

An analysis on the interactions between actors of the innovation ecosystem and incubators

Uma análise sobre as interações entre atores do ecossistema de inovação e incubadoras

Un análisis de las interacciones entre actores del ecosistema de innovación y las incubadoras

DOI: 10.55905/ijsmvtv10n3-032

Originals received: 04/15/2024

Acceptance for publication: 05/20/2024

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Florianópolis - SC, CEP: 88040-900E-mail: clastefani@gmail.comOrcid: <https://orcid.org/0000-0003-1362-1255>**ABSTRACT**

This study underscores the significance of conducting research on innovation ecosystems, which are facilitated through the interaction between academia, industry, and government, commonly referred to as the "triple helix". Collaborative efforts among these stakeholders are vital for fostering coherent value propositions within the ecosystem. Additionally, the relevance of innovation habitats is emphasized, as they provide conducive environments for knowledge sharing and the emergence of new innovative companies. In this context, incubators play a crucial role in driving businesses during their early stages and facilitating knowledge sharing and support for entrepreneurship. However, despite its importance, there is still a lack of understanding regarding the interactions between actors in the innovation ecosystem and incubators, which is essential for the success of this innovation-driven environment. Therefore, this study aimed to analyze the primary interactions between business incubators and innovation ecosystem actors. To this end, a systematic literature review of the last ten years was carried out, resulting in 359 studies. Our findings revealed that incubators connect with the actors of the innovation ecosystem, mainly through support, network, and fomentation connections, in addition to listing the contributions of incubators in their respective innovation ecosystems. The interactions between incubators and innovation ecosystems are crucial for both to develop, highlighting that incubators must not act isolatedly from their innovation ecosystem, thus facilitating knowledge-sharing among the various participants.

Keywords: innovation ecosystem, ecosystem actors, innovation habitat, interaction, incubated.

RESUMO

O estudo ressalta a importância da pesquisa sobre ecossistemas de inovação, mediado pela interação entre academia, indústria e governo, conhecida como "tríplice hélice". A colaboração entre esses atores é crucial para o desenvolvimento de propostas de valor coerentes dentro do ecossistema. Além disso, destaca-se a relevância dos habitats de inovação, que proporcionam ambientes propícios ao compartilhamento de conhecimento e ao surgimento de novas empresas inovadoras, sendo as incubadoras um componente-chave nesse processo, impulsionando negócios em estágios iniciais e promovendo o compartilhamento de conhecimento e o apoio ao empreendedorismo. No entanto, apesar de sua importância, a compreensão das interações entre os atores do ecossistema de inovação e as incubadoras ainda é pouco explorada, sendo fundamental para o sucesso deste ambiente promotor de inovação. Dessa forma, essa pesquisa possui o seguinte objetivo, analisar as principais interações entre incubadoras de empresas e os atores do



ecossistema de inovação. Para tanto, foi realizada uma revisão sistemática de literatura dos últimos 10 anos, o que resultou em 359 estudos. Como resultado, identificou-se que as incubadoras se conectam com os atores do ecossistema de inovação, principalmente, por meio de conexões de suporte, rede e fomento. Ademais, são elencadas as contribuições das incubadoras nos seus respectivos ecossistemas de inovação. Concluiu-se, portanto, que as interações entre incubadoras e ecossistemas de inovação são importantes para o desenvolvimento de ambos, destacando que as incubadoras não devem atuar de forma isolada do seu ecossistema de inovação, facilitando assim o compartilhamento de conhecimento entre os diversos partícipes.

Palavras-chave: ecossistema de inovação, atores do ecossistema, habitat de inovação, interação, incubadas.

RESUMEN

El estudio destaca la importancia de la investigación sobre ecosistemas de innovación, mediados por la interacción entre academia, industria y gobierno, conocida como la "triple hélice". La colaboración entre estos actores es crucial para desarrollar propuestas de valor coherentes dentro del ecosistema. Además, destaca la relevancia de los hábitats de innovación, que brindan entornos propicios para el intercambio de conocimientos y el surgimiento de nuevas empresas innovadoras, siendo las incubadoras un componente clave en este proceso, impulsando negocios en etapas tempranas y promoviendo el intercambio de conocimientos y el apoyo al emprendimiento. Sin embargo, a pesar de su importancia, aún se explora poco la comprensión de las interacciones entre los actores del ecosistema de innovación y las incubadoras, siendo fundamental para el éxito de este entorno de promoción de la innovación. Por lo tanto, esta investigación tiene el siguiente objetivo, analizar las principales interacciones entre las incubadoras de empresas y los actores del ecosistema de innovación. Para ello se realizó una revisión sistemática de la literatura de los últimos 10 años, que resultó en 359 estudios. Como resultado, se identificó que las incubadoras conectan con actores del ecosistema de innovación, principalmente a través de conexiones de apoyo, redes y promoción. Además, se enumeran las contribuciones de las incubadoras a sus respectivos ecosistemas de innovación. Se concluye, por tanto, que las interacciones entre las incubadoras y los ecosistemas de innovación son importantes para el desarrollo de ambos, destacando que las incubadoras no deben actuar aisladas de su ecosistema de innovación, facilitando así el intercambio de conocimientos entre los distintos participantes.

Palabras clave: ecossistema de innovación, actores del ecossistema, hábitat de innovación, interacción, incubados.

