Business incubators and the relationship with the innovation ecosystem in the light of bibliometrics

Incubadora de empresas e a relação com o ecossistema de inovação a luz da bibliometria

Incubadora de empresas y la relación con el ecosistema de innovación a la luz de la *bibliometría*

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Abstract

This study analyzed how academic research relates business incubators in the context of the innovation ecosystem and its co-occurrences. The article used the bibliometric review supported by the VOSviewer software. As for the database search, the following repositories were used: Scopus and Web of Science, both accessed in February 2025, with the search string: (ecosystem) AND ("business incubator"), identified in the titles, abstracts, and keywords, from 2013 to 2024, returning 187 articles. No articles addressing this theme were found, thus solidifying a unique and original article. In this way, it was possible to show the evolution of research, the occurrence network involving the main keywords, the journals corroborating the theme, the most cited authors and co-authors and their networks, and the countries that publish the most. Identifying knowledge gaps through the analysis of co-occurrences between authors and works in literature allows guiding future research in the theoretical, practical, and social realms of business incubators. Lastly, the importance of developing far-reaching and in-depth studies and using methods that bring results in the search for developing new studies through context analyses and the relevant connections such research brings.

Keywords: Habitat of innovation; Actors; Innovation ecosystem; Business incubator; Bibliometric review.

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Introducción

Business incubators are important innovation environments that drive the innovation ecosystem due to how robust it has become, especially when seeking to create value, its interdependence, and the competitive relationships between the actors, with innovation development as the main focus (Gomes et al., 2018; Granstrand & Holgersson, 2020; Steinbruch et al., 2021; Silvestro et al., 2024; Silvestro et al., 2024). Among the actors that make up an innovation ecosystem, the business sector can be considered one of the most favored since startups with a high concentration of innovation in their core suffer the most threats of early failure due to the "liability of novelty" (Kohler, 2016; Usman & Vanhaverbeke, 2017; Bereczki, 2019).

It is essential for startups or any other company to receive support from incubators through knowledge transfer and develop a good relationship with the other actors of the innovation ecosystem to which they belong, resulting in new relationship networks (Silvestro et al., 2024; Silvestro et al., 2024). The services offered by business incubators are importance for managing and formalizing new companies (Lai & Lin, 2015; Silvestro et al., 2024), as well as supporting the relationship process through their networks of customers, suppliers, research institutes, universities, competitors, and partners, among others, so that companies can be increasingly integrated into innovation networks, especially those in the initial phase (Bereczki, 2019; Silvestro et al., 2024).

Thus, these entities are involved in a set of actors and perform multiple functions in favor of the ecosystem; therefore, there are interactions and relationships between organizations (Moore, 1993; Autio & Thomas, 2013; Foguesatto et al., 2021), and "research points to an urgent need to study the collaborations between startups and other actors within an innovation ecosystem" (Spender et al., 2017). Nonetheless, little attention has been given to incubators, which, in turn, have the critical role of connecting companies to the network (Silvestro et al., 2024).

The lack of attention in the literature on business incubators has been demonstrated in bibliometric reviews. For instance, a study conducted between 1985 to 2015 found that research on business incubation is underrepresented in the fields of business, management, and economics due to the limited number of reliable sources. Therefore, to leverage research in the context of business incubators, this study sought to analyze, through a bibliometric review from 2013 to 2024, how academic research relates to business incubators in the innovation ecosystem and shed more light on the connections between the two terms.

Furthermore, no studies were identified aiming to understand how literature relates to business incubators and the innovation ecosystem in this period, making the present study important for academic research.

Methodology

The present article used a bibliometric review supported by VOSviewer software (version 1.6.18) to achieve the research objectives. To make the review viable, it is necessary to observe the correlations between research output and the dissemination of scientific knowledge (Araújo, 2006). This study employed a qualitative approach, which, according to Creswell (2010), "is the intentional selection of participants, locations, documents, or visual material that will best help the researcher understand the problem and research question."

The following search string was used: (ecosystem) AND ("business incubator") for the titles, abstracts, and keywords from 2013 to 2024. The Scopus and Web of Science databases were used and accessed on February 26, 2025; they were selected because they contain the most relevant publications and have the highest impact factor scores (IF), returning 187 articles in the first search (Table 1).

