

DEVELOPMENT OF OPEN INNOVATION THROUGHOUT THE YEARS. A BIBLIOMETRIC ANALYSIS

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ABSTRACT

Open innovation has gained more and more interest from the research community in the past years as it is a method for companies to develop products and services using external knowledge along with internal information. This paper presents a bibliometric analysis of the academic research on open innovation from when it appeared. Based on the data from web of Science, a science mapping and performance analysis are performed in terms of co-citations, occurrences of keyword, bibliographic coupling and citations. Additionally, the retrieved data are classified under the most relevant research in terms of journals, articles, authors and institutions.

KEYWORDS: *bibliometric analysis, citation analysis, open innovation.*

DOI: 10.24818/IMC/2024/02.10

1. INTRODUCTION

Organizations have become increasingly aware of the importance of developing new products and services, in order to maintain their competitive advantages and ultimately, for their survival. Open innovation paradigm is being gradually adopted by companies that search to be more open and have a collaborative approach, incorporating internal and external knowledge in their strategic activities (Zhang et al., 2023). Along with the digitalization development and the availability of information, companies are under pressure to provide in a rapid pace innovative products and services. Henry Chesbrough introduced for the first time the concept of open innovation, arguing that organizations needed to reinvent the methods in which they innovate as the old closed method, do not work anymore only by itself (Chesbrough, 2017).

Research over the past decades on open innovation shows that the attention of researchers and academic institutions has increased in this field and proves how important is to gather knowledge from outside the company's boundaries (Holgersson et al., 2022; Lopes & de Carvalho, 2018; Mahdad & Roshani, 2024; McGahan et al., 2021). Studies in the open innovation field provide evidence to organizations that they should adopt these practices, using an open strategy and vision directed toward implementing external ideas throughout the innovation process. The open strategy is based on collaboration for common products, crowd input into decision-making, collective involvement and action, and the creation of collective benefits (Kanda et al., 2021).

Since the beginning, the open innovation concept has gone through diverse versions: open innovation 2.0, open innovation 3.0 and open innovation 4.0. The 2.0 version of the open innovation is based collaboration between various organizations, government and academic institutions which developed several components as: business model innovation, openness to innovation and culture, shared value and vision, social innovation, co-creation and innovation

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platforms, ecosystem orchestration and management and others related to the paradigm (Curley, 2015).

At the same time, 3.0 version emerged which was about synchronization of organizational structures and processes with collaborative processes in respect with communities and stakeholders. This version incorporates four communities: Communities of Affinity (persons interested in an organization's products and services), Communities of Practice (persons interested in solving problems), Communities of Interest and Communities of Science (knowledgeable persons) (Hafkesbrink & Schroll, 2011). Open innovation 4.0 brought up sustainability and digitalization as key aspects to support companies in their innovation process (Costa & Matias, 2020).

The purpose of this study is to explore the key aspects of open innovation as an important strategy for companies in today's world. The objectives of this study are: concepts in relation to open innovation researched throughout the years; main authors and their contributions to the concept of open innovation; evolution of literature throughout the years; the keywords pertaining to open innovation concept.

There were authors who conducted a bibliometric analysis of the open innovation concept, however, these studies did not take the concept as a sole paradigm, always it was in relation with other concepts (Palumbo et al., 2023; Rautela, 2024; Siriwong et al., 2024). In this research, I provide a wide perspective of the concept since it's beginning.

2. LITERATURE REVIEW

The twentieth century was marked by companies practicing a closed innovation process based on employees' work to develop new services or products. This approach is referred to as closed innovation and is based on a classic hierarchical and controlled business model (e.g. vertical integration) (Purdy et al., 2023). For a long period of time, this model was thought to best capture the value of firm-level knowledge, and many companies during this period invested large amounts of capital in internal R&D efforts. The issues of developing innovations in the greatest secrecy, and the complexity of their design, were the main drivers of competitive advantage during these years (Foege et al., 2019). This closed innovation model is based on the theory of utilizing only the company's own resources while maintaining the principles of high protection against competitive factors and continuous control. Some researchers believe that closed innovation can be implemented only in large and highly profitable firms with funds to be allocated for innovation activities (Skowron-Grabowska, 2023).

As a result of the expansion of technologies, the need to collaborate to exploit complementary resources, and complex digital transformations, organizations have migrated to a more dynamic and open business model, turning their attention beyond organizational boundaries to exploit both inbound and outbound information flows (Purdy et al., 2023). Other factors that have contributed to the adoption of an open business model are: the dynamic migration of the workforce to competing firms, the accelerated speed of global information diffusion due to digitization, all of which lead to customers being rapidly informed about firms and the products they sell (Chesbrough, 2003). Due to these reasons, the open innovation paradigm emerged and it was first studied by Henry Chesbrough in 2003. Open innovation refers to the process of generating, developing and implementing new ideas and technologies by leveraging internal and external resources and knowledge. It involves collaboration and co-creation with partners, customers and other stakeholders, and this type of innovation is often characterized by a more decentralized and networked approach to the innovation process (Vanhaverbeke, 2017; Mota et al., 2023).