1 INTRODUCTION

Research on innovation ecosystems has received considerable interest from academia regarding management practices since it is directly connected to the locus of economic, social, and sustainable growth of Brazil through the triple helix that supports entrepreneurship and innovation (Dias Sant'ana et al., 2020; Teixeira; Audy; Piqué, 2021; Gu et al., 2021; Liang et al., 2022; Scaliza et al., 2022). The helices, whether academia, industry, and government, should constantly interact, creating a healthy dynamic and ensuring a balance among the actors of the innovation ecosystem (Moore, 1993; Etzkowitz; Zhou, 2017; Foguesatto; Santini; Martins; Faccin; Mello; Balestrin, 2021). The actors must collaborate to generate knowledge and innovation in this environment (Xie; Wang, 2020), and organizations, in turn, require the contributions of numerous actors so that they can coherently develop a value proposition within the ecosystem (Sant'ana et al., 2020).

Innovation habitats stand out among the various actors of the innovation ecosystem; they are characterized by differentiated and favorable spaces for innovation and are driven by innovation agents, including universities, business class, and public authorities (Teixeira; Ehlers; Abdala; Macedo, 2016). Innovation habitats are favorable environments for knowledge sharing in innovation ecosystems, promoting regional development and generating new innovative enterprises through their relationship networks (Botelho; Gauthier; Macedo, 2015).

Business incubators are among the innovation habitats and have relevant functions favoring the local innovation ecosystem; they use their relationship networks to enhance and leverage the businesses of their residents, especially those in the early stages, and connect with the other actors of the ecosystem by promoting knowledge sharing and supporting innovation and entrepreneurship (Gerlach; Brem, 2015; Bereczki, 2019; Vaz et al., 2022).

Antonovica et al. (2022) described several factors that determine the degree to which entrepreneurs' expectations exiting incubator programs are met and showed that being in an incubator is a key factor for economic development, knowledge generation, new skills, market insights, leadership, and effective and efficient business management.

Lian-Lian et al. (2022) complemented by stating that no matter why the entrepreneur starts a business, they view incubators positively due to professional consulting services, socioeconomic benefits, housing and infrastructure services, and consulting services focused on the bureaucratic/administrative part of the business.

Nevertheless, despite incubators' relevance to businesses and innovation ecosystems, there is a need to understand how these relations and interactions between innovation ecosystem actors and incubators occur. This subject has been little addressed in the literature and deserves attention as it may be a factor of success or failure for the incubator, since external connections are fundamental to its operation. Albort-Morant and Ribeiro-Soriano (2015) conducted a study from 1985 to 2015 that stated "research on incubation has a poor representation in business, management, and economics because there are few reliable sources." Thus, few new studies exist on the relationships between actors in the local innovation ecosystem and incubators (Spender; Corvello; Grimaldi; Pierluigi, 2017).

Given the above, the following guiding question was posed: how do incubators relate with innovation ecosystem actors? Hence, this study sought to analyze the main interactions between incubators and innovation ecosystem actors. Furthermore, we aimed to shed more light on the importance of incubators for the innovation ecosystem. This study brings theoretical and managerial contributions; for the theoretical contributions, this study evidences the relations between publications and themes that connect incubators with the innovation ecosystem. As managerial contributions, we note the need for incubator managers to connect with the other actors of the innovation ecosystem.

Therefore, this study is structured as follows: after this introduction, the methodological procedures are presented in the next section, followed by the results and discussions in Section 3, and the conclusion in Section 4.

2 METHODOLOGY

In order to achieve the proposed objective, a systematic literature review was conducted from 2013 to 2023, covering the last ten years of publications in the Scopus and Web of Science databases. Their representativeness justifies the choice of these

databases concerning the indexing of high-impact journals. The research protocol followed was the one presented by Tranfield et al. (2003), Kitchenham (2004), Biolchini et al. (2005), Kraus et al. 2020a, and Mas-Tur A et al. (2020).

Following the protocol, the search string was used: (“innovation ecosystem*”) AND (“business incubator*”) and identified in all fields. The inclusion criteria used were scientific articles in English published in peer-reviewed journals and articles in which the string terms appeared, thus justifying the results found, which are listed in Table 1.

Table 1. Search process

Steps taken	Scopus	WOS	Total
Total searches	337	22	359
After excluding the redundancies	337	6	343
After reading the abstract, title, and keywords	39	4	43

Source: prepared by the authors.

As shown in Table 1, in order to reach the final corpus of this review, the titles, abstracts, and keywords were read to identify adherence to the research topic, resulting in a final corpus of 43 articles. The VOSviewer software (version 1.6.18) was used to analyze connections and co-occurrence networks to present the connections between the keywords, demonstrating the degree of interaction between them and the main clusters.

A qualitative review was also utilized to better understand the content of publications and analyze the ecosystem players that form means of connection between incubated companies through incubators and how this typology develops these opportunities. According to Creswell (2010), intentionally selecting participants or locations (or documents or visual material) will best help the researcher understand the problem and the research question. Thus, our findings are presented in the following section.

