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INNOVATION ECOSYSTEMS: A SCIENTIFIC PRODUCTION ANALYSIS

ECOSSISTEMAS DE INOVAÇÃO: UMA ANÁLISE CIENTÍFICA DA PRODUÇÃO

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Abstract: The aim of this article is to systematize the discussion regarding the actors of the innovation ecosystem and their interactions. The research method adopted is a Systematic Literature Review (SLR). The databases consulted were Web of Science and Scopus, and the articles analyzed correspond to publications from 2018 to 2022. The data analysis techniques applied were bibliometric analysis and content analysis. Based on the developed framework, the actors of the innovation ecosystem are categorized into seven groups: ideation, investors, research and development (R&D), support and related organizations, industries, startups, and society. This study aims to contribute to the literature on the innovation ecosystem and its actors by examining their roles and interactions. Through the SLR, it was possible to construct a framework comprising seven actor groups. The descriptive analysis revealed similarities among the published articles, indicating shared themes of interest across research groups. Moreover, the author analysis identified that many researchers tend to work independently, possibly due to geographic constraints or thematic differences. The study also highlights evidence of cross-national collaborations among authors from different countries.

Keywords: Innovation Ecosystem; Innovation Ecosystem Actors; Systematic Literature Review.

Resumo: *O objetivo deste artigo é sistematizar a discussão sobre os atores do ecossistema de inovação e suas interações. Para isso, utilizou-se o método de Revisão Sistemática da Literatura (RSL), contemplando as bases de dados Web of Science e Scopus, considerando publicações entre 2018 e 2022. As técnicas de análise aplicadas foram a análise bibliométrica e a análise de conteúdo. A partir do framework desenvolvido, os atores do ecossistema de inovação foram categorizados em sete grupos: ideação, investidores, pesquisa e desenvolvimento (P&D), organizações de apoio e correlatas, indústrias, startups e sociedade. A análise descritiva evidenciou semelhanças entre os artigos publicados, enquanto a análise de conteúdo permitiu identificar os papéis e as interações entre os diferentes atores, contribuindo para o avanço teórico e para a formulação de políticas e estratégias voltadas ao desenvolvimento de ecossistemas de inovação.*

Palavras-chave*: Ecossistema de Inovação; Atores do Ecossistema de Inovação; Revisão Sistemática da Literatura.*

1 INTRODUCTION

Since 2000, the term “ecosystem” has become a focus of interest for academia, political decision-makers and organizational management (Aarikka-stenroos; Ritala, 2017; Adner, 2017; Jacobides et al., 2018). The literature highlights the innovation ecosystem as the fastest-growing research topic (Dÿbrowska et al., 2019; Grandstrand; Holgersson, 2020; Klimas; Czakon, 2022). The main characteristics of an ecosystem are providing new ways to generate knowledge and developing new partnerships to create and capture value (Nambisan; Zahra; Luo, 2019).

In an environment where organizations are increasingly specialized, an organization needs more internal resources for developing and implementing innovation (Adner; Kapoor, 2010; Talmar et al., 2020). Therefore, companies need contributions from different internal or external stakeholders to create a value proposition for the entire ecosystem (Talmar et al., 2020). In this way, innovation ecosystems are understood as a network of interconnected and interrelated actors (Gomes et al., 2018).

Several studies deal with innovation ecosystems, and Yamamura and Lassalle (2019) analyzed the institutional actors’ proximity in constructing entrepreneurship ecosystems. Abootorabi et al. (2020) investigated an entrepreneurial ecosystem using the academic spinoff approach. Adner and Lieberman (2021) researched a business ecosystem in which its actors are complementarians. Sant’Ana et al. (2020) analyzed the main classifications related to the innovation ecosystem’s structure, phases and life cycle, and their classification according

to the innovation ecosystem level. An innovation ecosystem becomes consolidated and develops through the interaction and participation of its actors. In other words, interaction occurs when specific actors are engaged, such as public actors, knowledge actors, institutional actors, funding actors, business actors, and innovation habitat actors (Teixeira; Trzeciak; Varvakis, 2017). However, a research gap remains regarding the identification of these actors and the nature of their interactions within the innovation ecosystem.

From this context, we seek to answer the following question: According to the literature, who are the actors in innovation ecosystems, and how do they interact? The research aims to systematize the actors in the innovation ecosystem and analyze their interaction. We carried out a descriptive, bibliometric and content analysis.

As a research theoretical contribution, there is a need for more studies of innovation ecosystems investigating actors and their interaction, to generate knowledge and develop the ecosystem. Furthermore, there needs to be more systematic literature reviews on the subject. As a practical contribution, the types of actors' analysis, performance, and interaction can provide bases for constructing public policies for the development of ecosystems and offer feedback to the organizations' management.

We structured this article into five sections, including the introduction. The second section addresses the theoretical framework. The third section deals with the methodological procedures used in the SLR. In the fourth section, we presented the principal results based on descriptive analysis and bibliometrics. In the fifth section, we discussed the results through content analysis. Finally, in the last section, we present the study's main contributions.

2 BACKGROUND: INNOVATION ECOSYSTEMS, THEIR ACTORS AND FUNCTIONS

The innovative ecosystem concept originates in biology, which describes a system interacting with living organisms within their physical environment (Cavallo et al., 2019). Ecosystems emphasize the strategic relevance of the business environment of companies, helping organizations achieve a sustainable competitive advantage (Zhang; Watson, 2020).

Innovation ecosystems are independent actors combining specialized and complementary capabilities and resources, which seek to co-create and add value to their end users, providing gains received in their processes (Walrave et al., 2018) . As for Granstrand and Holgersson (2020), the innovation ecosystem is the actors set that evolve simultaneously with their activities and artifacts. Innovation ecosystems form a cooperative environment around their innovation activities. Their actors are in co-evolution and organized in co-innovation processes, resulting in creating and delivering new value through innovation (Klimas; Czakon, 2022).