The open innovation process encompasses several steps, including idea generation and evaluation, product concept development, integration of external knowledge (external to internal) and incorporation of internal innovation efforts (internal to external), and combined approaches of the two. Embedding external knowledge inside the organization implies opening a company's

innovation processes to external information. At the same time, there is a second branch of knowledge flows that is an important part of the model: the flow of knowledge from inside the firm to the outside. In inside-out open innovation, the organization allows unused and underused knowledge to flow outside the organization for others to use in their business models. Also, another perspective is to combine the two approaches: inside-out and outside-in (Chesbrough, 2019; Terhorst et al., 2023; Andriyani et al., 2024).

Under conditions of continuous evolution and change of business sectors, organizations need to rely on capabilities to manage the processes of assimilation of internal and external information, what knowledge they will retain and which of them they will discard. Thus, there are six knowledge capabilities (Vasi et al., 2024) that a company can rely on to process new knowledge:

- a) Inventive capability - the ability of a firm to explore knowledge internally,
- b) Absorptive capacity - the ability of a firm to explore knowledge externally,
- c) Innovative capacity - the capacity of a firm to exploit knowledge internally,
- d) Absorptive capacity - the capacity of a firm to exploit knowledge externally,
- e) Transformative capability - the ability of a firm to internally retain knowledge,
- f) Connecting Capability - the ability of a firm to retain knowledge externally.

Consequently, the organizations that rely on flexibility in setting strategies and actively seek collaborations with external partners can develop innovative services and products aligned with new industry trends, creating competitive advantages over competitors.

3. METHODOLOGY

Bibliometric analysis has received an increased recognition in the past years, due to the support it brings to academic research, representing an approach for examining the evolution of research fields, including subjects and authors, based on the social, intellectual and conceptual structures of the disciplines (Donthu et al., 2020; Wang & Su, 2020). By conducting a bibliometric analysis, the paper proposes to contribute to the scientific research publications about "open innovation" by providing a time evolution of the studies undertaken in the field.

The Web of Science database was used to retrieve the articles and it was elected due to its more than 34 000 journals. Two of the main strengths of the Web of Science are reference tracking and citation reporting in order to identify results and trends in a particular field of research (Huang et al., 2022; Khandelwal et al., 2022) and it provides comprehensive bibliographic data. A number of authors have chosen WoS as a database for bibliometric research in the field of management (Khandelwal et al., 2022; Matic & Sunjka, 2022; Polat & Seyfi, 2023).

As such, using an interrogation in the WoS database was performed a research using the phrase "open innovation" and 7,285 results were retrieved.

For the performed bibliometric analysis, the PRISMA methodology for conducting systematic reviews of research, is followed as it can be seen in Figure 1. The publication years are from 2003-2024, in order to provide a robust observation of the open innovation concept.

In order to analyse data, VOSviewer (vosviewer.com) version 1.6.19 was used. This software program was chosen because it is adapted for the visualization of bibliometric networks, being able to observe the connections between publications, countries, authors, keywords and research organizations, identifying the themes addressed, by using the data taken from the resulting publications.

The resulting Web of Science publications have been exported (in TXT format) as sources for map creation. The distance between elements in the network visualization indicates the relationship between them. The closer the elements are, the stronger the relationship between them, and the size of the circle shows the importance of that element. On the other hand, in the superimposed visualization, one can observe an evolution of concepts (van Eck & Waltman, 2023).

For data analysis, the following research directions were set:

- a) Citations analysis (sources)
- b) Citations analysis (authors)
- c) Co-occurrence of keywords (authors)