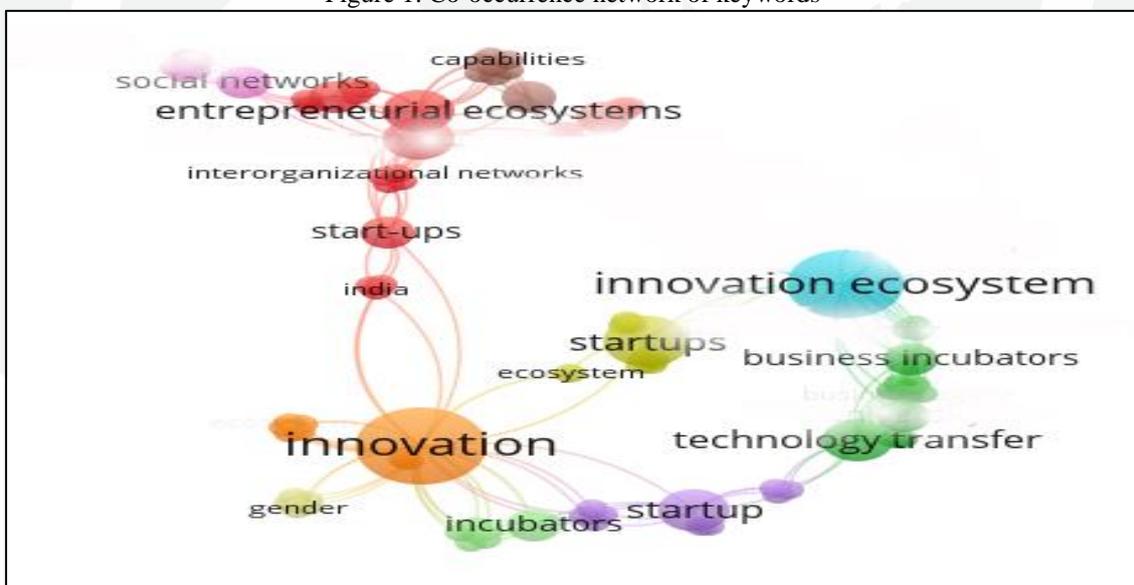
3 RESULTS AND DISCUSSION

This section presents the results obtained through the final text corpus of this research. The analyses performed are based on the protocol and the research problem, and a brief sample description is given.

3.1 KEYWORD CO-OCCURRENCE NETWORK ANALYSIS

The co-occurrence network of the keywords is provided in Figure 1, in which one can observe the interaction formed by three large clusters. The first one highlights the word “innovation ecosystem” in blue, the second “entrepreneurship ecosystem” in red, and the third cluster with the keyword “innovation” in orange.

Figure 1. Co-occurrence network of keywords



Source: Prepared by the authors

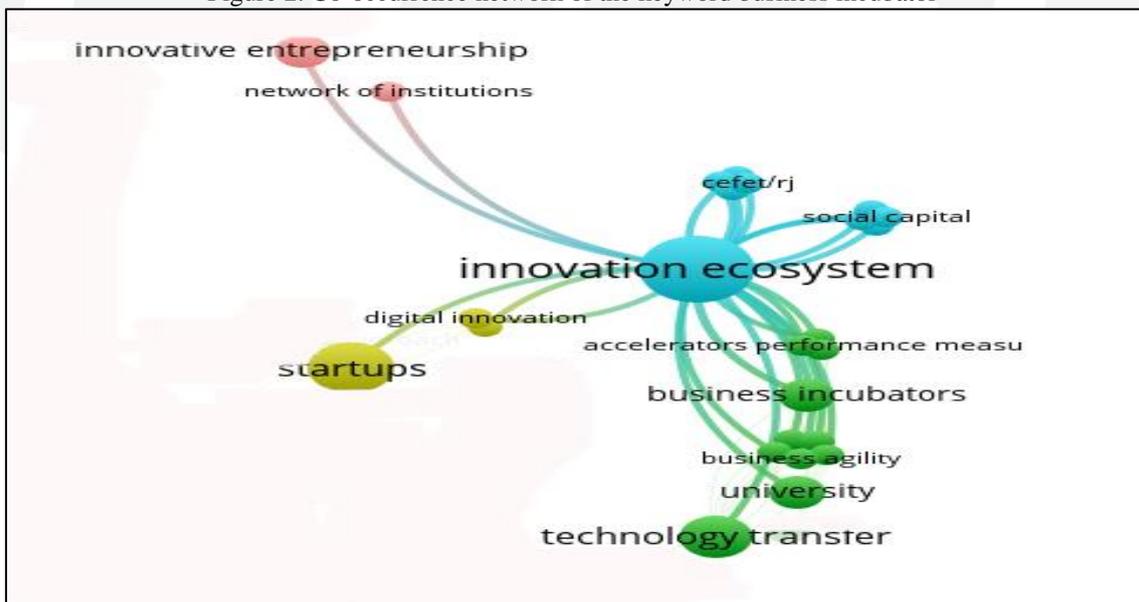
The junction of these three clusters forms an important link for promoting and boosting the entire ecosystem. When organizations are anchored in networks and collaborate on behalf of their organizations, the entire ecosystem benefits through innovation and entrepreneurship (Machado Junior; Felden; Teixeira, 2018; Dias Sant’ana et al., 2020). A developed innovation ecosystem has the necessary infrastructure to enable

the evolution of actors in an entrepreneurial context and continuous development for innovations (Romano; Passiante; Vecchio; Secundo, 2014; Gastaldi; Corso, 2016).

