Systematic Review of The Literature on The Concept of Civil Society in The Quadruple Helix Framework

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Abstract: The literature has shown the importance of incorporating civil society into the regional innovation system to favor companies' long-term growth. This research aims to carry out a systematic review on the definition and classification of society in the innovation model based on the contexts that relate to the university, business, and government. The results show that the concept of civil society has been approached in the literature from four perspectives: demand-side, media and culture, independent non-profit, and intermediary organizations. These results may help clarify the concept of civil society, having significant implications for academics and companies, and regional innovation agencies that promote the participation of civil society in their innovation systems.

Keywords: quadruple helix, society, citizen, innovation, innovation

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1. Introduction

Innovation is a very relevant factor that allows companies to obtain a sustainable competitive advantage (Vermeulen, 2004) and has a direct impact on regional economic growth (Malik et al., 2021).). There are different systemic approaches to studying innovation. Among others are the regional innovation systems, the triple and the fourth helix (Geldes & Heredia, 2016). The triple helix focuses the innovation model on the relationships between firms, universities, and government to explain the development of knowledge-based economies (Etzkowitz and Leydesdorff, 2000), where society's structure is continuously altered transformations originating in techno-sciences (Leydesdorff, 2012). The triple helix innovation process is characterized by academia, government, and industry acting together to create or discover new knowledge, technology, or products and services that can be transmitted to users (Macgregor, Marques-gou, & Simon-Villar, 2010). The quadruple helix adds another group of actors to the cooperation model (Parveen, Senin, & Umar, 2015). It arises as a consequence of the fact that the triple helix is not a sufficient condition for innovative long-term growth and that civil society must play an active role in knowledge creation and sustainable growth (Macgregor, Marques-Gou, & Simon-Villar, 2010). Quadruple helix initiatives have recently materialized in several projects in which civil society organizations are intentionally involved in the organization of innovation systems (Lindberg, Lindgren, & Packendorff, 2014). The quadruple helix model focuses on the users of innovation and favors the development of innovations that are suitable for the users (civil society) (E. G. Carayannis & Rakhmatullin, 2014).

The elements that define the fourth helix are: citizens influenced by media and culture, civil society, as well as "art, artistic research, and art-based innovation." The influence of media and culture integrates and combines two forms of 'capital.' From the perspective of culture (e.g., tradition, values, etc.), there is "social capital." While the media optic (e.g., television, internet, newspapers, etc.) also contains 'information capital' (e.g., news, communication, social networks) (E. G. Carayannis et al., 2012). All this represents the prospect of a "democratic dimension" or "democratic context" for knowledge, knowledge production, and innovation (Carayannis & Campbell, 2017). This quadruple helix concept encourages considering societal and democratic perspectives to support, promote and advance knowledge production (research) and knowledge application (in innovation) (Mavroeidis & Tarnawska, 2017).

This research aims to conduct a systematic review of the literature on the concept of civil society in the quadruple helix model, based on the contexts that relate to the university, business, and government. This review is carried out in two phases: first, a bibliometric analysis is performed for 2009-2020, based on the Web of Science and Scopus databases; and second, content analysis is performed on the selected papers that address the concept of civil society. In recent years, there has been a growing number of publications that have developed applications of the quadruple helix model in different contexts (Galvao et al., 2019) and incorporate civil society in various forms of collaboration: sustainable green resources, eco-innovation, or smart cities (Galvao et al., 2019). However, the concept of civil society is not clearly defined by the literature (Nordberg, 2015). Defining civil society has become a challenge, as it depends, in many cases, on the analytical purpose of the studies conducted (Aryati, 2017).

2. Methodology

In this work, we follow the method suggested by Snyder (2019) and Vallaster et al. (2019). The one that adopts a two-step approach to deepen understanding a phenomenon. The review uses bibliometrics and content analysis. Combining these two methods aims to determine trends in the literature demonstrated by a detailed review of topics and articles (Agostini & Nosella, 2018). Bibliometrics uses

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activity indicators to measure productivity; quality indicators, citation frequency; and relationship indicators, based on keywords (Martínez et al., 2014). Content analysis allows confirming patterns associated with specific topics (Vallaster et al., 2019).