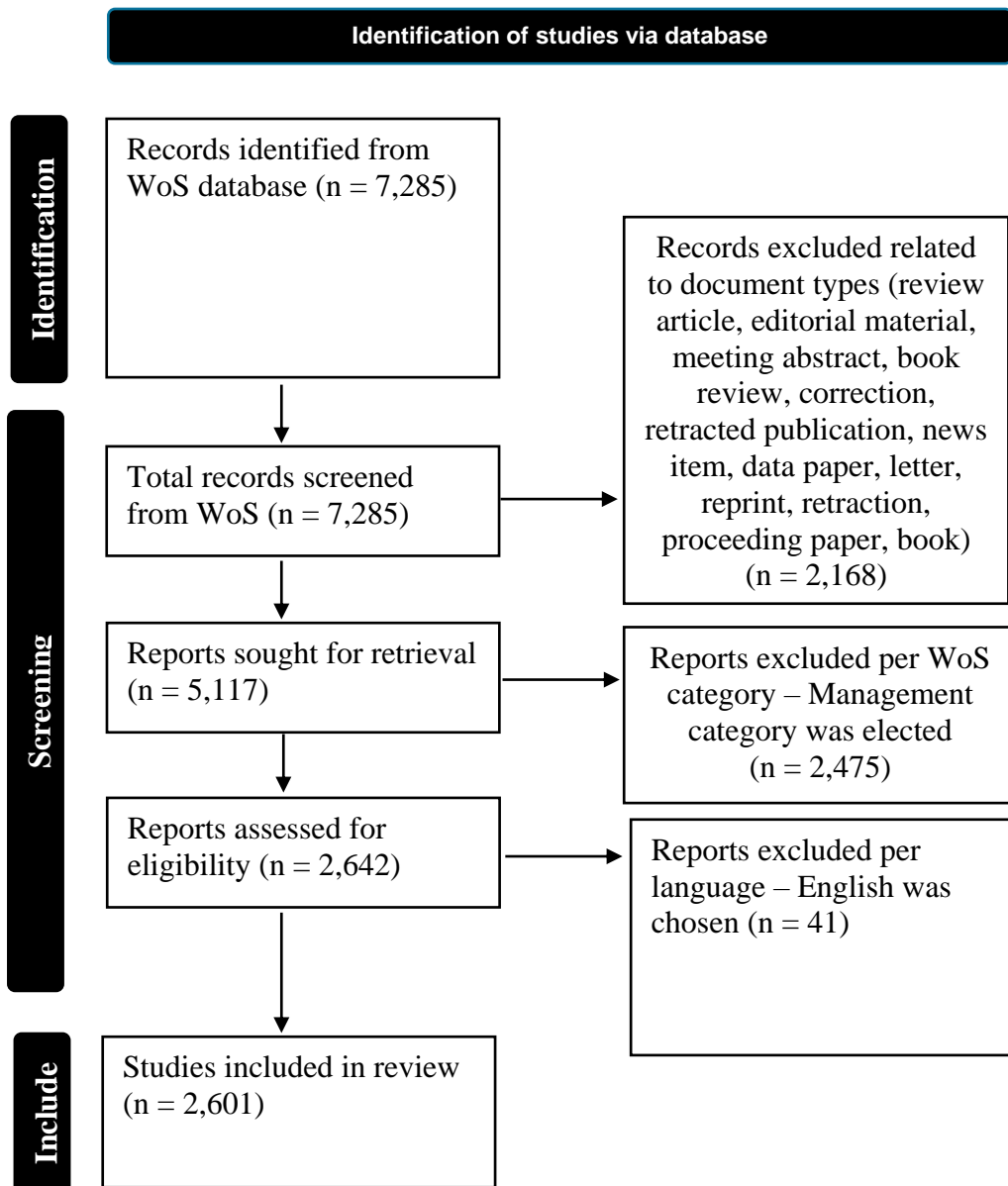


Figure 1. PRISMA diagram flow

Source: Author elaboration based on PRISMA diagram flow (PRISMA, 2024)

4. RESULTS AND FINDINGS

It can be observed in Figure 2 that the most published articles were in 2021, with a sum of 260 papers on “open innovation” subject. The research on the subject increased steadily over the years, counting more than 200 publications per year during 2019-2023. For the current year, the number of publications is 140, with possibility to reach at least the value of publications from 2023.