In addition, the innovation ecosystem has a network of entrepreneurs, mentors, service providers, and investors, which can support the creation and development of companies with more assertive scalability (Haines, 2016). This is because they require new networks to ensure the transmission of knowledge and efficiently use resources provided by the network, as well as companies with superior open innovation niches in a particular ecosystem to ensure advantages in technology and capital resources when maintaining ties with the innovation network (Xie; Wang, 2021).

Figure 2 shows the co-occurrence network of the keyword “business incubator,” the second search string used in the search. This keyword is connected by the “innovation ecosystem” cluster, thus revealing important relationships between them. This connection also occurs with other keywords: “technology transfer,” “university,” “business agility,” “accelerators performance measure,” “startups,” “digital innovation,” “social capital,” “network of institutions,” and “innovative entrepreneurship,” which contributes to the development and results of this study.

Figure 2. Co-occurrence network of the keyword business incubator



Source: elaborated by the authors

By analyzing the figure above, one can observe that the moment a network makes a junction between incubator and university, there is economic viability, building entrepreneurs' profiles, the possibility of contributing to local and sectorial development, the application and transfer of new technologies, the possibility of interaction with research centers, rapid growth, and employment generation (Anprotec-MCTI, 2012).

Hence, incubators are not simply shared spaces but also a network of individuals and organizations that operate and relate to each other to make this structure work, thus enabling a direct connection with universities and members of the university community to leverage the transfer and agility of innovation (Hackett; Dilts, 2004). Furthermore, using their methods, incubators construct interactions between resident companies and ecosystem players to generate networking amongst participants (Felizola; Gomes; Almeida, 2019). Therefore, they are considered to support organizations, which activate methods that build the innovation ecosystem through activities that involve knowledge, partnerships between their stakeholders, business model validation, training, and capacity building, thus generating opportunities for innovation (Mwandosya; Apiola; Lahde, 2016).

3.2 ANALYSIS OF THE RELATIONS BETWEEN INCUBATORS AND THE INNOVATION ECOSYSTEM

By reading the articles comprising the final corpus ($n = 43$), comparative tables were created to clarify and identify the ecosystem players forming connections between incubated companies through incubators and how this typology develops these opportunities. Table 2 illustrates the networks created and intermediated by incubators to assist their residents in a healthier entrepreneurial journey. These information and knowledge transfer networks are formed by links between innovation ecosystem players, identified by Teixeira, Audy, and Piqué (2021), such as knowledge, public, entrepreneurial, civil society, innovation habitat, institutional, and funding.

Table 2. Connections between ecosystem actors and resident companies.

Innovation Ecosystem Actors	Connection Networks	Author
Knowledge	University Research Center Technology Transfer Laboratories	(Barbe; Green; Chang, 2010); (Ojaghi, Mohammadi; Yazdani, 2019) (Hayter, 2016); (Felizola; Gomes; Almeida, 2019); (Carvalho; Bersani; Maldaner; Piqué, 2020); (Etzkowitz; Zhou, 2017); (Ho; Yoon, 2022); (Ismail; Kamel; Wahba, 2018); (Castro; Araujo; Fragoso; Costa; Ligia, 2021); (Tumelero; Sbragia; Borini; Franco, 2018).
Business	Network Companies Support Network Internship Programs Connection with associations Partnerships	(Ojaghi; Mohammadi; Yazdani, 2019); (Etzkowitz; Zhou, 2017); (Ho; Yoon, 2022); (Cukier; Fox; Rahnama, 2012); (Mwandosya; Apiola; Lahde, 2016); (Chan, Krishnamurthy; Sadreddin, 2022); (Theodoraki; Messeghem; Rice, 2018); (Mungila, 2020); (Ismail; Kamel; Wahba, 2018); (Castro; Araujo; Fragoso; Costa; Ligia, 2021); (Santos, 2022)
Public	Government	(Etzkowitz; Zhou, 2017)
Innovation Habitat	Coworking and co-living pre-accelerator Business Environments Research Center Infrastructure Technical Network	(Ho; Yoon, 2022); (Carvalho; Bersani; Maldaner; Piqué, 2020); (Santos, 2022); (Cukier; Fox; Rahnama, 2012); (Mwandosya; Apiola; Lahde, 2016); (Chan; Krishnamurthy; Sadreddin, 2022); (Theodoraki; Messeghem; Rice, 2018); (Mungila, 2020); (Ismail; Kamel; Wahba, 2018); (Castro; Araujo; Fragoso; Costa; Ligia, 2021); (Tumelero; Sbragia; Borini; Franco, 2018).
Civil Society	Mentor Network Community Client	(Barbe; Green; Chang, 2010); (Felizola; Gomes; Almeida, 2019); (Cukier; Fox; Rahnama, 2012); (Mwandosya; Apiola; Lahde, 2016); (Chan; Krishnamurthy; Sadreddin, 2022); (Theodoraki; Messeghem; Rice, 2018); (Castro; Araujo; Fragoso; Costa; Ligia, 2021)
Funding	Investors Angels Financial Institutions Venture Capital Financing	(Barbe; Green; Chang, 2010); (Ojaghi; Mohammadi; Yazdani, 2019); (Felizola; Gomes; Almeida, 2019); (Ismail; Kamel; Wahba, 2018); (Castro; Araujo; Fragoso; Costa; Ligia, 2021); (Tumelero; Sbragia; Borini; Franco, 2018)

Source: developed by the authors.