Table 1. Search process

Steps taken	Scopus	WOS	Total
Total searches	141	46	187
After excluding redundancies	97	38	135
After being read, the abstract, title, and keywords	44	8	52

Note: created by the author (2025)

The titles, abstracts, and keywords were read to identify the adherence of the selected articles, resulting in a final corpus of 52 documents used to build the bibliometric review. The VOSviewer software (version 1.6.18) was then used to show the evolution of the theme, identify and describe correlations, such as the network of the main keywords, the countries that disseminate the theme, the timeline of the publications, citation count, and the connection of the articles with the authors in the area, as well as the journals that contribute to and are highlighted in the publications.

Results

The first analysis focused on the keywords used in the authors' studies, totaling 128. The keywords most used by the authors were "innovation ecosystem" (n = 9), "entrepreneurship" (n = 8), "innovation" (n = 7), and "business incubator" (n = 5), thus revealing the four most used keywords (Table 2).

Table 2. Number of occurrences of the main keywords

Keywords	No.	Keywords	No.
Innovation ecosystem	9	Business incubator	5
Entrepreneurship	8	Technology transfer	3
Innovation	7	Entrepreneurial ecosystem	3
Startup	7	University business incubator	3

Note: created by the author (2025)

The predominance of **"innovation ecosystem"** as the most cited keyword suggests a strong academic focus on the interconnected networks that support innovation and business development. Similarly, the recurrence of **"entrepreneurship"** and **"innovation"** reflects the foundational role of these concepts in studies related to incubators and startup ecosystems. The presence of **"business incubator"** as a frequently used keyword further reinforces the centrality of incubation programs in fostering entrepreneurial growth and technological advancement.

These results indicate that research in the field primarily revolves around understanding how innovation ecosystem's function, the role of entrepreneurship in driving innovation, and the mechanisms through which business incubators contribute to economic and technological progress. The keyword analysis provides insights into the primary areas of academic interest and the evolving discourse on incubation models and innovation strategies.

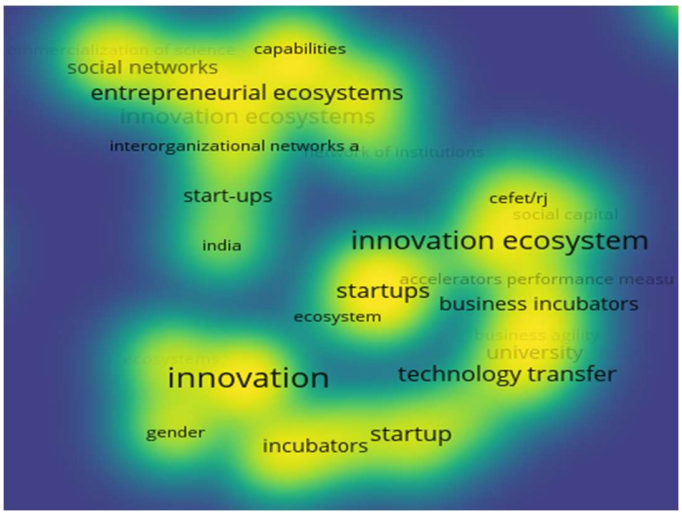

Figure 1. Density of occurrences of the keywords

Note: created by the author (2025)

Figure 1 shows the density of occurrences generated by the most used keywords in the search corpus. Notably, the five keywords most used by the authors are directly related to the search strings (i.e., "innovation," "entrepreneurial," and "startup") and belong to the same universe. The developed innovation ecosystems have the necessary infrastructure to evolve actors in an entrepreneurial context and facilitate continuous development for innovations (Romano et al., 2014; Gastaldi & Corso, 2016; Barile et al., 2024).

In addition, the innovative ecosystem has a network of entrepreneurs, mentors, service providers, and investors that can be used to support the creation and development of scalable startups (Haines, 2016). This is because companies must build innovation networks as they are fundamental to guaranteeing transmission of knowledge and achieving the efficient use of the resources provided by the network. Companies with superior open innovation capabilities in each ecosystem guarantee advantages in technology and capital resources when they maintain ties with the innovation network (Xie & Wang, 2021).

The co-occurrence network seeks to present the existing connections between the keywords, demonstrating the degree of interaction between them and the main clusters of this interaction. In Figure 2, one can observe that this interaction is formed by three large clusters, the first with the word "innovation ecosystem" (in blue), the second "entrepreneurial or entrepreneurship ecosystem" (in red), and the third cluster with the keyword "innovation" (in orange).

