOGY

The main guiding documents for the study related to Sebrae's ELI methodology were the "Manual of methodology for action, management and monitoring by maturity levels of Innovation Ecosystems", prepared by Sebrae-PR in partnership with the Foundation for Reference Centers in Innovative Technologies (CERTI) and the e-book "Radar of the Innovation Ecosystem of Piauí", prepared by Sebrae Piauí in line with the ELI methodology. In the conceptual model of the ELI methodology, the innovation ecosystem must support the different stages of development of an enterprise.

The stages of developing a business are: Discovery, Problem-Solution, Solution-Market, Scale, and Diversification. Two other important pillars in the methodology include the analysis of the effectiveness and integration of the actors during this entrepreneurial journey. Effectiveness refers to the quality in which an actor in the innovation ecosystem achieves its objective. In other words, it is linked to efficiency, to the degree of competence in which an actor delivers results to the ecosystem.

It is also understood that the effectiveness of actions and their integration interfere with the maturity of the ecosystem. To develop the methodology, Sebrae analyzed several studies that deal with innovation ecosystems (Certi Foundation's Innovation Ecosystem Methodology (2019); Endeavor's Study of Entrepreneurial Cities (2016, 2017); Babson Global, by Daniel Isenberg (2011); European Commission (2014); among others).

After analyzing the studies, it was understood that the proposed methodology should meet the characteristics of Sebrae's performance and, with the prism that an innovation ecosystem, should support the development stages of an enterprise. In addition, it was noticed that one strand represents a macro area that has a great impact on an innovation ecosystem.

In this methodology, the ecosystem was organized into 6 strands and 17 members of the strands.

Table 1

Strands and members of the strands

Strand	Members of the strands
Innovation Environments	Pre-incubator
	Accelerator
	Technology park
	Maker space
	Innovation Center
	Coworking
Programs and Actions	Programs and actions
	Business protagonism
ICTI	Talent training
	Innovation
Public policies	Innovation and benefits legislation
	Public innovation agency
Capital	Angel Investors
	Venture capital
	Funding institutions
Governance	Governance

Source: Sebrae - CERTI (2019)

Table 2

Stages of Development of the Enterprise

Stages of Development of the Venture				
Discovery	Tuning Problem Solution	Tuning Solution Market	Scale	Diversify
(I want to be an entrepreneur)	(I have a business idea)	(I want to win first customers)	(I want to expand the market share)	(I want to look for new markets)

Source: Source: Sebrae - CERTI (2019).

In addition, Sebrae defined the Stages of Implementation of the Methodology in an Innovation Ecosystem, which are: a) Characterization Stage of the Innovation Ecosystem; b) Stage Maturity Level of the Innovation Ecosystem; c) Identification of Improvement Points Stage; d) Intervention Plan Stage; e) Organization for Intervention Stage Organization of the Intervention; f) Stage Joint Action of the Actors; g) Ecosystem Monitoring Stage.

It is observed that the methodology, in general, contemplates several steps in order to meet the objectives of Sebrae as an institution and its mission, in addition to suggesting a practical approach in working with ecosystems. As this work aims to analyze the ecosystem actors mapped by Sebrae Piauí, in line with the MIT iEcosystems methodology, it becomes more imposing for this study to focus only on the stage of Characterization of the Innovation Ecosystem, when all aspects and their existing members are analyzed.

In the analysis of the strands and their members in the Innovation Ecosystem, a mapping form of the members of the innovation ecosystem was structured. This form is organized by the strands and its analysis is broken down into members of the strands. In other words, the idea is to analyze the entire innovation ecosystem. In fact, institutions that show interest in being recognized as actors in the ecosystem can submit to the form and analysis.

The evaluation of the members of the strands is carried out based on two factors that directly impact the maturity of an ecosystem: EFFECTIVENESS and INTEGRATION. Effectiveness evaluates the ability to do what has to be done, achieving the objectives set and using resources in the best possible way.