When analyzing the networks created by incubators regarding the knowledge actor, we perceived that the relationship of this actor with the resident companies should occur freely, thus strengthening the nodes of high technological knowledge (Tumelero; Sbragia; Borini; Franco, 2018). From this, the moment the company connects to the university, it is supported through the adoption of entrepreneurial education; hence, the incubator, as a protagonist, influences the territory through interactions and programs

aimed at innovative development using the spaces of innovation and innovation support fostered by the knowledge actor (Etzkowitz; Zhou, 2017).

Ismail, Kamel, and Wahba (2018) emphasized the need to build strong ties with universities, especially in designing incubation programs since incubators make partnerships that drive entrepreneurship and innovation throughout their country (Ismail; Kamel; Wahba, 2018). In the entrepreneurial actor, incubators contribute significantly through an entrepreneurial base by promoting interactions and strategies to improve the ecosystem's efficiency and effectiveness, mainly by being supported by the entrepreneurial support network (Santos, 2022).

Moreover, they are important environments that mediate the actions between the ecosystem's actors, not only to boost traditional innovation but with practices aimed at mediating and connecting social enterprises with other entities focused on social impact (Ho; Yoon, 2022). Cukier, Fox, and Rahnama corroborate the other authors, reinforcing that business incubators, through business support and mediation developed within their programs, build an entrepreneurial culture that strengthens the individual competencies of young people, thus seeking the consolidation and engagement of the local ecosystem (Cukier; Fox; Rahnama, 2012).

When brought to the public actor, incubators encourage innovation by funding dynamics within the innovation ecosystem; when connected with the other actors, the public actor becomes the secret of the most innovative regions, as is the case of Silicon Valley (Etzkowitz; Zhou, 2017). These dynamics can also be observed in other organizations, including technology transfer offices, venture capital firms, and science parks, both of which seek to foster the region's innovation ecosystem (Etzkowitz; Zhou, 2017).

In this case, business incubators, an important typology of innovation habitats that develop and articulate to boost their residents, require other actors to build new networks so their incubates can plead new connections and accelerate their innovation and entrepreneurship processes. Therefore, the innovation habitat actor, when intermediated by incubators, are essential organizations that contribute to developing the local innovation ecosystem (Ho; Yoon, 2022), contributing significantly to their innovation

and entrepreneurship ecosystem development, especially regarding the entrepreneurial journey of each entity (Castro; Araujo; Fragoso; Costa; Ligia, 2021).

Nevertheless, the interaction to connect companies to other innovation habitats, be it a maker environment, a technology innovation hub, or even a science and/or technology park, to create small labor markets or even create new talent, makes business incubators a crucial entity of the innovation ecosystem to form connections with their residents (Mwandosya; Apiola; Lahde, 2016). For Chan, Krishnamurthy, and Sadreddin, incubators are bridges that facilitate knowledge interactions between different actors of the ecosystem, catalyzing regional innovation clusters and connecting their incubates to external people, such as mentors, alumni, and the community in general, among others, to add social capital and market knowledge (Chan; Krishnamurthy; Sadreddin, 2022).

To connect the actors of the innovation ecosystem to their residents, incubators need to use the “time” aspect, which is the intervention generated by the incubator in the incubation cycle according to the monitoring performed, inserting individuals or legal entities to maintain the integrity and continuity of the residents in the incubation cycles, including providing mentors, experts, and consultants, so that there is an articulation in favor of the company keeping them in the established deadlines (Theodoraki; Messeghem; Rice, 2018).

As for the funding actor, these are important institutions that leverage the innovation ecosystem through the organized distribution of resources for the correct use of the participants in projects, edicts, financing, and loans, among others. Felizola, Gomes, and Almeida reported a significant lack of assistance to foster entrepreneurship, mainly by the government and several venture investors (Felizola; Gomes; Almeida, 2019). This obstacle can be overcome by the network formed by incubators since one of its aspects is related to the connection with sources of resources. Incubators help entrepreneurs manage participation in public notices, angel investors (Felizola; Gomes; Almeida, 2019), and access to funding (Ismail; Kamel; Wahba, 2018; Castro et al., 2021).

Ojaghi, Mohammadi, and Yazdani reported that some institutions, such as incubators, are key players in startups' innovations and that they can identify needs through their methods, including financial vulnerabilities, to ensure that they cultivate a comprehensive resource base (Ojaghi; Mohammadi; Yazdani, 2019). Table 3 lists the

interaction of how incubators relate to the innovation ecosystem, building connections or even networks between their incubates with the most diverse stakeholders.

In summary, we identified a synergy in the articles between three axes representing how incubators relate their incubates with the innovation ecosystem: support, network, and fomentation.