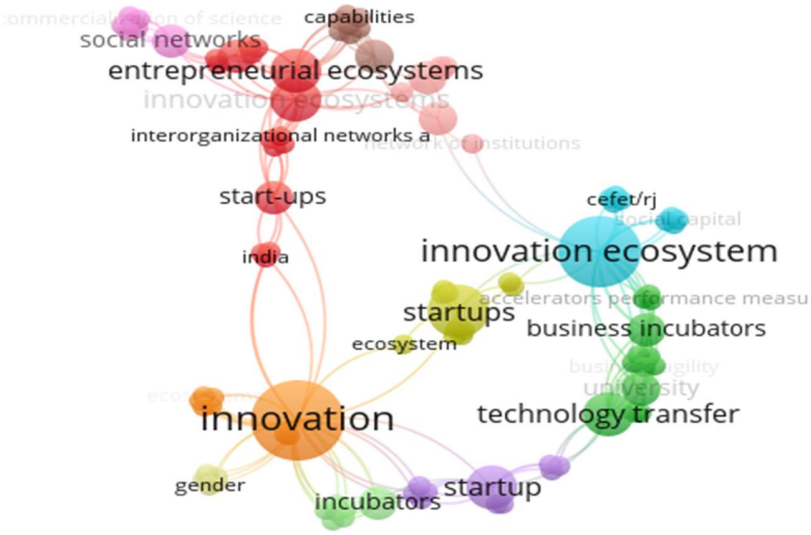

Figure 2 - Keyword co-occurrence network
Note: created by the author (2025)

The co-occurrence network analysis provides valuable insights into the relationships between key terms, illustrating the strength of interactions and the main thematic clusters in the research domain. As shown in Figure 2, three dominant clusters emerge, each representing a fundamental aspect of the field.

The first cluster (blue) is centered around the keyword "innovation ecosystem", which appears as the most frequently used term and serves as a connecting hub between various research strands. This cluster emphasizes the role of structured ecosystems in fostering innovation through collaboration among startups, universities, and industries. It also highlights the significance of network formation and institutional support in driving sustainable technological advancements.

The second cluster (red) revolves around "entrepreneurial ecosystem" or "entrepreneurship

ecosystem", underscoring the importance of entrepreneurial activity in shaping innovation landscapes. This cluster is strongly linked to studies on startup growth, policy frameworks, and venture capital, indicating that successful innovation ecosystems require both business incubators and external financial support to thrive.

Finally, the third cluster (orange) is anchored by the term "innovation", representing a broader and more cross-cutting dimension that integrates technological, social, and economic perspectives. This cluster connects both the entrepreneurial ecosystem and the innovation ecosystem, demonstrating how innovative processes emerge from the interaction between entrepreneurial initiatives and structured support systems.

The interconnections among these three clusters highlight the multidimensional nature of innovation ecosystems, reinforcing the idea that business incubators function as bridges between entrepreneurial efforts and institutional frameworks. The analysis further reveals that the synergy between innovation, entrepreneurship, and ecosystem structures is essential for fostering sustainable business development and technological progress.

Combining these three clusters forms an essential link for developing and boosting the entire ecosystem. When organizations are anchored in networks and there is mutual collaboration, the entire ecosystem benefits (Machado et al., 2018), thereby ensuring knowledge sharing.