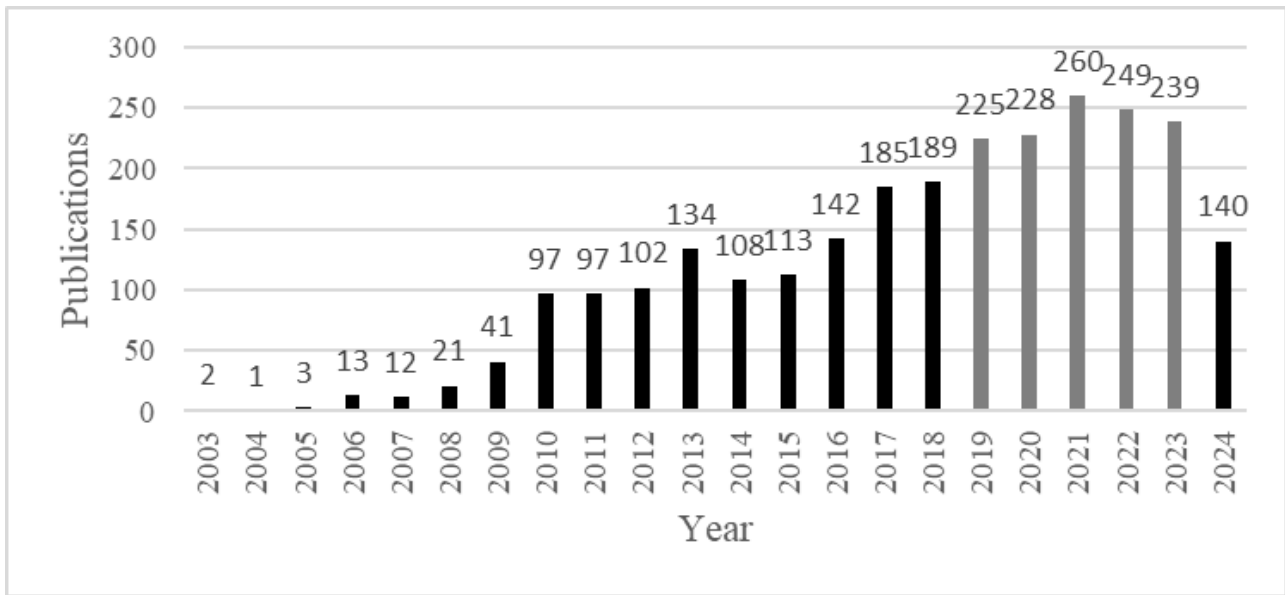


Figure 2. Evolution of published papers in the “open innovation” field (2003-2024)
 Source: Web of Science (WoS, 2024)

As per the analysis from Web of Science, articles are related to various categories as seen in Figure 3. Even if the Management category was selected for the analysis, the publications are related to other categories. The most publications are related to Management, Business, Engineering Industrial, Operations Research Management Science, Information Science Library Science and Economics, having the higher number of articles.

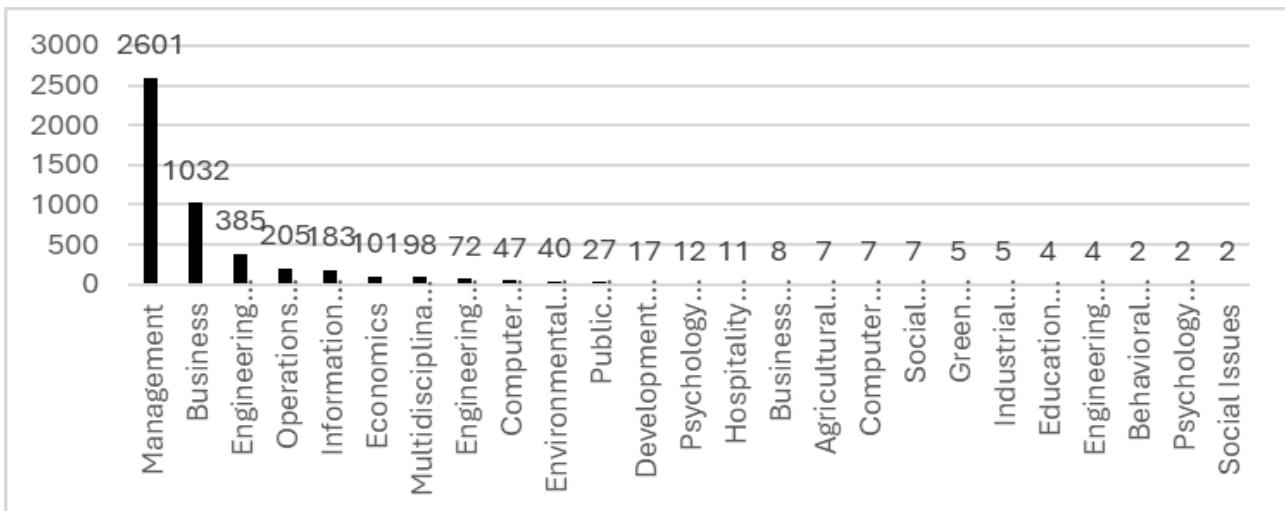


Figure 3. Web of Science category
 Source: Web of Science (WoS, 2024)

In relation with the most cited articles based on Web of Science, the top 10 can be seen in Table 1:

Table 1. The most cited articles

Title	Authors	Publication Year	Total Citations
How open is innovation?	Dahlander, Linus; Gann, David M.	2010	1534
The era of open innovation	Chesbrough, HW	2003	1529
Open innovation in SMEs: Trends, motives and management challenges	van de Vrande, Vareska; de Jong, Jeroen P. J.; Vanhaverbeke, Wim; de Rochemont, Maurice	2009	1219
Open R&D and open innovation: exploring the phenomenon	Enkel, Ellen; Gassmann, Oliver; Chesbrough, Henry	2009	1132
Beyond high tech: early adopters of open innovation in other industries	Chesbrough, H; Crowther, AK	2006	1077
Open innovation: State of the art and future perspectives	Huizingh, Eelko K. R. E.	2011	1031
The future of open innovation	Gassmann, Oliver; Enkel, Ellen; Chesbrough, Henry	2010	895
Open innovation in SMEs-An intermediated network model	Lee, Sungjoo; Park, Gwangman; Yoon, Byungun; Park, Jinwoo	2010	834
Smart tourism: foundations and developments	Gretzel, Ulrike; Sigala, Marianna; Xiang, Zheng; Koo, Chulmo	2015	777
Marginality and Problem-Solving Effectiveness in Broadcast Search	Jeppesen, Lars Bo; Lakhani, Karim R.	2010	686

Source: Web of Science (WoS, 2024)

The next steps are visualizing the results using VOSviewer and as stated above, three directions were taken (citations – sources, citations – authors, co-occurrence of keywords – authors).

4.1 Citation analysis (sources)

There has been done a citation analysis according to sources. Only sources with minimum 15 documents per source and a minimum of 15 citations of a source were considered and from 321 sources, only 34 met de criteria. Thus, 10 journals with the highest number of documents published on “open innovation” are as shown in Table 2:

Table 2. Top 10 journals with the highest number of documents published on “open innovation”

Journal	Number of documents
International Journal of Innovation Management	153
R & D Management	129
Technovation	112
European Journal of Innovation Management	102
Technology Analysis & Strategic Management	98
Research Policy	86
IEEE Transactions on Engineering Management	84
Journal of Knowledge Management	83
Management Decision	74
International Journal of Technology Management	72

Source: VOSviewer

As can be seen, international journal of innovation management is the publication which has the highest number of documents published (153), followed by r & d management (129) and technovation (112).

4.2 Citations (author)

In terms of citations per author, per the minimum number of documents per author (15) and minimum number of citations per author (15), 11 authors met the criteria. Henry Chesbrough, as the pioneer of the “open innovation” concept, has published 33 documents, coming second is Federico Frattini (30) and on the third place is Ulrich Lichtenthaler (28) and it is exemplified in the density visualization in Figure 4.

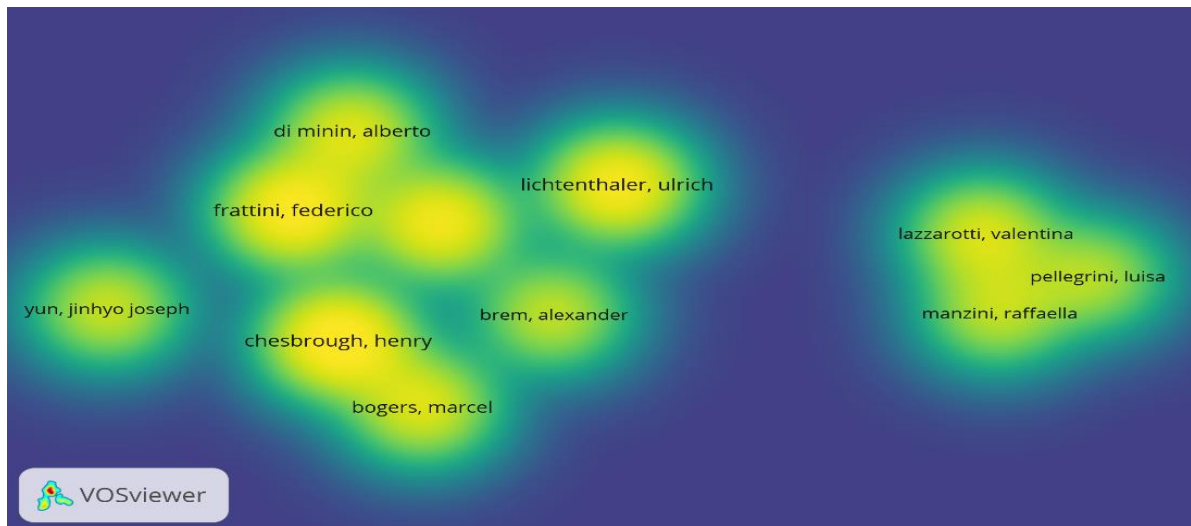


Figure 4. Density visualization of authors

Source: VOSviewer

4.3 Co-occurrence of keywords (authors)

The last analysis will be performed to observe the co-occurrence of the authors' keywords, as the authors' perspective on the domain under study is best reflected. A first step was the creation of a dictionary in which a cleaning of the data in the file was performed to combine the different forms of the terms (singular/plural, American/British form, abbreviated/long form of the words).