Innovation ecosystems became famous in 2010, relating mainly to entrepreneurship, according to Isenberg (2010) and Stam (2015), and became linked to innovation. Since then, the term innovation ecosystem began gaining space in academic discussions.

According to Autio and Thomas (2014) and Spigel (2017), there are two contexts for actors and entrepreneurs: institutional and social. It forms the institutional context of governments, universities, incubators, accelerators and science parks, which support the companies' development and growth through direct financing or training activities.

In the social context, entrepreneurs can receive support from industrial actors such as consumers, other entrepreneurs, and business angels to access different resources, such as venture capital, talented workers, marketing resources and production capacity (Autio et al., 2014).

Among the innovation ecosystem actors, it is also important to point out technological incubators, accelerators, startups and industries that play an essential role within the innovation ecosystem.

Technological incubators accelerate economic development and assist in the

growth and development of startup companies (Somsuk, 2014) Incubators allow entrepreneurs at an early stage of development to be assisted and provide business support to help them increase their market survival rate (Tang et al., 2019).

The formation of ecosystems stems from cultural aspects, attributes, and regional actors that foster socioeconomic differences and evolve in ways similar to regional environments (Spiegel, 2017). An analysis of the study on innovation ecosystems in Alagoas (Brazil) reveals that local incubators are the most important actors in fostering and creating businesses. The environment of education, research, and university extension enabled the emergence of new ventures, leading the first incubator in the state to promote the establishment of 14 new incubators by the late 1990s (Barros; Paixão, 2021).

Business accelerators are companies with programs that develop knowledge within organizations at an early stage (startups) to help launch new projects associated with learning processes for business refinement (Cohen et al., 2019). In this same context, it created business accelerators to mediate the development of business models between market shareholders and entrepreneurs, collaborating with companies from different segments (Cohen; Hochberg, 2014).

Another article analyzes the strategies and processes for developing entrepreneurship and innovation ecosystems in low-population-density areas, focusing on the following projects: the Vale do Tejo Technology Park, developed in the city of Abrantes (Portugal); the Living Lab Beira da Cova, located in the city of Fundão (Portugal); and the Habitat of Business Innovation in Strategic Sectors, implemented in the city of Penela (Portugal) (Álvares et al., 2020).

Startups are the initial stages in which organizations have experience innovating, investing in products and existing business models, and taking action in uncertain times (Luger; Koo, 2005; Rocha et al.,2019). Furthermore, startups are organizations designed under a business model that is agile and lean, capable of generating value for the consumer and can solve a real problem and, to achieve this objective, can offer market scalable solutions with the technology use as the main fator (Abstartups, 2023).

In Brazil, one study focuses on startups, analyzing how they are structured, how they cluster, and how they leverage the resources of innovation ecosystem actors throughout the stages of creation, development, and market entry (Marcon; Ribeiro, 2021).

Industries 4.0 integrates physical and digital technologies, including analytics, robotics, artificial intelligence, additive manufacturing, advanced materials, high-performance computing, natural language processing, cognitive technologies and augmented reality (Luthra; Mangla, 2018). It focuses on digitalization, automation and adaptation, optimization and customization of production, the interaction between man and machine, adding value to services and businesses, and automatic data exchange and communication (Posada et al., 2015; Roblek et al., 2016).

In Italy, a study aimed to identify actions and guidelines that enable and promote the adoption of Industry 4.0, as well as to understand the role of innovation ecosystem actors, such as companies, educational organizations, and regional policymakers (Dominink et al., 2021).The following section presents the methodological procedures used in this research.

3 METHODOLOGICAL PROCEDURES

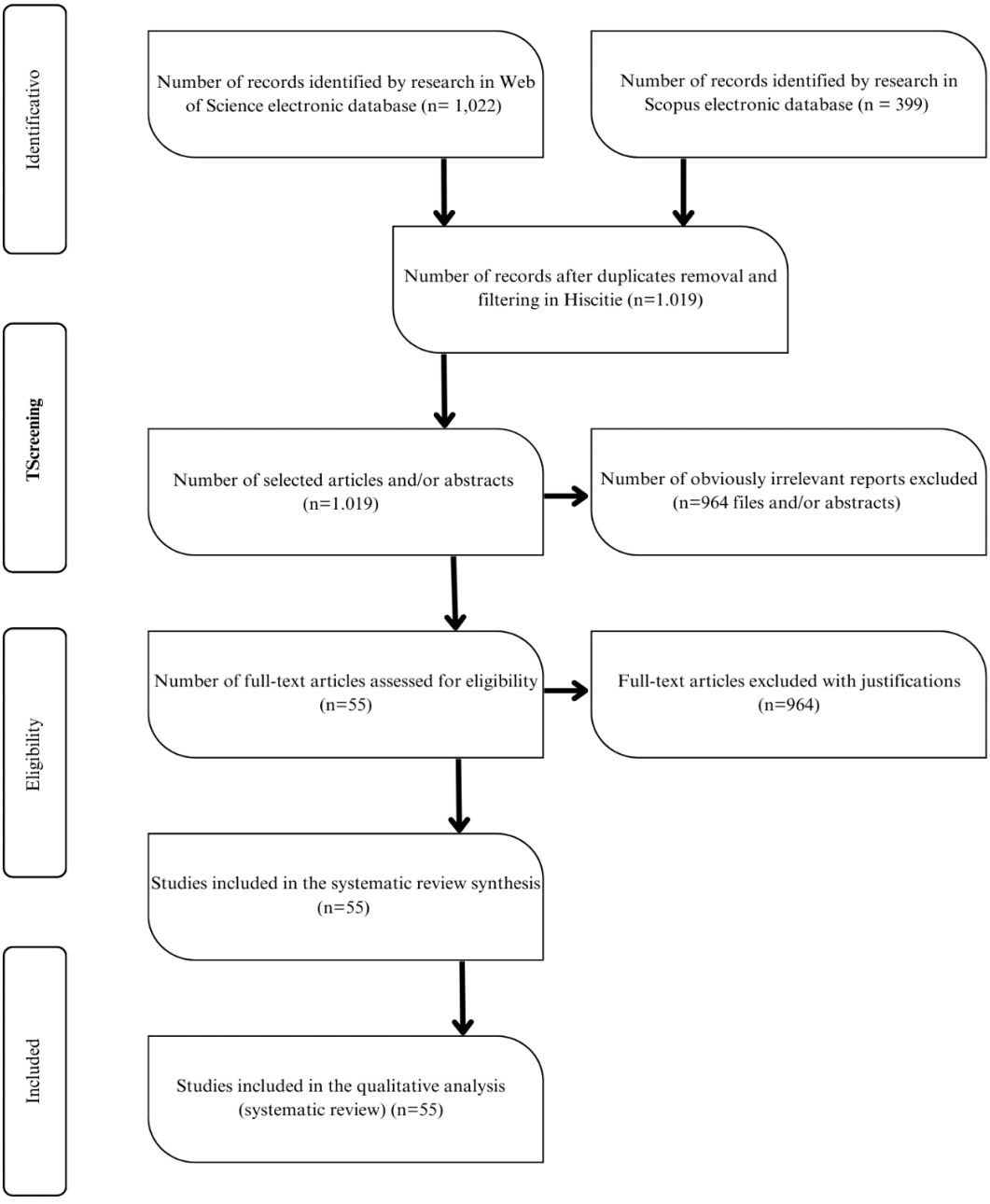
The research is a Systematic Literature Review (SLR), including bibliometric analyses (Okubo, 2017;Jr; Araújo, 2023) and content analysis (Downe-wamboldt, 1992), Bibliometric analysis and content analysis combined allow the identification of trends, themes, areas with excellent discussion and gaps in the literature (Gomes et al., 2018).