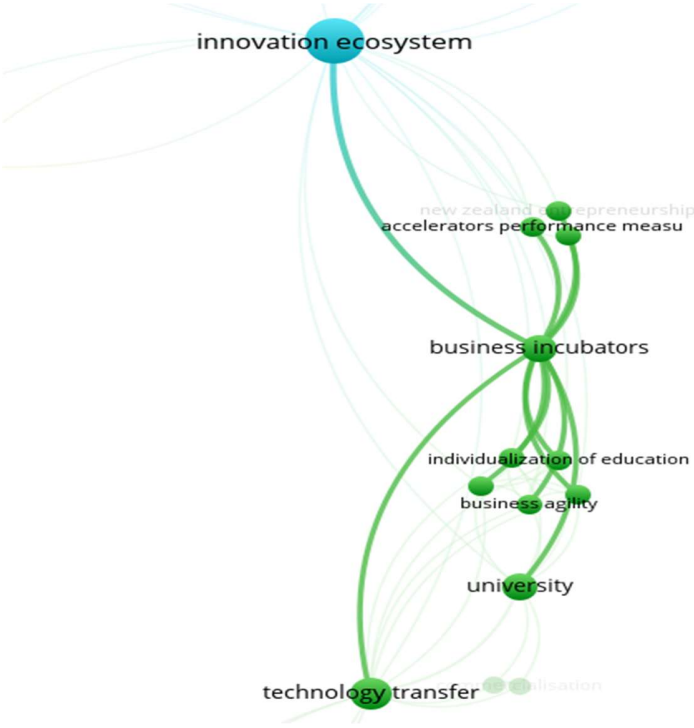

Figure 3 - Network of co-occurrences of the keyword "business incubator"
Note: created by the author (2025)

Figure 3 shows the network of co-occurrences of the keyword identified by the word "business incubators," which is the second search string used, appearing parallel and in the same cluster as the keyword "innovation ecosystem," thus revealing the relationships between them and the connections with other important words for the development and evolution of the terms: "technology transfer," "university," "business agility," "individualization of education," and "accelerators performance."

When there is a connection between business incubators and universities through interaction with other innovation habitats, it is possible to identify the development of the region through the generation of

jobs and the construction of an entrepreneurial profile in companies (Anprotec-MCTI, 2012).

Incubators are not simply shared spaces but also serve as a network of individuals and organizations that operate and relate to make this structure work through managers, consultants, universities, and university community members (Hackett & Dilts, 2004), strengthening knowledge transfer mechanisms and agility in management processes. Figure 4 shows the year of publication of the terms. By using a search corpus from the last decade, the terms used originate from recent studies, starting from 2019, and the main occurrences involve "innovation ecosystem" and "business incubators."

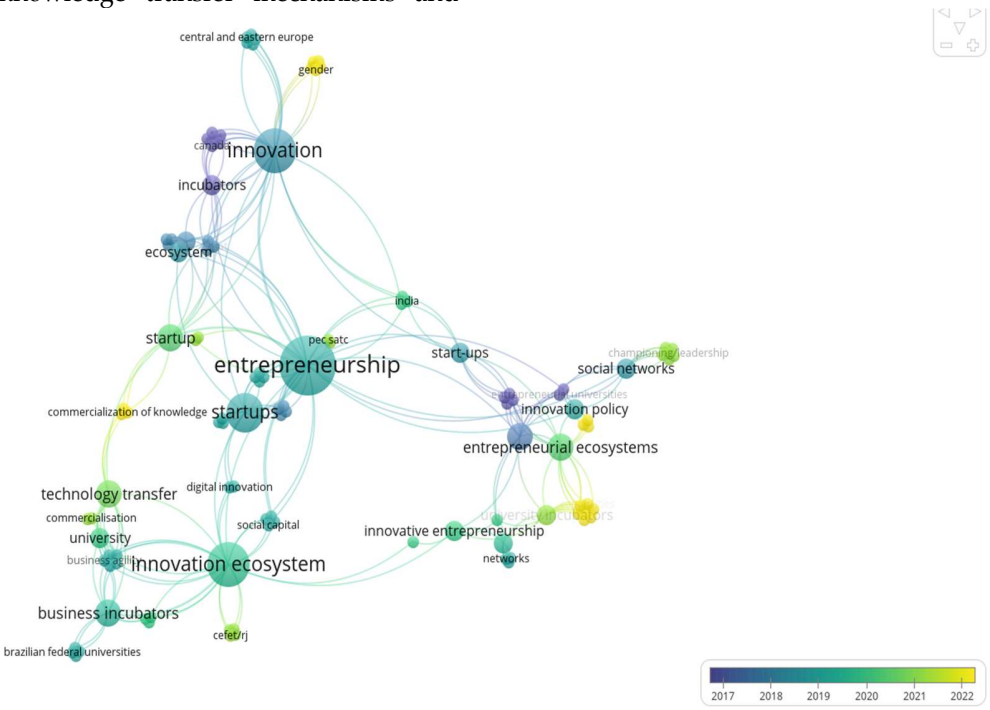

Figure 4 – Publication year of the words
Note: created by the author (2025)

The analysis of Figure 5 and Table 2 provided insights into the co-authorship networks, highlighting key contributors to the research on business incubators and innovation ecosystems. Among the 109 identified authors, Etzkowitz and Guerrero stood out as the most prolific, each having two published articles on the subject. This finding underscores their significant role in shaping academic discussions in this field.