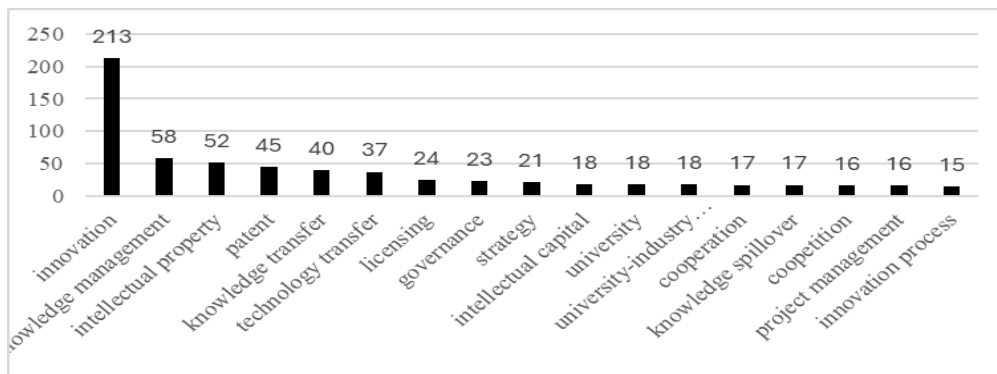


Figure 6. Cluster 1 – Keywords occurrences
 Source: Author elaboration from VOSviewer

Cluster 2 – Open innovation

The cluster 2, “Open innovation” comprises of 14 items as be seen from Figure 7, and is displayed with color green. The dominant concept is “open innovation” (1251), followed by absorptive capacity (103) and innovation performance (62). It can be seen that this cluster consists of open innovation dimensions in terms of innovation types and categories.

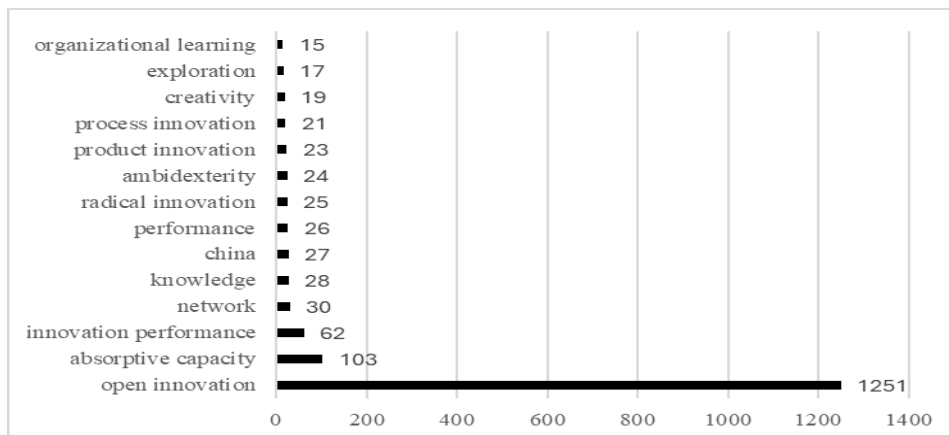


Figure 7. Cluster 2 – Keywords occurrences
 Source: Author elaboration from VOSviewer

Cluster 3 – Collaboration

Cluster 3 contains 12 keywords as can be observed in Figure 8, is with blue in the map and its name is “Collaboration” defined by the highest ranked item with 96 occurrences. The following items with more than 30 occurrences are: crowdsourcing (93), technological innovation (61), research and development (57), ecosystem (39), companies (31) and platform (31). Methods of implementing open innovation characterize this cluster.

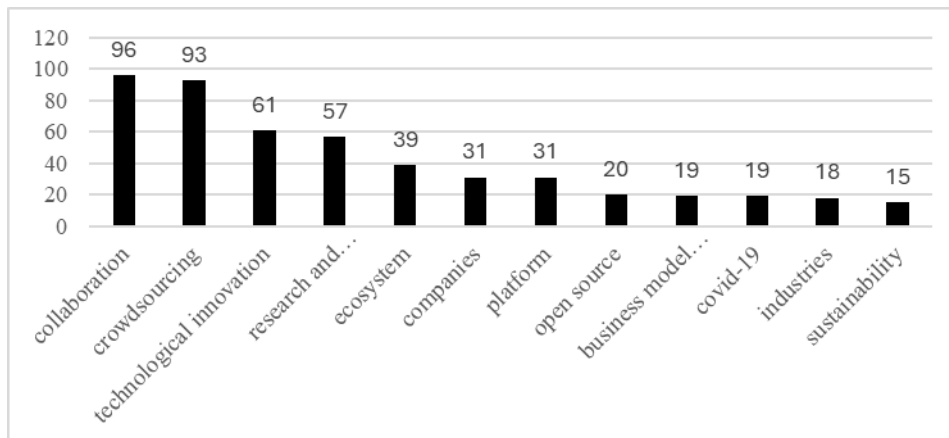


Figure 8. Cluster 3 – Keywords occurrences
 Source: Author elaboration from VOSviewer

Cluster 4 – Small and medium-sized enterprises

Small and medium-sized enterprises is the name of the fourth cluster as seen in Figure 9, which is coloured with yellow, and it has the highest number of occurrences (116). The next three items with more than 30 occurrences are: openness (39), firm performance (34), inbound open innovation (33), dynamic capabilities (30). The cluster describes a company's strategy related to open innovation.