Table 3. How incubators relate to the ecosystem

Axis	Relationship	Authors
Support	<ul style="list-style-type: none"> - Adopting a diagnostic method capable of assessing the maturity level of startups over time. - Contributing to the economy through business activity attracted to the incubator. - Supporting market and product development are also key factors. - Promoting bottom-up initiatives through its interactions and programs. The innovation space through various innovation support structures. - Boost the growth of new startups seeking to develop the ecosystem through innovative mechanisms - Supporting through tax incentives and grants, among others). - Supporting entrepreneurs throughout the community. -Provides benchmarking and sharing of best service practices. - People with skills and ideas can participate and get a variety of support to leverage these ideas and technologies. - Through advisory services, providing infrastructure and technical knowledge to start-up companies. - Technology (in the creation, launch, and growth phases), talent (in the creation and launch phases), location (in the creation, launch, and growth phases), and market (in the launch and growth phases). - Developing technology transfer contract. 	<p>(Castro; Araujo; Frago; Costa; Ligia, 2021); (Barbe, Green; Chang, 2010); (Cukier Fox; Rahnama, 2012); (Etzkowitz; Zhou, 2017); (Ojaghi; Mohammadi; Yazdani, 2019); (Santos, 2022); (Ismail; Kamel; Wahba, 2018); (Mwandosya; Apiola; Lahde, 2016); (Carvalho; Bersani; Maldaner; Piqué, 2020); (Tumelero; Sbragia; Borini; Franco, 2018).</p>
Network	<ul style="list-style-type: none"> - Adopting a diagnostic method capable of assessing the maturity level of startups over time. - Contributing to the economy through business activity attracted to the incubator. 	<p>(Barbe; Green; Chang, 2010); (Cukier; Fox; Rahnama, 2012); (Etzkowitz; Zhou, 2017); (Ojaghi; Mohammadi; Yazdani, 2019); (Santos, 2022)</p>



	<ul style="list-style-type: none"> - Supporting market and product development are also key factors. - Promoting bottom-up initiatives through its interactions and programs. The innovation space through various innovation support structures. - Boosting the growth of new startups seeking to develop the ecosystem through innovative mechanisms. - Supporting through tax incentives, grants, etc.). - Supporting entrepreneurs throughout the community. - Providing benchmarking and sharing of best service practices. - People with skills and ideas can participate and get much support to leverage these ideas and technologies. - Through advisory services, providing infrastructure and technical knowledge to start-up companies. - Technology (in the creation, launch, and growth phases), talent (in the creation and launch phases), location (in the creation, launch, and growth phases), and market (in the launch and growth phases). - Developing technology transfer contract. 	<p>(Ismail; Kamel; Wahba, 2018); (Ho; Yoon, 2022); (Felizola; Gomes; Almeida, 2019); (Mungila, 2020); (Theodoraki; Messeghem; Rice, 2018); (Chan; Krishnamurthy; Sadreddin, 2022); (Carvalho; Bersani; Maldaner; Piqué, 2020); (Tumelero; Sbragia; Borini; Franco, 2018).</p>
Funding	<ul style="list-style-type: none"> - Connecting with outside companies to help the incubates obtain resources such as financial capital, social capital, and market knowledge. - Finance (in the creation and launch phases). - The incubator positively influences the technological capacity of the companies through its financial and technological networks. 	<p>(Chan; Krishnamurthy; Sadreddin, 2022); (Carvalho; Bersani; Maldaner; Piqué, 2020); (Tumelero; Sbragia; Borini; Franco, 2018)</p>

Source: developed by the authors.

Each axis seeks to explain the connections built by incubators to foster their activities regarding support to entrepreneurs and demonstrate how this relationship occurs. These connections often cover existing pains in integrating ecosystem players with incubated companies (Carvalho; Bersani; Maldaner; Piqué, 2020).

The “support” axis is related to how the incubator, within its structures and methods, corroborates these arrangements since it also uses its operations to support the incubates and connect them to the ecosystem resources and, through its actions, builds an

entrepreneurial culture (Chan; Krishnamurthy; Sadreddin, 2022; Cukier; Fox; Rahnama, 2012).

Supportive actions by the incubator towards its residents drive innovation relationships with other companies as they foster connections with ecosystem resources (Ojaghi; Mohammadi; Yazdani, 2019; Chan; Krishnamurthy; Sadreddin, 2022). Other authors complement that incubators, with the use of their methods appropriate for each case of startups, contribute to achieving the objectives of their incubated companies and the innovation and entrepreneurship ecosystem in as much as monitoring and validating the entrepreneurial pathway is concerned (Castro; Araujo; Fragoso; Costa; Ligia, 2021); in addition, they can be installed in strategic regions to provide support and services to boost the local ecosystem (Theodoraki; Messeghem; Rice, 2018).

Nevertheless, the “network” axis seeks to explain the channels through which the incubator converges with other companies in its environment to maintain a good relationship with its residents. Some means have been reported in the literature, such as constructing creative dialogues for the relationship to mature (Tumelero; Sbragia; Borini; Franco, 2018). Another similar form of dialogue between companies is that incubators build these creative conversations in their relationships between individuals and legal entities in aspects with the convergence of interests (Tumelero; Sbragia; Borini; Franco, 2018).

Incubators, in contrast, create and assist in developing new innovative companies as well as creating mutual partnerships with other companies in the ecosystem (Barbe; Green; Chang, 2010); corroborating such statements, incubators also mediate and connect social entities with other entities through projects, programs, and actions aimed at having social impacts (Ho; Yoon, 2022).

These activities developed have present forms of leveraging the capacity of human resources, technology, financial resources, and greater and better collaboration with other actors in the ecosystem (Mwandosya; Apiola; Lahde, 2016; Carvalho; Bersani; Maldaner; Piqué, 2020). In this context, the connection with universities stands out in terms of development and support in technology transfer contracts (Tumelero; Sbragia; Borini; Franco, 2018), since incubators are key actors in relations with universities as they allow building links of high knowledge between technology networks and university

laboratories (Ojaghi; Mohammadi; Yazdani, 2019; Tumelero; Sbragia; Borini; Franco, 2018).