The study is based on analyzing the concept of civil society in the quadruple helix model. The information of the papers was retrieved from Clarivate and Scopus Web of Science databases, from all categories (Loi et al., 2016). The following search criteria were used: "(Quadruple Helix OR Triple Helix OR Quintuple Helix OR Quadruple Helix Model OR Triple Helix Model OR Quintuple Helix Model OR Quintuple Helix Model)" which can be contained in the title, abstract, or keywords of the articles. The resulting database corresponds to 644 records.

To ensure that each paper is relevant to the concept of civil society, the authors analyzed the abstracts and keywords of the 644 papers. They identified 108 articles that address the concept of civil society from the perspective of the triple, quadruple or quintuple helix. With this selection, a single record is created in a file containing the variables author, language, year of publication, country of authors, keywords, and references cited for each article. The tools used for bibliometric analysis are: the VOSviewer software for constructing bibliometric maps (Waltman & Van Eck, 2012) and the Bibliometrix software, an open-source program proposed to perform comprehensive comprehensive comprehensive bibliometric analysis (Aria & Cuccurullo, 2017).

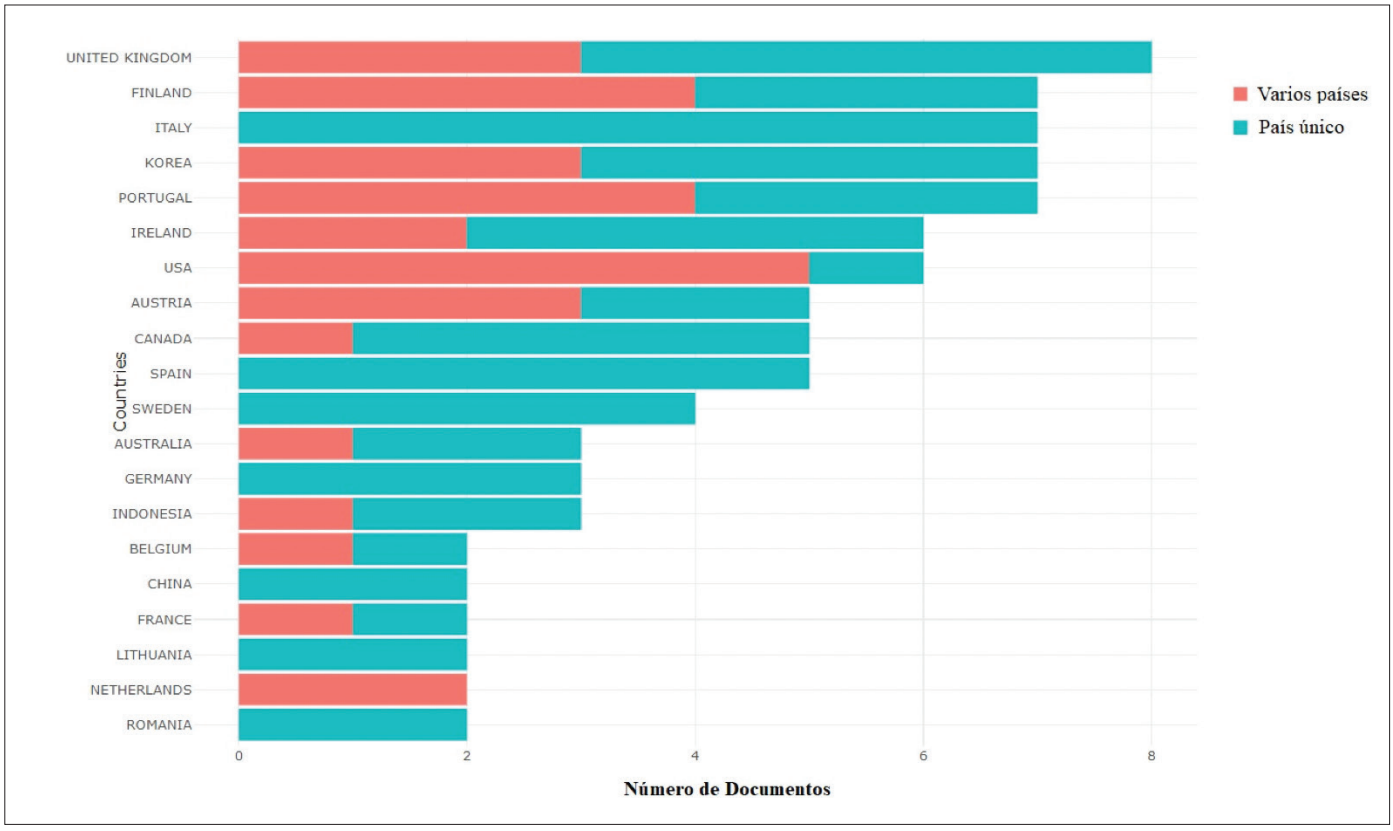
3. Analysis of Results

3.1. Descriptive analysis

Of the total number of publications, the journals that most deals with this topic are Journal of the Knowledge Economy with 15 articles, R & D Management with eight publications, Technological Forecasting and Social Change with six articles, Scientometrics with four articles, and Sustainability with 3. A total of 278 authors have researched the subject, the most important in terms of citations being Etzkowitz H., Carayannis EG., and Leydesdorff L.

A total of 37 countries are represented in terms of authors' affiliation. The most productive are the United Kingdom, Finland, Italy, Korea, and Portugal. Figure 1 shows the number of contributions from the top 20 countries. It is possible to visualize the number of works developed in collaboration with other countries and those with the participation of a single country.

Figure 1. Countries of origin of authors



The results also show that the number of authors publishing "n" papers on civil society in the context of the triple, the quadruple, and the quintuple helix is inversely proportional to "n2", fulfilling the probability distribution that describes the productivity of authors, known as Lotka's law (1926). Figure 2 shows this distribution, in which it is possible to identify that 258 authors contribute 93% of the scientific production.