Integration evaluates how environments, programs, actors, and institutions interact and work together for the benefit of the innovation ecosystem. Effectiveness is evaluated in all aspects and, consequently, in its 17 members. Integration, on the other hand, is evaluated only in three aspects: innovation environments, programs and actions, and ICTI. This is because in these three strands, integration with other elements and institutions of the ecosystem directly impacts the success of their activities.

According to the material available on the Sebrae Piauí website, entitled "Piauí Innovation Ecosystem Radar", the mapping of the actors of the local innovation ecosystem carried out through the ELI methodology (local innovation ecosystems) are categorized according to the stage of the innovative journey most consistent with their role.

4.2 iECOSYSTEMS MODEL

The iEcosystem model from the Massachusetts Institute of Technology (MIT) represents an innovative approach to understanding and fostering innovation and entrepreneurship ecosystems. According to Budden and Murray (2018) and Budden, Murray and Turskaya (2017), this methodology is distinguished by its holistic view, as it considers the fundamental elements that support innovation-focused entrepreneurship. Although it is a recent proposal, with little scientific literature available, its practical character suggests that evidence of its effectiveness will come from applied projects and research.

The MIT iEcosystem structure is composed of four essential elements that interact to create a competitive advantage and positively influence the ecosystem (Sebrae, 2020). The foundation institutions form the foundation, establishing the rules, practices, and standards that protect and enhance investments in diverse capabilities and assets, including laws, intellectual property protection, financial institutions, and an environment open to new ideas and businesses.

At the heart of the model are innovation capabilities (I-CAP) and entrepreneurship capabilities (E-CAP), which function as drivers of the system. I-CAP refers to the ability to generate innovative new ideas and turn them into tangible impact, while E-CAP focuses on creating new businesses. Together, these capabilities drive the emergence of innovation-driven enterprises (IDEs), differentiating themselves from traditional small and medium-sized enterprises (SMEs) for their potential for impact and growth.

In the iEcosystems model, innovation capacity (I-CAP) and entrepreneurship capacity (E-CAP) are analyzed through five critical dimensions: human capital; financing; infrastructure; demand; and culture; incentives. Each of these dimensions plays a role in the innovation-driven entrepreneurship ecosystem, namely: human capital refers to the presence of talent with entrepreneurial skills and technical knowledge; financing includes favourable fiscal policies, strategic investments and the availability of risk capital; the infrastructure encompasses flexible and accessible workspaces equipped with state-of-the-art technology and high-speed connectivity; the demand encompasses government contracts, financial incentives and prizes that stimulate innovation; and, finally, culture and incentives, which include intellectual property legislation, the appreciation of entrepreneurship and the incentive to be seen as a viable career.

These capabilities are not uniformly developed across regions, but tend to specialize in specific areas, creating a comparative advantage. However, this advantage is built on unique and distinctive characteristics of a region's innovation and entrepreneurship capabilities, often manifested in geographic clusters or specific industrial sectors.

Finally, the impact of these ecosystems is measured by a combination of economic and social metrics. Economically, GDP per capita is often utilized despite its limitations. Socially, indicators such as the Social Progress Index (SPI) or the UN Sustainable Development Goals (SDGs) are considered more appropriate. In addition, qualitative changes, such as the local perception of entrepreneurship, are also important and can be evaluated through personalized metrics, aligned with the strategies and aspirations of stakeholders. It is recognized that significant changes in terms of impact are observed in the long term, reflecting the depth of the interventions carried out in the ecosystem (Sebrae, 2020).

4.3 CONGRUENCE BETWEEN ACTORS MAPPED BY SEBRAE AND MIT iECOSYSTEMS METHODOLOGY

To carry out the most coherent analysis possible, first the detailed description of each actor mapped on the Sebrae Piauí radar is highlighted.