Additionally, entrepreneurial university consists of activities that incubators seek to provide to students (Barbe; Green; Chang, 2010), including creating academic and non-academic contacts that unite professors and students to other networks so they can contribute to the success of spin-offs (Hayter, 2016), bringing an entrepreneurial culture to young people earlier on, building educational effects that directly influence entrepreneurial actions (Cukier; Fox; Rahnama, 2012) and building assets and strengths with the university (Ismail; Kamel; Wahba, 2018).

Lastly, the “funding” axis reports an essential advance for companies in terms of financial capital. The authors portray some ways that incubators influence the financial aspect, which through their networks, leverage the technological capacity of companies (Tumelero; Sbragia; Borini; Franco, 2018). One of the ways is the connection points with other external companies, which help and contribute to the incubated companies to obtain support (e.g., financial and social capital) (Chan; Krishnamurthy; Sadreddin, 2022), both in the creation phase of the company and in the validation of the business model (Carvalho; Bersani; Maldaner; Piqué, 2020), contribute significantly to companies’ development and the economic development of the country (Barbe; Green; Chang, 2010).

It is important to highlight that the knowledge-sharing network created by incubators is a critical intermediary organization between the actors of the innovation ecosystem because, through the partnerships that form a niche of collaboration with other actors of the ecosystem (Ho; Yoon, 2022; Ismail; Kamel; Wahba, 2018), it also strengthens the regional innovation ecosystem, contributing to the growth of the country’s research and development (Mungila, 2020), therefore being protagonists in promoting competitiveness and sustainability among companies (Santos, 2022).

3.3 THE IMPORTANCE OF BUSINESS INCUBATORS FOR THE INNOVATION ECOSYSTEM

Table 4 summarizes incubators' importance to the local innovation ecosystem. Three axes of contribution were identified utilizing the literature: the first is associated with the growth of the local economy, the second covers the boosting of the companies formed, and the third is associated with the opening of new innovative enterprises.

Table 4. Importance of business incubators for the innovation ecosystem.

Axis	Contribution	Authors
Regional economic growth	<ul style="list-style-type: none"> - Contribute to the economic development of the city - Support the development and growth of companies - Stimulates the economy; - Increase competition; - Promote innovation - Increase the efficient allocation of resources in economies - The incubators assume an important role in transferring technology among their external network to create new patents, products, and services, leveraging the local economy. - Ability to support employment generation - It is a key player in identifying international needs, including structures, infrastructure, and networks. - The network promoted by incubators ensures that startups cultivate a comprehensive resource base of co-commercializing science in the ecosystem through entrepreneurship. - Maintain and develop the innovation of startups and promote the development of the innovation ecosystem. 	(Barbe; Green; Chang, 2010); (Ho; Yoon, 2022); (Santos, 2022); (Mungila, 2020); (Ismail; Kamel; Wahba, 2018); (Ojaghi; Mohammadi; Yazdani, 2019);
Boosts business	<ul style="list-style-type: none"> - Incubators develop mechanisms to maintain contact with their graduates to promote a growing and supportive innovation ecosystem. - Help the entrepreneur and startups adapt to the development of the business network; - Assist startups and managers in steps of business management; - Incubators are trainers of entrepreneurship and innovation through their programs and support structures. - The effectiveness of the relationships between the incubator and the ecosystem actors will optimize resource use, reduce redundancies, and strengthen unity among the contributors to business support within a region. - The relationship with the incubators influences 70.6% of the technological capacity of the companies through the insertion in the financial and technological networks. - Strengthen new technological arrangements, particularly open innovation processes. 	(Chan; Krishnamurthy; Sadreddin, 2022); (Felizola; Gomes; Almeida, 2019); (Etzkowitz; Zhou, 2017); (Theodoraki; Messeghem; Rice, 2018); (Tumelero; Sbragia; Borini; Franco, 2018)
	- Entrepreneurial universities enhance the development of	(Cukier; Fox;



Opening of new companies	<p>skills and attitudes in young people;</p> <ul style="list-style-type: none">- Foster an innovative culture.- Push young people toward entrepreneurial learning.- Connect spin-offs with the entrepreneurial ecosystem- The incubator was developed to serve university students in internship programs by supporting skills they lack in their university education.- Create small labor markets for technology professionals and nurturing technology talent are pressing issues driving the operations of technology hubs.- As part of other important development activities, business incubation is a crucial part of the innovation ecosystem.- Provide support in the early stages of company development- At universities, they support projects from scientific and technological developments;- Promote the development of startups and spin-offs.- Monitor entrepreneurs and startups for progress on the entrepreneurial journey.	<p>Rahnama, 2012); (Hayter, 2016); (Mwandosya; Apiola; Lahde, 2016); (Carvalho; Bersani; Maldaner; Piqué, 2020); (Castro; Araujo; Fragoso; Costa; Ligia, 2021)</p>
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Source: developed by the authors.

By analyzing the first axis, business incubators enhance the growth of the cities' economies since they stimulate the opening of new companies, thus increasing competition among them and more efficient distribution of resources in local economies (Santos, 2022). Mungila (2020) complements that incubators assume an important role in transferring information among their network of stakeholders to create new patents, products, and services, thus leveraging the local economy.