Furthermore, when evaluating the citation impact, it was observed that 31 out of the 109 authors had received more than 12 citations, indicating a strong academic influence. Notably, Etzkowitz led the ranking with 127 citations, followed by Hayter with 116, Zhou with 99, and Guerrero with 31 citations. This distribution highlights the impact of these scholars' contributions, particularly in advancing knowledge related to innovative ecosystems and the role of incubators in entrepreneurial development.

These findings emphasize the concentration of research efforts among a select group of highly cited scholars, demonstrating their influence on the academic community. The citation patterns also reveal the growing interest in the subject, reinforcing the importance of expanding future research to include a more diverse set of perspectives.

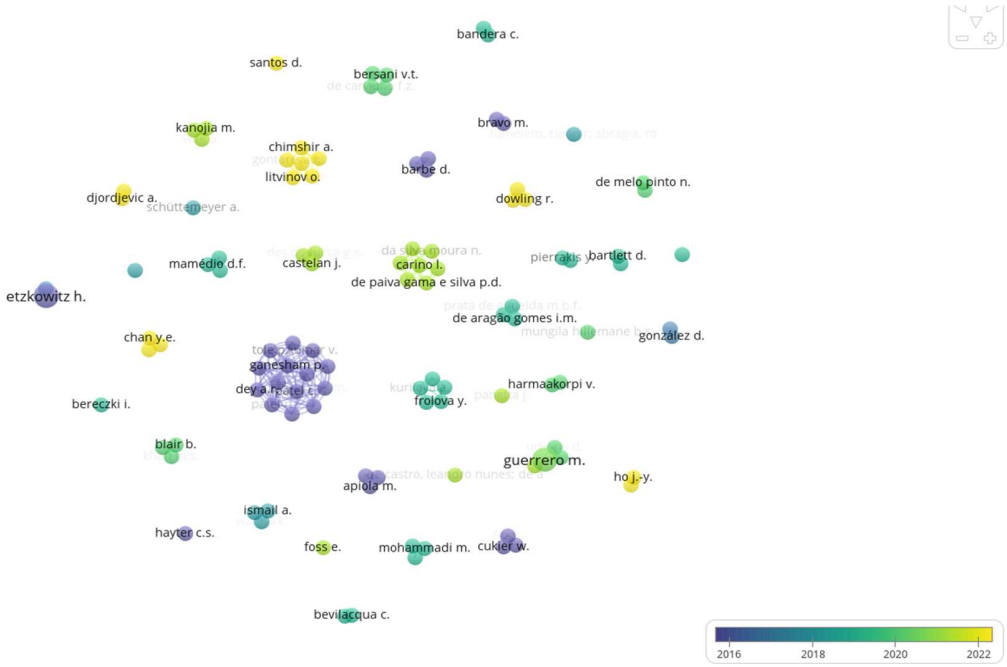

Figure 5 - Co-authorship network
Note: created by the author (2025)

This finding highlights a significant gap in academic literature, as the most cited authors contribute independently to the field without forming a collaborative network. The lack of direct connections between these key researchers suggests that the development of the innovation ecosystem and business incubator themes occurs in isolated knowledge silos rather than through a collective and interdisciplinary effort. This fragmentation may limit the creation of a unified theoretical framework, which could enhance the overall understanding of how incubators function within innovative ecosystems.

Furthermore, the absence of co-authorship among the most influential authors indicates that different perspectives on the topic are being developed separately, potentially leading to redundancies or inconsistencies in the research. This reinforces the need for greater collaboration, encouraging researchers to engage in joint studies to build a more cohesive body of knowledge. Establishing academic networks and fostering interdisciplinary research could improve the integration of theories, methodologies, and findings, ultimately enriching discussions on the role of business incubators in fostering entrepreneurship and innovation.

Given the significant number of citations despite the lack of direct connections, it becomes evident that the topic holds considerable academic and practical relevance. Future studies should focus on bridging these gaps by promoting international collaborations and cross-disciplinary research efforts, ensuring a more holistic and comprehensive approach to understanding the relationship between business incubators and innovative ecosystems.