Table 3

Actors/actions of the Sebrae Piauí Ecosystem

DETAILED DESCRIPTION OF THE ACTORS/ACTIONS OF THE SEBRAE PIAUÍ ECOSYSTEM	
Entrepreneur Fair	The Entrepreneur Fair is an event promoted by Sebrae in several states of Brazil, including Piauí, which offers business opportunities, entrepreneurial training, networking and access to relevant information for entrepreneurs and businessmen.
Startup Day	Startup Day is a day dedicated to entrepreneurship and innovation, with a special focus on startups. During the event, lectures, panels, workshops and mentoring are offered to inspire, train and connect entrepreneurs, providing essential knowledge for the development and growth of startups.
ALI - Entrepreneurial Education	ALI Entrepreneurial Education is aimed at promoting the application of entrepreneurial education and innovation in schools. While it is not directly aimed at startups, it may be relevant for startups that want to get involved in educational projects or that could benefit from schools' engagement in the adoption of educational technologies.
Sebrae Like a Boss	Sebrae program aimed at supporting and fostering high-impact entrepreneurship and innovative startups. The program offers training, mentoring, connections with investors, and access to a support network to help startups develop their businesses in a structured and scalable way.
Empretec	Empretec is an entrepreneurial training program developed by the United Nations (UN) and carried out in Brazil by Sebrae. The program aims to stimulate the development of entrepreneurial and behavioral characteristics essential for success in business. Through an intensive methodology, based on experiences, Empretec works on skills such as search for opportunities, persistence, taking calculated risks, goal setting, planning, among others.
InovAtiva	InovAtiva Brasil is a startup acceleration and training program carried out by the Ministry of Economy, in partnership with Sebrae and other institutions. The program aims to boost the development and consolidation of innovative startups in the country. It offers mentoring, training, and connections with investors to help startups improve their business models.
Centelha Program	The Centelha program is an initiative that seeks to stimulate the creation of innovative ventures throughout Brazil. It is an action promoted by the Ministry of Science, Technology, Innovation and Communications (MCTIC) and the Financier of Studies and Projects (FINEP), in partnership with state institutions for the promotion of research and innovation.
InovaUFPI	To stimulate the production of knowledge combined with the promotion of enterprises, the Federal University of Piauí (UFPI) launched the

	Inova UFPI Program, which supports innovative proposals from researchers to transform them into businesses. Inova UFPI serves professors and students who wish to improve projects and enhance the applicability of innovative processes, products or services. With a total of R$ 250 thousand reais, the notice is aimed at the payment of scholarships, and the selected proposals are linked to the Incubator of Technology-Based Companies of Teresina (INBATE/UFPI).
Startup Northeast	Program focused on developing innovative small businesses in the Northeast Region, through the promotion of the innovation ecosystem, thus increasing the regional productive matrix with high value-added products and services. It operates in several actions on seven main fronts: Governance, Culture, Impact, Qualification, Promotion: Granting of up to two Innovation Stimulus Scholarships per small business selected in the public calls for innovative projects, Branding and Matchmaking.
ALI - Rural	The Rural ALI is relevant for startups operating in the agricultural sector. It seeks to promote innovation in different aspects of the rural business, such as improvements in production processes, cost reduction, marketing and sales strategies, management controls, and new product development.
INEAGRO	The Piauí Agribusiness Business Incubator - INEAGRO is a special extension project of the Federal University of Piauí (UFPI). It has scientific-cultural, financial and economic partnerships with SEBRAE/PI, EMBRAPA MEIO-NORTE, FADEX and IFPI.
INBATE	The Technology-Based Business Incubator of the Federal University of Piauí (INBATE/UFPI) was created with the aim of stimulating the production of knowledge combined with the promotion of enterprises, INBATE supports innovative proposals from researchers and students of the university, aiming to transform them into successful businesses.
Portal MEI Tools	MEI Tools is a platform developed by the Industry Portal to be a showcase of open opportunities for innovation projects. The platform brings together a variety of public and private notices and calls, covering different stages and support modalities.
ALI - Productivity	ALI Productivity is important for startups, as it helps to identify and solve the company's main problems, focusing on increasing productivity and profit. This is crucial, especially for early-stage startups, as operational efficiency and resource optimization are key to sustainable growth.
ALI - Digital Transformation	ALI Digital Transformation is essential for startups that want to adapt and take advantage of the opportunities offered by the digital age. This program helps entrepreneurs to identify digital solutions that boost their business, whether by reducing costs, improving processes, or increasing revenue.
TecNova	It is Finep's economic subsidy program that aims to promote a significant increase in innovation activities and increase the competitiveness of companies and the state economy through support for innovation projects, which involve significant technological risk associated with market opportunities.
Bank of the Northeast	Banco do Nordeste offers a specific line of credit aimed at innovation, called "FNE Innovation". This line of credit aims to support companies and entrepreneurs in the Northeast region of Brazil in the development and implementation of innovative projects. The FNE Innovation credit line offers, at attractive rates, financial resources to finance