We extracted the analyzed articles from the Web Of Science and Scopus and conducted the database search on March 27, 2022. The search strings used were: “ecosystem” and

"innovation". The search in the Web of Science database yielded 1,022 articles. The search in the Web of Science database resulted in 1022 articles. We used the "articles" filter for "types of documents." The language selected was English, and the publication period was the last five years, with articles from 2018 to 2022. The selected categories were "management", with 682 articles, and "business", with 610 articles, totaling 1,022.

The exact string "ecosystem" and "innovation" were used in the Scopus database. Using "articles" as the type of document, the language used was English, and the categories used were "business management and accounting." The period was the years 2018 to 2022. The search resulted in 399 articles. By unifying the results from the Web of Science and Scopus databases, we received 1,421 articles. After filtering, the articles were exported to Histcite software to exclude duplicates. The result after unification was 1,019 articles. We presented the prism flow diagram in Figure 1.

Figure 1 – Prism flow diagram



Source: Prepared by the authors based on the theory of Pollock and Berge.

After reading all the abstracts and checking the titles and keywords, we excluded 964 articles, leaving 55 published articles. Table 1 shows the inclusion and exclusion criteria articles (Atkinson et al., 2015).

Table 1 - Articles inclusion and exclusion criteria

Inclusion criteria	Exclusion Criteria
Available full text	Available only summary or part
The theme focused on the innovation ecosystem	Presented context only about the ecosystem or only about innovation
Objective of the article aimed at studying the actors of the innovation ecosystem	It did not present an objective aimed at studying the actors of the innovation ecosystem.
Presentation of a summary focused on the topic of innovation ecosystems and their actors	Innovation ecosystems are mentioned but discussed superficially.
Keywords innovation ecosystem	Presented other types of ecosystems not related to the objective of the work

Source: Prepared by the authors.

As an example of an article that met the research criteria, we can mention the work developed from the multi-actor network perspectives in the Cali Baja region, a binational and emerging innovation ecosystem. We noted that the article presents a multi-actor perspective mapping of interested parties and identifying the main actors in the binational innovation ecosystem of the Cali Baja (Arnkil et al., 2010; Carayannis; Rakhmatullin, 2014).

Among the articles excluded for not complying with the criteria is “Unpacking the Construction of the Innovation Ecosystem: evolution, gaps and Trends” by Gomes et al. (2018), we excluded it because it was not related to the research aim.

According to the data demonstrated, we found some results through bibliometric analysis. We used the VOSviewer viewing tool and software to analyze the network of keywords and co-citations to observe citations of the articles. In this way, it is possible to identify similarities and, therefore, the common themes and interests of the research groups (Van Eck; Waltman, 2010).

We based the content analysis on the Bardin method (2016); it presents and includes three phases: the pre-analysis phase, the materials exploration phase, and the results treatment phase, as well as inferences and interpretations. We carried out the pre-analysis phase in the reading form, called the first contact with the documents, in conjunction with developing indicators capable of guiding the interpretation and formal analyzed material preparation. The composition and definition of the indicators were as follows: type of ecosystem, ecosystem actors, trends and research gaps in innovation ecosystems.

The material exploration phase was done by reading all selected articles, identifying and defining indicators, and developing a framework. Therefore, we conducted the treatment phase and results collection, inference, and interpretations in the following section, which presents the results and discusses the proposed topic.