Table 3. Authors, citations and number of documents published

Authors	Citations	Documents	Authors	Citations	Documents
Etzkowitz H.	127	2	Ganesham P.	30	1
Hayter C. S.	116	1	Grupta A. K.	30	1
Zhou C.	99	1	Kumar V.	30	1
Guerrero M.	31	2	Mahanta H.	30	1
Dey A. R.	30	1	Patel C.	30	1

Note: created by the author (2025)

The 28 studies identified in the study collectively amass 420 citations, reflecting their influence on the dissemination of knowledge in this field. Among them, "Small Business Economics" stands out as the most cited, with 116 citations, highlighting its significant role in discussing entrepreneurial dynamics and economic impact. Similarly, "The Triple Helix", with 99 citations, reinforces the interaction between university-industry-government as a key driver of innovation.

Additionally, the "Journal of Open Innovation", with 30 citations, emphasizes open innovation models, which align with the collaborative nature of business incubators and their role in fostering entrepreneurial ecosystems. "Social Science Information", with 28 citations, provides a multidisciplinary perspective, further enriching discussions on incubation models and innovation networks. By identifying these leading journals, the study not only highlights the most influential publication sources but also establishes a theoretical framework for future research, ensuring that scholars and practitioners can build upon a well-defined knowledge base.

This systematic mapping of citations strengthens the theoretical foundation of the field, offering guidance for researchers seeking reliable sources and cutting-edge discussions on the relationship between incubators and innovation ecosystems. Furthermore, by pinpointing key academic contributions, the study facilitates the expansion of research collaborations, encouraging deeper exploration of entrepreneurship, technology transfer, and innovation-driven economic development.

Table 4. Journals with the most citations

Journal	Citations	Journals	Citations
Small Business Economics	116	*Technology Analysis and Strategic Management*	26
The Triple Helix: University-industry-government innovation in action	99	*IEEE Transactions on Engineering Management*	19
Journal of Open Innovation: Technology, Market and Complexity	30	*Journal of Technology Transfer*	17
Social Science Information	28	*Journal of Management Development*	16

Note: created by the author (2025)

When analyzing the countries that publish the most articles on the theme (Table 5), the United States stands out with 10 publications, followed by Brazil (n = 7), India (n = 7) the United Kingdom (n = 5), Spain and Finland (n=3), Italy (n=4), Chile, Canada and South Korea (n = 2), and China (n = 1).

When comparing Table 5 on publications and citations by countries, the degree of relevance between them stands out due to the volume of citations and the number of publications. The United States is ahead with 285 citations and 10 published articles, followed by the United Kingdom (n = 149), Italy and China (n = 99 citations), India and Chile (n = 31), and Brazil (n = 30).

Table 5. Publications and citations per country

Countries	USA	Brazil	India	UK	Italy	Spain	Finland	Chile	Canadá	South Korea	China
Articles	10	7	7	5	4	3	3	2	2	2	1
Citations	285	30	31	149	99	16	5	31	4	2	99

Note: created by the author (2025)

This growing number of publications and citations has been developing due to several factors, the maturation of the academic fields, which has been sparking interest in the subject, the development and transfer of new technologies, and the competition between the actors within the innovation ecosystem due to emerging

relationships and connections (Trzeciak et al., 2018). The interactions in the ecosystem are responsible for demonstrating the flow of value, which is fundamental to stimulating technological and economic development and built based on collaboration, competition, trust, and co-creation of value (Hwang & Horowitz, 2012; Bhat, 2023; Isher & Gangwar, 2024).

In the ecosystem, studies are developed cooperatively and competently by sharing a vision of the future and exploring a shared set of knowledge, technologies, or complementary skills (Lemos, 2011; Moore, 2006; Gobble, 2014; Isher & Gangwar, 2024). Incubators act as openly as possible to stimulate the flow of knowledge from within to the outside of the ecosystem, thus accelerating internal innovation and its distribution in the market (Bhat, 2023; Spinosa et al., 2015).

Final Considerations

In compliance with the proposed methodology using the VOSviewer software, it was possible to build evidence regarding the evolution of the innovation ecosystem and business incubator themes. To meet the proposed objectives of this article, correlations were identified and described, such as the network of main keywords, the main countries that are spreading the theme, the chronology of publications, the citation count, the connection of articles with authors in the area, and the journals that corroborate and are highlighted in the publications, to answer the key question of how academic research relates to business incubators in the context of innovation ecosystems.