	investments in innovation, such as equipment acquisition, new product development, process improvement, technological training, among others.
Piauí Development (BADESPI)	Piauí Fomento is a development financial institution in the state of Piauí, whose objective is to promote economic growth and regional development. The institution offers lines of credit and financial services to support entrepreneurs, micro-enterprises and small and medium-sized businesses. The credit lines made available can be directed to working capital, fixed investments, innovation, modernization, among other purposes.
Sebraetec	Sebrae program that offers specialized technological services for companies, including startups, at different stages of maturity. The program covers several areas, such as innovation, design, sustainability, productivity, and quality. Startups can access consulting, training, prototype development, laboratory tests, among other services.
Startup Growth	The program, designed and promoted by Sebrae, aims to prepare startups to accelerate growth and attract potential investors. With activities focused on increasing sales and revenues of these businesses, the program allows startups to trace paths, from choosing their main growth engine and defining the ideal customer profile, to adjusting the product to the market and applying sales strategies.
Finep Startup	An initiative of the Financier of Studies and Projects (Finep) aimed at fostering and supporting innovative startups in Brazil. The program offers a financial incentive through non-reimbursable resources. This incentive aims to boost the development and consolidation of startups, enabling them to carry out innovation projects and increasing their chances of success.
Investe Piauí	Investe Piauí is a mixed-economy company created by State Law No. 7,495/2021 with the mission of articulating public policies to promote regional economic development. In addition, Investe Piauí supports the state's technological district, encouraging research, innovation and the acceleration of technology-based companies.
FONIT	The Center for the Promotion of Innovative Business and Technology – FONIT, intends to support the development of new companies, focused on innovation, providing technology-based service, access to new markets and providing technical, managerial and entrepreneurial training support for participants, contributing to the increasing development of Piauí.
SPA	The Export Processing Zone (EPZ) of Parnaíba assists in the import and export of products from the region, nationally and internationally. In practice, the EPZ materializes in an area of free trade with the outside world, where the installed companies have access to tax incentives at the federal, state and municipal levels.
Thech	The objective is to foster entrepreneurship, innovation and maker culture, promoting research, teaching and institutional development for the execution of studies and activities to support the municipality of Teresina. The Municipality of Teresina is the great achiever, through the idealization of an Innovation Program of its Municipal Secretariat of Economic Development and Tourism (SEMDEC) and execution of Softex. The THEch program is divided into 05 main axes. They are: THEch Maker, THEch Valley, THEch Educação, THEch Startups and THEch Investimentos.

PEIEX	The PEIEX (Export Qualification Program) is an initiative developed by Apex-Brasil (Brazilian Trade and Investment Promotion Agency) in partnership with several institutions. The program aims to help companies that wish to start or expand their activities in the international market.

Source: Adapted from Sebrae-PI (2023).

To enable the analysis between actors mapped by Sebrae and the MIT *iEcosystems methodology,* the criterion of dividing the actors by stage of development of the enterprise is excluded from this analysis. As suggested by the ELI methodology, each actor was analyzed in isolation. In the table below, a parallel is made between the five elements of the *iEcosystems methodology* and their *inputs* (columns 1 and 2, respectively) and the conceptual adequacy of these elements with the six strands, 17 members and 26 actors, identified in Sebrae's ELI methodology.