Figure 2. Lotka's Law

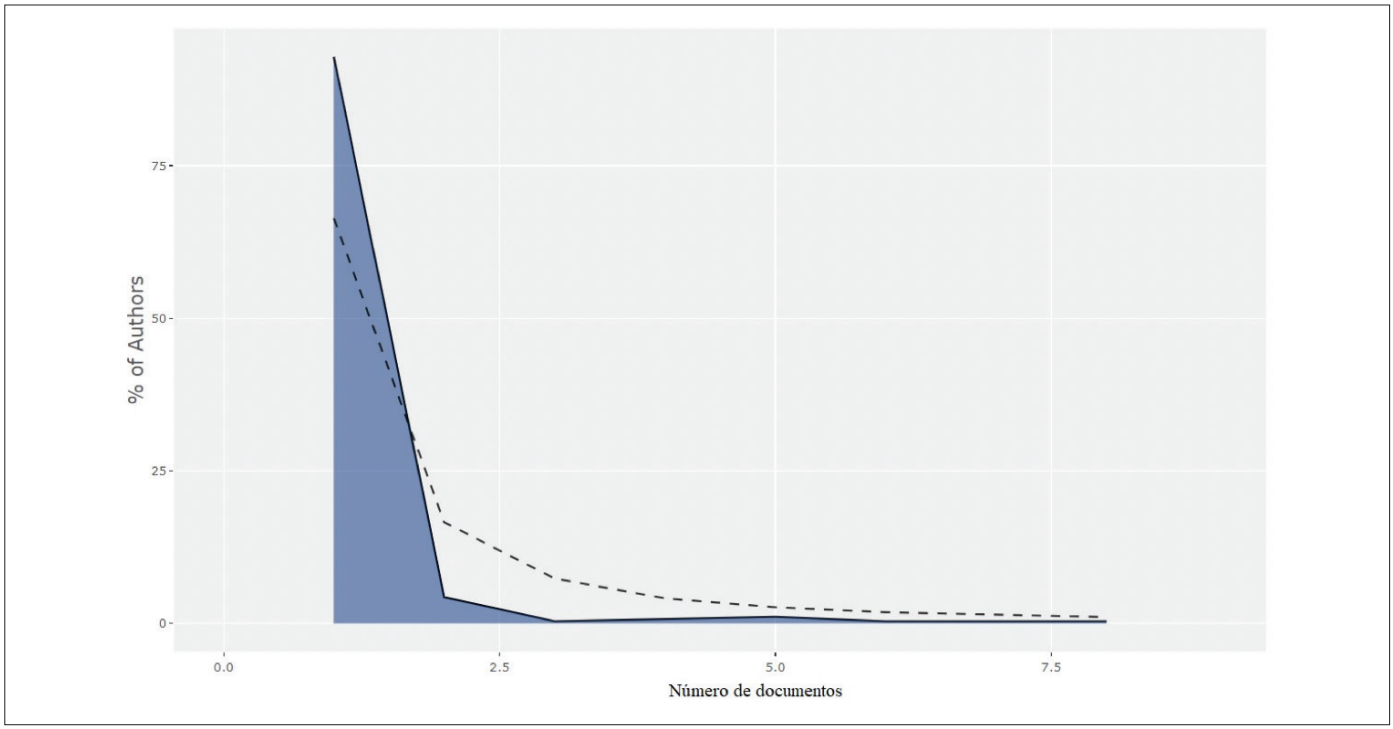
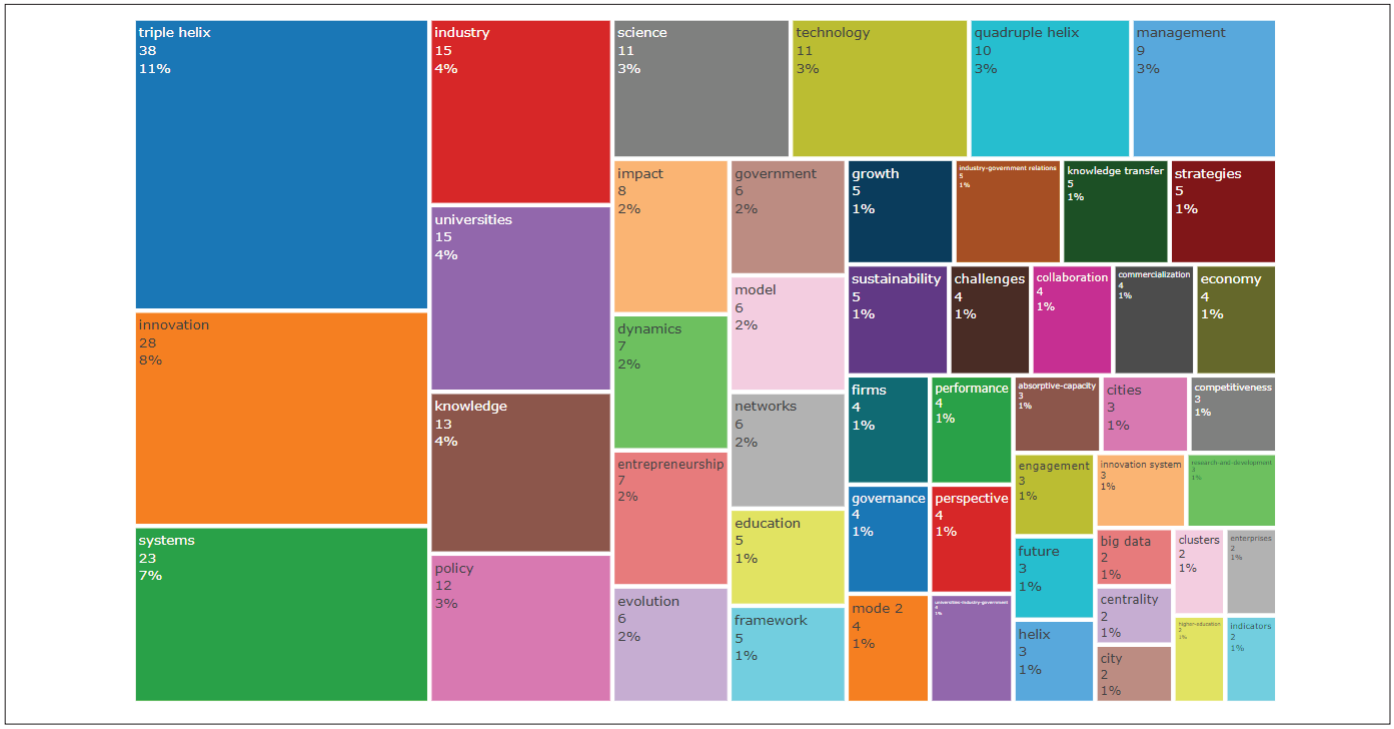


Figure 3 shows the word tree. It corresponds to the representation of each of the concepts. The relative weight of each word is expressed as a function of the total and the number of occurrences. The concepts triple helix, innovation, system, industry, universities, knowledge, and policy stand out.