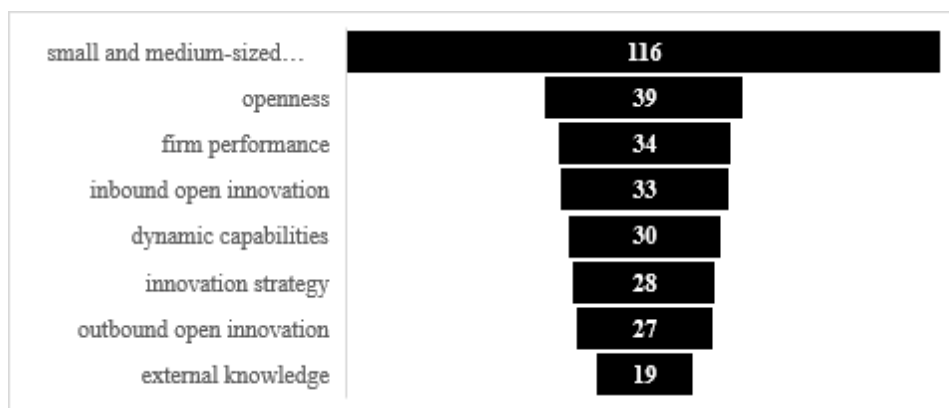


Figure 9. Cluster 4 – Keywords occurrences
 Source: Author elaboration from VOSviewer

Cluster 5 – Innovation management

Cluster 5 is named "Innovation management" (58 occurrences), comprises of 9 keywords, and it is with purple in the map. The following items with more than 30 occurrences as seen in Figure 10, are: new product development (45), knowledge sharing (41), co-creation (33). The cluster is related to developing new products based on open innovation process.

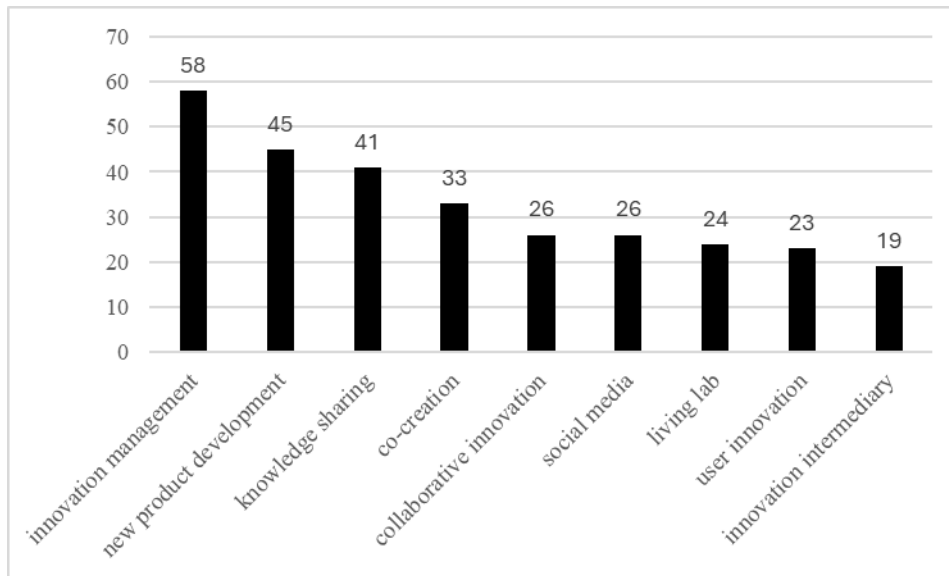


Figure 10. Cluster 5 – Keywords occurrences
 Source: Author elaboration from VOSviewer

Cluster 6 – Business model

Business model (48 occurrences) is the name for the sixth cluster which contains 8 keywords as it can be observed in Figure 11 and is with light blue in the map. Digital transformation (30), value creation (27), open source software (23) are the 3 keywords following business model (48) with more than 20 occurrences. The cluster characterizes open innovation from a digital perspective.