Table 4

iEcosystems and ELI Sebrae Methodologies

IECOSYSTEMS METHODOLOGY		ELI SEBRAE METHODOLOGY		
iECOSYSTEMS ELEMENTS	**INPUTS OF iECOSYSTEMS ELEMENTS**	**STRAND**	**MEMBER OF THE STRAND**	**ACTOR MAPPED BY SEBRAE/PI**
Foundation Institutions	Institutions, rules, practices and standards that allow investments in a wide variety of capacities and assets to be effectively protected and leveraged for the benefit of the economy. These include laws, mechanisms for the protection of property rights (especially intellectual property), financial institutions, openness to new ideas (including in the scientific field) and ease of doing business.	Public Policies	Innovation and Benefits Legislation; Public Innovation Agency.	Investe Piauí
		Capital	Angel Investors; Venture Capital; Development institutions.	TecNova Bank of the Northeast Piauí Development Finep Startup
Entrepreneurship Capacity (E-CAP)	Amount of higher education graduates, perceived entrepreneurship capabilities, easy access to loans, electricity and telephony infrastructure, logistics performance, buyer	Programs and Actions	Programs and Actions; Business Protagonism.	Entrepreneur Fair Empretec Centelha Program INEAGRO Portal MEI Tools Thech

	sophistication; Entrepreneurship as a career choice, entrepreneurial freedom.			
Innovation Capacity (I-CAP)	Quality of education in science and technology, number of graduates, doctors; Expenditures on research and development; Access to technology and information, internet quality, availability of recent technologies; Government procurement of advanced technology; Research, university, industry; Quality of scientific research institutions, graduates in science and engineering.	Innovation Environments	Pre-incubator; Incubator; Accelerator; Technology Park; Maker Space; Innovation Center; Coworking.	Startup Day Sebrae Like a Boss Innovative InovaUFPI Startup Northeast ALI - Rural INBATE ALI - Productivity ALI - Digital Transformation Sebraetec Startup Growth FONIT SPA PEIEX
		ICTI - Science, Technology and Innovation Institutions	Talent Training Innovation	ALI Entrepreneurial Education
Comparative Advantage	Geographic clusters or industrial sectors; Main assets; Main areas of knowledge and talent; Critical issues/challenges.			
Impact		Governance	Governance	

Source: Prepared by the authors.

It is observed that in the analysis imposed, in the element of foundation institutions, the actors mapped by Sebrae, such as Invest Piauí, TecNova, Banco do Nordeste, Piauí Fomento, Finep Startup, among others. They are well aligned with the institutions suggested in the *iEcosystems* methodology, as they represent financial institutions, base institutions for openness to new ideas and ease of doing business (Budden; Murray, 2018; Budden; Murray; Turskaya, 2017).

They cover aspects of financing, public policy, and institutional support needed to protect and leverage investments. It could also add legal instruments, such as the New Legal Framework for Innovation, known as the National Code of Science, Technology and Innovation, of January 11, 2016 (Law No. 13,243/2016), Decree No. 9,283/2018, which aims to regulate measures to encourage innovation and scientific and technological research in the productive environment, as well as Law No. 9,279, of May 14, 1996, which regulates rights and obligations related to industrial property, portfolios such as that of the Government of the State of Piauí and bodies such as the Board of Trade of the State of Piauí – Jucepi.

The Entrepreneur Fair, Empretec, Centelha Program, INEAGRO, MEI Tools Portal, Thech, among others, are programs and actions that foster entrepreneurship, offer training, support, and promote an entrepreneurial culture. They align well with the E-CAP aspects of the *iEcosystems methodology* and emphasize entrepreneurship and the business environment for the formation of new companies (Sebrae, 2020).