Ismail, Kamel, and Wahba (2018) further reinforce incubators' ability to support employment generation since they stimulate the creation of new companies. In this way, incubators contribute activities that maintain and seek to develop the innovation of innovative companies, thus promoting the expansion and development of the local innovation ecosystem (Ojaghi; Mohammadi; Yazdani, 2019). The second point of importance addressed in the literature is boosting already established companies. The authors commune that incubators assist in the business management stages of startups that foster innovation (Felizola; Gomes; Almeida, 2019). It also allows for optimizing resources and reducing repetition in its processes, which is due to the relationships that this habitat has with the actors of the region's ecosystem (Theodoraki; Messeghem; Rice, 2018), since incubators, through their support programs, are trainers of entrepreneurship and innovation (Etzkowitz; Zhou, 2017).

Tumelero, Sbragia, Borini, and Franco (2018) reported that technological and financial networks built by business incubators leveraged 70.6% of their ability to innovate, reinforcing the need for the insertion of these habitats with the networks of technology bases and universities since they dispose of relationships of high technical content.

The third point raised is associated with the opening of new innovative ventures. Incubators, through internship programs at universities, attending to students' lack of ability in their training (Mwandosya; Apiola; Lahde, 2016), interact with the entrepreneurial ecosystem when they insert and connect new spin-offs (Hayter, 2016). In fact, universities are important players, so incubators may empower new spin-off insertions into the entrepreneurial ecosystem by using their methods. Cukier, Fox, and Rahnama (2012) corroborate this practice by stating that the entrepreneurial university culture enhances young people's new skills and creative attitudes.

Finally, the authors complement each other when they portray that business incubators develop crucial activities in the development of new companies in the innovation ecosystem (Mwandosya; Apiola; Lahde, 2016); this is because they are supported since the initial phase of business modeling until their maturity through monitoring and validation of their progress in the entrepreneurial journey (Carvalho; Bersani; Maldaner; Piqué, 2020; Castro; Araujo; Fragoso; Costa; Ligia, 2021). These are some of the ways the authors share similarities when addressing the importance of business incubators to the local innovation ecosystem.

4 CONCLUSIONS

This study aimed to identify fundamental points demonstrating incubators' relevant role within the innovation ecosystem and how research deals with the theme, outlining and contributing to developing and disseminating knowledge concerning incubators and their interaction with innovation ecosystems.

The clustering of the keywords generated by the authors and the identification of the main co-occurrence networks, their connections, and interactions enabled us to produce a synthesis between the clusters (innovation ecosystem, innovation, and

entrepreneurial ecosystem), which, when connected to the business incubator and the university, form a link to boost the entire ecosystem, directly contributing to the economic and social development of the region, through the success of the companies, with an eye on startups and spin-offs.

Through the corpus analysis, one verifies a common ground amongst authors concerning incubators' importance to the ecosystem and the dynamic and organic means they possess to create these connections. Thus, the growth of the local economy, the boosting of the companies formed, and the opening of new innovative companies are highlighted as the factors that most make incubators relevant actors in an innovation ecosystem.

Furthermore, it was possible to observe that incubators have taken on a crucial role in creating and intermediating knowledge networks to assist their residents on their entrepreneurial journeys, sharing with all actors in the innovation ecosystem knowledge, public, entrepreneurial, civil society, innovation habitat, institutional, and fomentation. Thus, it was possible to perceive that incubators connect with universities, research centers, laboratories, companies, support networks, internship programs, associations, coworking and co-living, pre-accelerator, entrepreneurial environments, research centers, technical networks, mentor networks, communities, customers, angel investors, financial institutions, venture capital, and financing.

Additionally, this interaction with the most diverse stakeholders ensures synergy between the connections built by the incubators, thus creating support for entrepreneurs through the axes, support, network, and promotion, thus strengthening an entrepreneurial culture. As for the theoretical implications of this study, one can highlight that incubators should not act in isolation from their innovation ecosystem in order to develop partnerships that facilitate the sharing of knowledge among the various participants in a win-win relationship between ecosystem players and incubator residents.

Thus, by considering the approaches employed, this article's main gain in terms of leveraging new research on the theme is the identification and synthesis brought by the authors regarding the importance that incubators of companies have for the innovation ecosystem and the arrangements between all of the ecosystem's actors for the transfer of knowledge amongst its residents. As a contribution, incubator managers should first



connect with other innovation ecosystem actors to understand this ecosystem's players and establish partnerships with agents to contribute to incubated residents' success.

Despite the relevant information generated in this study, one may identify some limitations that do not exclude the rigor and quality of the information and results generated. Thus, the first limitation is that this study is only theoretical and considers studies that relate to incubators and innovation ecosystems. Hence, we suggest future studies to analyze case studies at incubators to validate the information collected in this study and verify which of these connections are more critical in the view of incubator managers.

ACKNOWLEDGEMENTS

The authors would like to thank the Coordination for the Improvement of Higher Education Personnel (CAPES) and the National Council for Scientific and Technological Development (CNPq) for financially supporting this study through scholarships, the Federal University of Santa Catarina through the Graduate Program in Engineering and Knowledge Management (PPGEGC), the Federal Institute of Mato Grosso for guaranteeing the authors' studies and research.

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