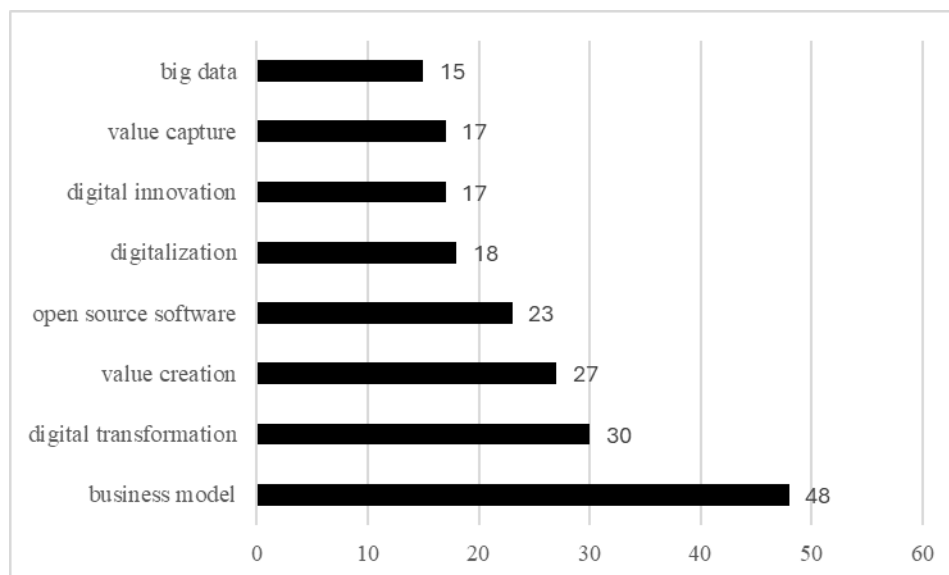


Figure 11. Cluster 6 – Keywords occurrences
 Source: Author elaboration from VOSviewer

Cluster 7 – Entrepreneurship

The last cluster is called “Entrepreneurship” after the highest ranking keyword in terms of occurrences as can be seen in Figure 12, and it is with orange in the visualization map. The other keywords are startup (45), innovation ecosystem (25) and social capital (18), which relates to the management of companies.

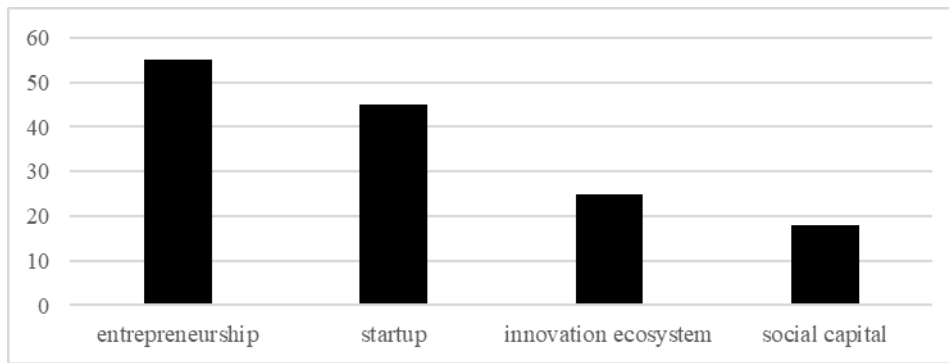


Figure 12. Cluster 7 – Keywords occurrences

Source: Author elaboration from VOSviewer

5. CONCLUSIONS

Digitalization, knowledge sharing, collaboration are a few of research paths included in the open innovation process throughout the years. The studies in the field have increased in the past years, many researchers have become interested in finding methods for organizations to develop new products and services, so they can remain competitive in the activity sector. Closing partnerships with other organizations or motivating customers to provide new ideas, are considered important ways for the open innovation. At the same time, the issues related to protection of intellectual property and patents, need to be considered.

The conducted research has highlighted some important research directions the “open innovation” concept has adopted since its beginning, in terms of “coopetition”, “sustainability”, “co-creation”, “ambidexterity”, “digitalization”, “dynamic capabilities”.

This bibliometric analysis is an important step in the exploration of the “open innovation” field. The systematization of research during 2003-2024 and the analysis of authors, journals, keywords, has brought a wider understanding of the topic. Some results of the analysis are:

- “Open innovation, innovation”, “collaboration” are the keywords with the highest number of occurrences,
- Henry Chesbrough is the pioneer author of this concept and he is the most prolific author,
- International journal of innovation management is the publication with the most published articles,
- “How open is innovation?” by Dahlander, Linus, Gann, David is the publication with the highest number of citations (1534).

The limitations of this study are represented by one research field selected in Web of Science, thus constraining the results, which may impose an incomplete overview of the topic. Nevertheless, the results of the analysis provide valuable directions for future research on the concept. Other papers may include data from Scopus and/or Google Scholars which may be used in obtain additional bibliographic information. This paper may be a good starter for additional targeted interventions in the open innovation field.

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