In this context, actions such as Impulso Piauí, a reality show aimed at small businesses (EPPs) and microenterprises (MEs) based in the state of Piauí (Riso, 2024); Seduckathon, a programming competition involving students from the 2nd and 3rd grades of High School at SEDUC-PI, regularly enrolled in Systems Development and Game Programming courses, with the objective of selecting students and teachers for international exchange in the area of programming at reference institutions in technology and innovation (Seduc, 2024); and the Youth League Challenge, a Sebrae program that aims to promote a dispute between teams, which will have the challenge of solving a problem in their schools and/or communities, being protagonists of changes in their reality.

Solutions must use technology, whether digital (website, social networks, applications, games) or analog (forms of production, methodologies) (Sebrae, 2024). However, it should be noted that the programs already mapped by Sebrae directly or indirectly encourage higher education institutions, such as the Federal University of Piauí, and can be added to the Federal Institute of Piauí, the State University of Piauí and private Higher Education Institutions.

Innovation environments are essential for the development of I-CAP, according to the *iEcosystems methodology* and programs/actions such as Startup Day, Sebrae Like a Boss, Inovativa, InovaUFPI, Startup Nordeste, ALI - Rural, INBATE, ALI - Productivity, ALI - Digital Transformation, Sebralecte, Startup Growth, FONT, ZPE, PEIEX, which promote innovation and the connection between spaces. Some actors may even be consistent with both elements (I-CAP/E-CAP). Another recent highlight in this perspective is the Startup Piauí program, which offers a complete acceleration program, lasting one year, for startups that present innovative and technological solutions. The initiative is from Investe Piauí, an institution already mapped by Sebrae in its study.

The *iEcosystems methodology* highlights that the sum of entrepreneurship capacity and innovative capacity promote comparative advantages, such as geographic clusters and specific industrial sectors to provide a solid basis for regional competitiveness. The table indicates an absence of specific actors that support or are part of *clusters* and the development of specialized industrial sectors in the context of Sebrae. It is pertinent to mention that there is a local characteristic of the state that does not have a strong industrial

sector when compared to other states, however, as a more similar element, there is the South Business Pole, in Teresina-PI, which emerged in the early 1990s. Law No. 2,515, of April 1997, established its creation, with its own autonomy, residences, areas of commerce, services and industry compatible with the needs of the inhabitants. According to the Piauí Negócios website (2022), "the aforementioned industrial district is located at km 13 of BR-316, south of Teresina, and has 143.92 hectares. Its implementation aims to attract companies that strengthen the local economy, through the generation of employment and income".

Governance is an important component for the effectiveness and sustainability of innovation ecosystems. The absence of specific actors dedicated to governance in the framework provided by Sebrae represents a gap that can impact the coordination and integration of the various elements of the ecosystem. However, it is also understood that this governance involves actors mentioned directly or indirectly in the Sebrae study in other classifications of the study.

The congruence between the elements and inputs of the *iEcosystems* methodology and the actors mapped by Sebrae is, in general, strong, with each element finding an appropriate correspondent among the actors. There are some gaps, especially in the specific governance detail and some more granular aspects in relation to comparative analysis that can be the subject of deeper analysis. The *iEcosystems* methodology offers a robust structure that can be complemented and enriched by the diversity and specificity of the actors mapped by Sebrae.

These analyses can be used to refine the development strategies of innovation ecosystems, ensuring that all critical dimensions are adequately covered and that actors collaborate in a more integrated manner. It is noted that Sebrae's ELI methodology has a practical and action-oriented character. On Sebrae's own website, there is a page on which those interested in composing the Piauí Innovation Ecosystem Radar can submit their action/program/institution according to the form suggested in the ELI methodology, that is, Sebrae carries out an active, passive and constant search of the ecosystem actors in the state, suggesting a constant update in its mapping.

Finally, in this study, it was possible to examine the congruence between the actors of the local innovation ecosystem mapped by Sebrae Piauí and the MIT *iEcosystems model* and, from this, to evaluate the congruence between the actors of the local innovation ecosystem mapped and identify new actors.

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