4 RESULTS

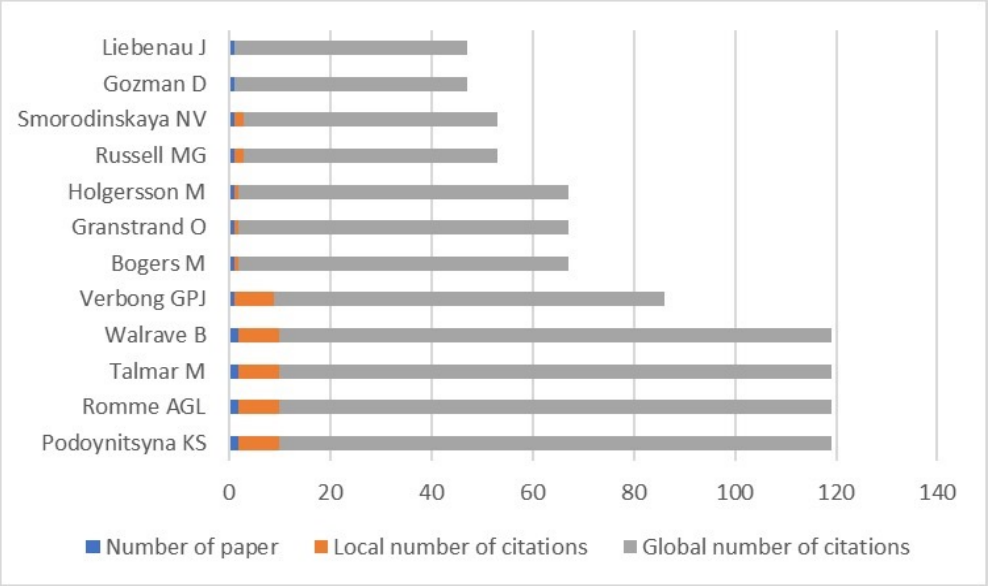
4.1 Descriptive analysis

Based on the results, after filtering the articles according to the theme and purpose, 55 articles

were selected. The chosen articles feature 167 authors, were published in 37 journals, had 3,287 citations and references, and presented 252 keywords.

After the screening, we list the research elite. Of the 167 authors directly involved in the study, 12 are considered the research elite. According to Price's criterion (1976), the concept of Research Elite is the number of prolific producers to the square root of the total number of authors; that is, it is the number of authors responsible for the articles in the research corpus. Figure 2 shows the number of citations, authors and number of articles.

Figure 2 - Composition of authorship of journals and subjects

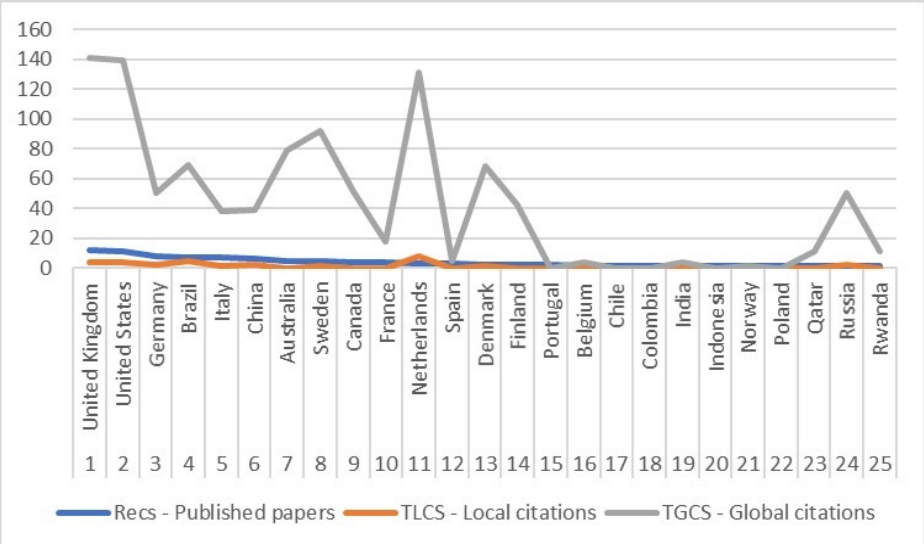


Source: Prepared by the authors - Histcite Software (2022).

Figure 2 presents the most cited authors and points out the authors Podoynitsyna K.S., Romme A.G.L., Talmar M. and Walrave B., as the authors who have the most published articles (2), have the highest number of local citations (8) and also the same number of global citations (109). The authors are mentioned in 12 articles, representing 21.82% of the textual corpus.

Using the Histcite software (2022), publications can be analyzed by country, local and global citation number and occurrences (TGCS). Figure 3 allows you to visualize the results.

Figure 3 - Publications by countries, local and global citation numbers



Source: Prepared by the authors - Histcite Software (2022).

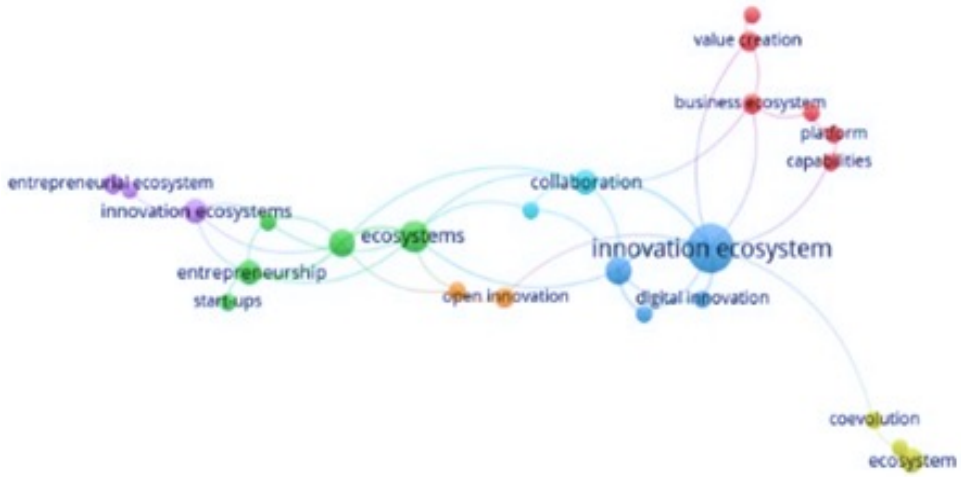
Figure 3 presents the results based on the number of articles published by country, as well as the outcomes of local and global citations. The United Kingdom ranks first, with 12 articles published over the past five years, followed by the United States, with 11 articles, and Germany, with 8 articles published during the same period. Notably, Brazil ranks fourth, with 7 articles published during the research period.