The co-occurrence analysis revealed that the most relevant keyword identified was "innovation ecosystem," with a higher use rate and a direct connection with the second search string, "business incubator." This evidence was demonstrated in the construction of literature and validated with the research corpus.

When analyzing startups in the context of an ecosystem, it became clear that they need to connect to an innovation network to reach the level of innovation and scalability required in their products or services. This support can be achieved through relationships with sharing networks created by business incubators and technology transfers driven by universities. The innovation network of incubators connected to universities results in the growth of the local economy by increasing spin-offs as well as enhancing the agility and performance of the companies resulting from this transfer of knowledge with local businesses.

It was also possible to identify the clusters related to the main terms of the study; the innovation ecosystem had the strongest link, followed by entrepreneurship and innovation, which are connected through networks created by business incubators, either through technology transfer, via the university or by accelerators, both identified in the research corpus.

When analyzing the publications and timeline, a notable growth was observed from 2016 due to the impact of 127 citations of the author Etzkowitz, who published two articles as the most relevant study on the subject. However, from 2019 and 2020, the research terms "innovation ecosystem" and "business incubator" began to be associated with greater intensity, as highlighted in Figure 4. When analyzing the countries that provide the most content on the subject and hold significant influence through citations, the United States, with 285 citations, leads this ranking and has the largest number of articles published (10 in all). This is followed by the United Kingdom, with 149 citations and 5 published articles.

Finally, it is concluded that, even with the low number of publications and the concentration of terms by the countries with the highest number of citations, the study becomes relevant when analyzing the context and connections brought by the search, as is the case of entrepreneurship and innovation, which are driven by research and highlight the importance of business incubators in their relationship with the local innovation ecosystem. In addition, it is crucial to explore the themes to produce further research through more in-depth reviews of each article identified in the searches, further enhancing the content on the subject and the relationship between business incubators and an innovation ecosystem and how both influence each other's performance.

This research contributes theoretically by mapping the evolution of the innovation ecosystem and business incubator themes through bibliometric analysis. The findings highlight how business incubators play a role in fostering innovation, reinforcing their connection with entrepreneurial ecosystems. Furthermore, by analyzing the growth of publications over time, the

study emphasizes the increasing academic interest in these topics, particularly after 2019, demonstrating the need for continued exploration within the field.

From a practical perspective, the research underscores the role of business incubators as strategic agents in supporting startups and enhancing their scalability. The findings indicate that incubators, in collaboration with universities, create knowledge-sharing networks and facilitate technology transfer, contributing to the agility and performance of emerging businesses. The study also highlights how different countries approach innovation ecosystems, providing policymakers and incubator managers with insights into best practices that can be adapted to different regional contexts. Additionally, by identifying the most cited works and influential authors, this research serves as a valuable reference for professionals and researchers looking to deepen their understanding of the subject.

On a social level, the research demonstrates that innovation ecosystems—when effectively structured through incubators—contribute to local economic development by fostering spin-offs and strengthening relationships between universities, startups, and industries. The study highlights the networking potential of incubators, which play a role in integrating entrepreneurs into a collaborative ecosystem that promotes long-term sustainability. By emphasizing the relationship between entrepreneurship and innovation, the findings reinforce the importance of expanding incubation programs to drive inclusive growth and technological advancement in diverse economic environments.

Based on the evidence gathered, future research could deepen the qualitative analysis of how different incubator models impact the performance of startups in distinct regional contexts, taking into account variables such as public policies, the maturity of the local ecosystem, and the level of interaction with universities. Additionally, comparative studies between countries that lead in publications and citations—such as the United States and the United Kingdom—and emerging nations may reveal gaps and opportunities for the development of more inclusive practices adapted to diverse socioeconomic realities. Another promising direction would be to explore, through case studies or organizational ethnographies, the specific mechanisms of technology transfer and knowledge sharing promoted by incubators, aiming to identify critical success factors for spin-off creation and the strengthening of innovation networks. Finally, longitudinal studies are suggested to understand the long-term effects of incubators on the innovation ecosystem, especially regarding startup sustainability and the generation of socioeconomic impact in the communities where they are located.

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