The research findings include studies conducted in various countries, such as the United Kingdom, the United States, Germany, France, Italy, Portugal, Finland, Norway, and Brazil. This demonstrates that the concept of innovation ecosystems is gaining popularity in academia, management, and policy fields as an approach to understanding innovation and performance across organizational, regional, and sectoral relationships (Granstrand; Holgersson, 2020). The studies on innovation ecosystems contribute to the understanding of innovation and can also enhance the performance of organizational, regional, and sectoral relations. The following section presents the bibliometric analysis conducted.

4.2 Bibliometric Analysis

We used the keyword network to identify the innovation ecosystem concepts and actors. In Figure 4, we presented the results of the co-occurrences and authors' keywords cited in the articles selected.

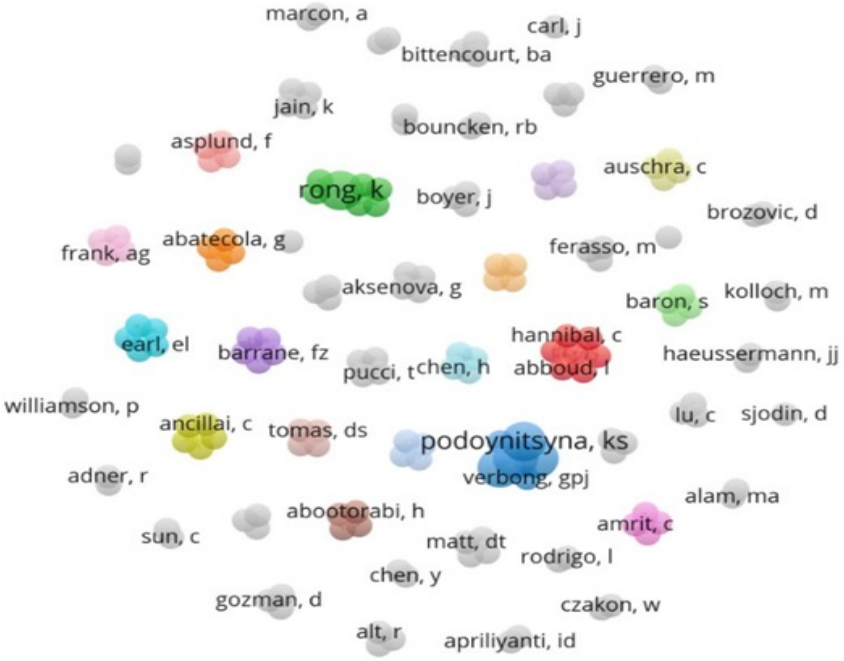
Figure 4 - Co-occurrence of author keywords



Source: Prepared by the authors - VOSviewer (2022).

In Figure 4, we can see the cloud formed by the co-occurrence of authors' keywords of the textual corpus. The result presents the number of 8 clusters, with cluster 1 having six items that show the keywords: "business ecosystem", "capabilities", "grounded theory", "platform", "service ecosystem", and "value creationCluster 2 presents the keywords: "innovation ecosystem", "digital" and "innovation", the third cluster also presents the keywords: "ecosystems", "entrepreneurship" and "startups". Figure 4 identifies occurrences between words and their results, demonstrating indications and connections between the main words and networks built between them. The total number of keywords was 236 words, considering the number of occurrences of 2 words, resulting in 27 items. Next, Figure 5 demonstrates the analysis, considering all authors.

Figure 5 - Global network of authors and co-authorship



Source: Prepared by the authors - VOSviewer Software (2022).

Figure 5 demonstrates an analysis of all authors, considering 1 document per author; the result shows a fragmented network, as the nodes are not interconnected, and the authors are writing in isolation due to some geographic factor or due to approaches to different themes. This result confirms the disparity in research approaches on innovation ecosystems. When reading the abstracts and delving deeper into the selected articles, we can see various methods; that is, some authors focus on the entrepreneurial ecosystem, others on the business ecosystem, service ecosystems, platform ecosystems, new technologies and industry 4.0, in startups and business clusters, among others. Figure 6 shows the co-authorship network by country.

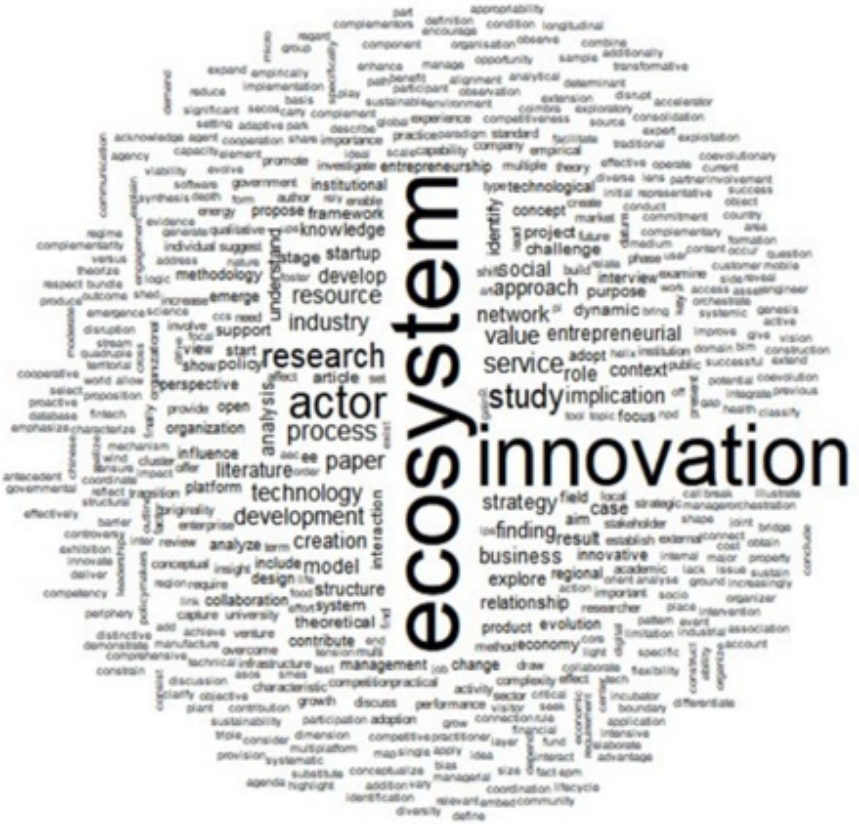
Figure 6 - Co-authorship Network and Countries

Source: Prepared by the authors - VOSviewer Software (2022).

According to Figure 6, there is an association between authors from different countries. Furthermore, we noted the association between the United States of America and Norway, England, China, Denmark, Australia, Canada, and Italy. England already has associations with Spain, Belgium, India, Australia, China, the United States, Denmark, Canada and Sweden. Brazil is associated with Italy.

We presented the occurrence results found in the articles selected for the research.

Figure 7 - Description of Occurrences Summary Iramuteq



Source: Prepared by the authors - Software Iramuteq (2022).

Figure 7 presents the results obtained in the search for the occurrences number. The research resulted in texts 55, segmented texts 303, occurrences 10,917, forms 2,131, and hapax 1,103, equivalent to 51.76% of forms and 10.10% of occurrences. Figure 7 (next page) presents the words “innovation” and “ecosystem” in the number of the most significant occurrences, followed by the occurrence “actor.” Given this, it is clear that themes related to the innovation ecosystem and its actors are gaining prominence in the research, contributing to the theoretical basis of this research. Table 2 presents the journals that published articles related to the area, the number of articles published, and the citations.

Table 2 - Journal description, article number and citations

Journal	Total articles	Total citations
Technological Forecasting And Social Change	10	210
Technology Innovation Management Review	3	18
Long Range Planning	2	97
Technology Analysis & Strategic Management	2	19
Review Of Managerial Science	2	9
Journal Of Business Research	2	8
Industry And Innovation	2	6
Ieee Transactions On Engineering Management	2	4
Entrepreneurship Research Journal	2	1
Journal Of Management Information Systems	1	46
Journal Of Service Research	1	36
Entrepreneurship And Regional Development	1	26
Business & Society	1	22
International Entrepreneurship And Management Journal	1	21
International Journal Of Innovation Science	1	14
Construction Management And Economics	1	13
Benchmarking-An International Journal	1	11
Management Decision	1	10
Chinese Management Studies	1	7
Strategy Science	1	6
Mp Journal	1	5
International Journal Of Managing Projects In Business	1	5
Journal Of Management Development	1	4
Schmalenbach Business Review	1	4
Systems Research And Behavioral Science	1	4
International Journal Of Energy Sector Management	1	2
International Journal Of Innovation	1	2
Journal Of Business Economics And Management	1	1
Journal Of Business Venturing	1	1
Industrial Marketing Management	1	0
International Journal Of Innovation And Technology Management	1	0
International Journal Of Nonprofit And Voluntary Sector Marketing	1	0
Journal Of Entrepreneurship In Emerging Economies	1	0
Journal Of Manufacturing Technology Management	1	0
Journal Of Science And Technology Policy Management	1	0
Risus-Journal On Innovation And Sustainability	1	0
Thunderbird International Business Review	1	0

Source: Prepared by the authors - Software Iramuteq (2022).

Table 2 presents the results obtained in research journals, articles cited and citations number per article. Highlight is the journal with the most cited articles; the Journal of Technological Forecasting And Social Change has ten articles and presents 210 citations. With three published articles and 18 citations, we have the Journal Technology Innovation Management Review. Next, the other seven journals present 2 published articles each, and the citation number varies from 1 to 97 citations.

According to the research results, the journal Long Range Planning is presented, with two articles published and 97 citations; the journal Technology Analysis & Strategic Management, with two articles published and 19 citations; the journal Review Of Managerial Science presents two articles published and nine citations, with the same articles number published, there is also the Journal Of Business Research with eight citations, the journal Industry And Innovation with six citations and the journals Ieee Transactions On Engineering Management and Entrepreneurship Research Journal with total of 4 and 1 citations, respectively. Table 3 presents twenty-eight journals

with one published article and citations ranging from zero to 46. We noted one published article and no citations in eight journals.

Table 3 – Journals Number by area, published articles and citations

Area	Articles number published	Citations number
Technology, Innovation	23	273
Entrepreneurship,management, strategic	19	146
Marketing, business, planning, service	15	193

Source:Prepared by the authors (2022).

In Table 3, we concentrated publications in journals from three different areas, technology and innovation, with 23 published articles and 273 citations. Another group is entrepreneurship, management, and strategy journals, which show 19 published articles and 146 citations. Finally, the journal group in marketing, business, planning, and services has 15 published articles and 193 citations. The result suggests that innovation ecosystems are on the rise, as it presents many published articles and citations on the subject in various research areas.

5 DISCUSSION: INNOVATION ECOSYSTEM

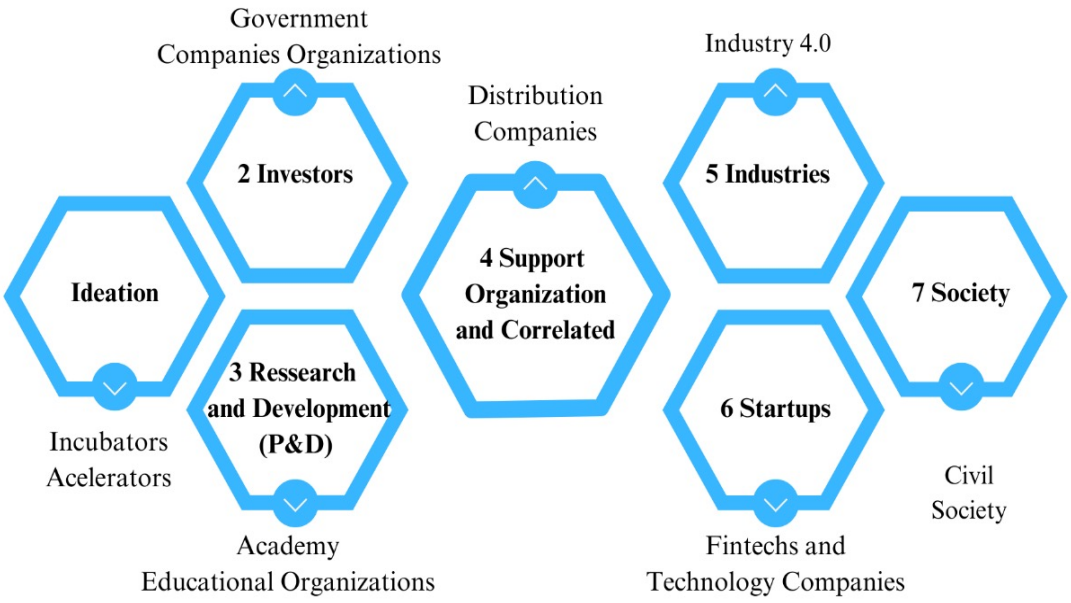
This section discusses the innovation ecosystem, the types of innovation ecosystem and the actors that make it up. The 55 selected articles are studied in more detail and analyzed in depth.

The articles dealt with and presented different approaches; for example, the article stands out and deals with strategies for forming entrepreneurship and innovation ecosystems, emphasizing the conceptual structure of Portuguese cases. The research deals with the entrepreneurial ecosystem, and the actors studied were social actors and technology parks. The result presented was the study's potential, focusing on forming the entrepreneurial and innovation ecosystem (Alvares et al, 2020). Another research sought to identify the multi-actor service innovation role in a service ecosystem and presented the development of 17 functions representing actors' resources and skills necessary to develop service intelligent systems (Anke et al ., 2019).

A study also addresses building trust in multi-stakeholder collaborations for developing new products in the digital transformation era, addressing the business ecosystem focusing on actors from industries and organizations (Barrane et al., 2020). The business ecosystem is also analyzed from accelerators as a startup infrastructure for business clusters through the platform, software and innovation ecosystem (Bliemel; Klerkc; Miles, 2019).

Among the 55 articles studied, the studies mentioned above stand out due to their relevance and because they are research focused on exploring the innovation ecosystem and the actors that make it up. The Systematic Literature Review (SLR) allows for the creation of a framework to assist in the search for subsidies and resources to carry out this research. In structuring the framework, we read 55 selected articles, and we carried out a screening to identify which researches describe the actors' role in an innovation ecosystem, as shown in Figure 8 (next page).

Figure 8 – Model of groups of actors in the innovation ecosystem



Source: Prepared by the authors (2022).

According to Figure 8, group 1, entitle ideation, comprises incubators and accelerators. Incubators contribute to the performance of academic spinoffs, which shape the formation of new ventures or companies. Academic spinoffs provide management support and advice on developing and managing the new organization through consultancy, training, guidance and exchange of experiences (Rasmussen; Wright, 2015; Soetanto; Jack, 2016). Technology incubators operate in connection with universities initially and later begin interacting with governmental and non-governmental organizations.

They defined accelerators as a “factory for startups”; they are considered an intensive capital investment that allows their operator to receive raw materials to transform them into startups (Miller; Bound, 2011). Their interaction involves incubated companies, universities, the government, and funding agencies.

Group 2 is nominated as the investor group and comprises the government, companies and organizations. An innovation ecosystem can encompass several actors, such as governments, banks, virtual capitalists, angel investors and companies that provide financing mechanisms for the phases that make up the construction of the ecosystem. For example, we can mention angel investors, who play an essential role in helping fast-growing small businesses and venture capitalists, who provide capital for startup ventures or support small companies that want to expand and do not have access to the stock Market (Teixeira; Trzeciak; Varvakis, 2017).

According to Figure 8, we nominated group 3 of Research and Development (R&D) because it was formed by academia and educational organizations. Knowledge actors are made up of academic and R&D institutions responsible for training qualified people, promoting the entrepreneurial spirit, and creating future companies. This actor also includes and interacts with students and researchers (Teixeira et al., 2016).

Support and related organizations, corresponding to group 4, are composed of those organizations that sell raw materials or distribute products and services in the innovation ecosystem. The role of this group is to connect organizations and facilitate the transfer of ideas and other resources to help them commercialize at scale (Moore, 1993; Teece, 2007). In this way, there is interaction among the actors representing this group.

Group 5 is composed of industries. Industries, such as Industry 4.0, are considered a broad phenomenon that requires a diverse group of actors interacting with each other, including companies,

the government, regulators, universities, and research centers (Gomes et al., 2018; Benitez et al., 2020). Furthermore, the development of an infant industry is a social process in which customer needs and behaviors are reshaped, as well as relationships in the production and transaction sector and government institutions. According to Figure 7, startups are entitled to group 6. Startups play an important role in introducing technologies to the market, mainly because they are responsible for innovations that they develop and that lead to economic growth (Nee; Opper, 2012; Van de Vem; Hargrave, 2004).

A startup is a temporary company looking for a scalable business model that is sustainable and repeatable amid uncertainty. Technological startups have contributed significantly to creating jobs and economic development at a regional and national level, generating revolutionary innovations that sometimes disrupt the pre-existing Market (Al-mubaraki; Busler, 2017; Daksa et al., 2018).

Group 7 is called society. Civil society can be perceived as innovation users, acting as a driver of innovation processes (Carayannis; Campbell, 2009). This group can also comprise individuals and associations of non-governmental organizations (NGOs) that create societal demands and needs, which can profoundly affect businesses and impact innovation in development or as customers. In this context, users are at the center of the model and encourage the development of innovations that are relevant to them (Arnkil et al., 2010; Carayannis; Rakhmatullin, 2014).

The group of actors was organized based on the theoretical framework. The group of actors within the innovation ecosystem, along with their functions and interactions, is summarized in Table 4.

Table 4: Group of actors, functions, and interactions in the innovation ecosystem

Group of actors	Functions	Interactions with	How they interact
Ideation: Incubators and Accelerators	Incubators: provide support and management advisory through consulting, training, guidance, and exchange of experiences. Accelerators: act as "factories for startups," aiming to speed up the creation of new businesses.	Universities, government, investors, and organizations.	Business plan development, CANVAS, Design Thinking; face-to-face and virtual interaction; cooperation agréments.
Investors: Government, angel investors, and organizations	Provide funding for businesses.	Accelerators, incubators, universities, organizations, and startups	Projects with Municipal, State, and Federal Government, MCTI; innovation calls for proposals; partnerships with investor groups; projects via FINEP, CNPq, INOVA RS, EMBRAPA, and Mais Ciência Program.
Research and Development (R&D): Academia and educational organizations	Provide training of qualified professionals and foster an "entrepreneurial spirit".	Educational institutions, universities, government, companies, and industry.	Funded research carried out with university students and professors; research supported by the Municipal Innovation Law.

Continue on the next page.

Group of actors	Functions	Interactions with	How they interact
Supporting and related organizations: suppliers and distributor	Commercialize raw materials, distribute products and services, connect organizations, and facilitate the transfer of ideas and other resources.	Industry, R&D, universities.	Development of support Technologies.
Industries	Industry 4.0 focuses on digitization, optimization, and customization of production, as well as automation and adaptation between humans and machines. It also develops services and businesses that add value and enable automatic data communication.	Universities, R&D	Development of R&D solutions.
Startups: fintechs, technology companies	Generate market innovations, fostering economic growth.	Incubators, accelerators, technology parks, government, universities, and organizations.	Receive advisory support and attract investment resources.
Society	Drive and stimulate innovation processes and use their products and services (customers).	Business entities, government, universities.	Fairs, events, and the Entrepreneur's Room Project.

Source: Research findings synthesis.

From Table 4, it can be observed that an innovation ecosystem comprises actors that interact with one another, generating synergies among organizations and fostering a business environment conducive to innovation.

According to Teixeira et al. (2016), an innovation ecosystem may encompass public actors, formed by institutions responsible for providing mechanisms such as programs, policies, incentives, and regulations. Knowledge actors consist of educational institutions and/or research and development (R&D) organizations. Institutional actors are composed of public or private and independent organizations that provide specialized assistance and knowledge to agents involved with innovation. Fostering actors include banks, governments, venture capitalists, industries, and angel investors, who provide funding mechanisms for the stages that shape the construction of the ecosystem. Business actors are made up of companies that supply requirements for the evaluation of solutions and the development of knowledge and technologies. Habitat and innovation actors

consist of environments that promote the interaction of local innovation agents, as well as the advancement of research and development (R&D) initiatives. Civil society represents an actor composed of individuals capable of creating societal demands and needs (Teixeira et al., 2016; Fenner et al., 2025).

Based on the theoretical framework, the functions of the actors in the innovation ecosystem are presented in Table 3. When comparing the functions of the actors derived from Teixeira et al. (2016) with the group of actors identified through the framework, it is possible to observe an evolution in their roles and a clearer allocation of specific actors into particular groups. This enables a better analysis of each actor's functions and the ways in which they interact with one another.

From this analysis, it was possible to develop a framework for the actors that make up an innovation ecosystem, in addition to verifying their functions and promoting insights into their interactions within the ecosystem. The following section presents a summary of the study's main contributions.

6 FINDINGS

This study aimed to systematize the discussion about the actors in the innovation ecosystem and analyze their interaction. We applied a Systematic Literature Review through descriptive, bibliometric and content analysis. From the descriptive analysis, it was possible to indicate and identify similarities between the published articles, revealing common themes and interests between the research groups. Regarding the authors' study, we verified a fragmented network, as the nodes are not interconnected; that is, the authors are writing in isolation due to some geographic factor or approaches with different themes. Furthermore, there is an association between authors from a country with other countries; for example, the United States of America has an association with Norway, England, Denmark, Australia, Canada and ItalyEngland has associations with Spain, Belgium, India, Australia, China, the United States, Denmark and Sweden.

Through content analysis of the selected articles, it was possible to create a framework of the main actors and identify seven groups: ideation, incubators and accelerators (group 1); investments, made up of the government, companies and organizations (group 2); Research and Development (R&D), made up of academics and educational organizations (group 3); support and related organizations are distribution companies (group 4); industries, such as industries 4.0 (group 5); startups, made up of fintech and technology companies (group 6); and, finally, society, made up of civil society (group 7). In general, the theoretical contributions of this research focus on elaborating the model of groups of actors in the innovation ecosystem and their interactions. The empirical contributions concern insights for private decision-makers based on knowledge of the interrelationship of these actors and public ones through the elaboration of public policies in favor of regional economic development.

As a limitation of the research, the definition of strings stands out, which limits the research search and the database used in this investigation. As suggestions for future research, the string "innovation ecosystem actors" should be included in another SLR. Furthermore, it is recommended that this framework of actors be applied in a specific innovation ecosystem case to validate the theoretical propositions elaborated in this investigation. It is suggested that future research on innovation ecosystems focus on specific areas, such as sustainable ecosystems in agribusiness or longitudinal studies on the evolution of innovation ecosystems, as well as comparative studies of innovation ecosystems across different regions.

7 DECLARATION OF CONFLICT OF INTEREST

The authors of this article declare that they have no financial, professional, or personal conflicts of interest that could have influenced the work in any inappropriate way.

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