Figure 3. Keyword cloud



The co-occurrence analysis based on the statistics of keywords that appear in the subject of the documents forms a network and clusters called maps. A minimum of 50 occurrences has been used. The size indicates the relevance of an element, and colors are used to group the elements (Mulet-Forteza et al., 2018). There are 5 clusters formed represented in Figure 4.

Figure 4. Co-occurrence map of words

Figure 5 shows the word trends from the title by period; a threshold of at least four occurrences has been used. It is interesting to visualize that the triple helix model remains exclusively in force until 2017, when the concept of partnership, relative to the quadruple helix, makes its appearance. In this framework, the development of innovation emerges as the most important result to be developed. The research raises several studies, models, systems, and cases whose participation of society, cities, and social aspects influence the relationship between governments, companies, and universities.

Figure 5. Word Trend

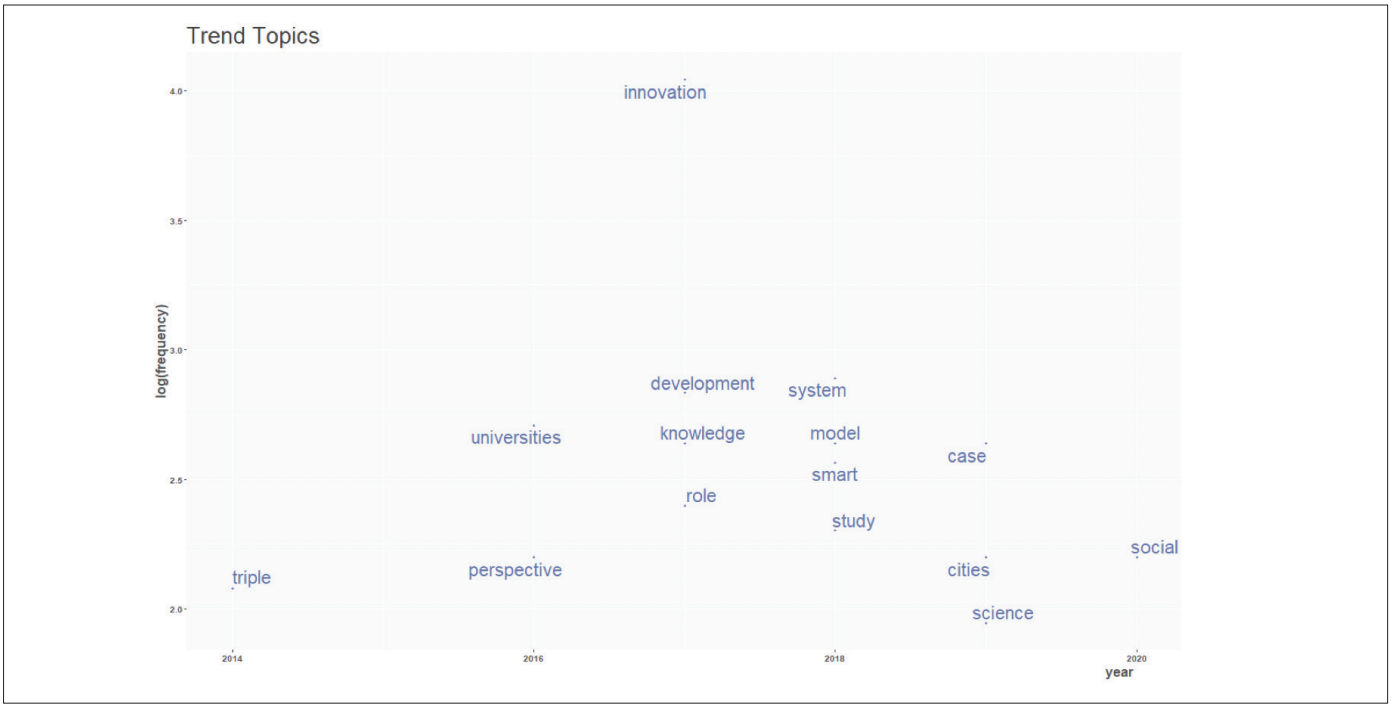
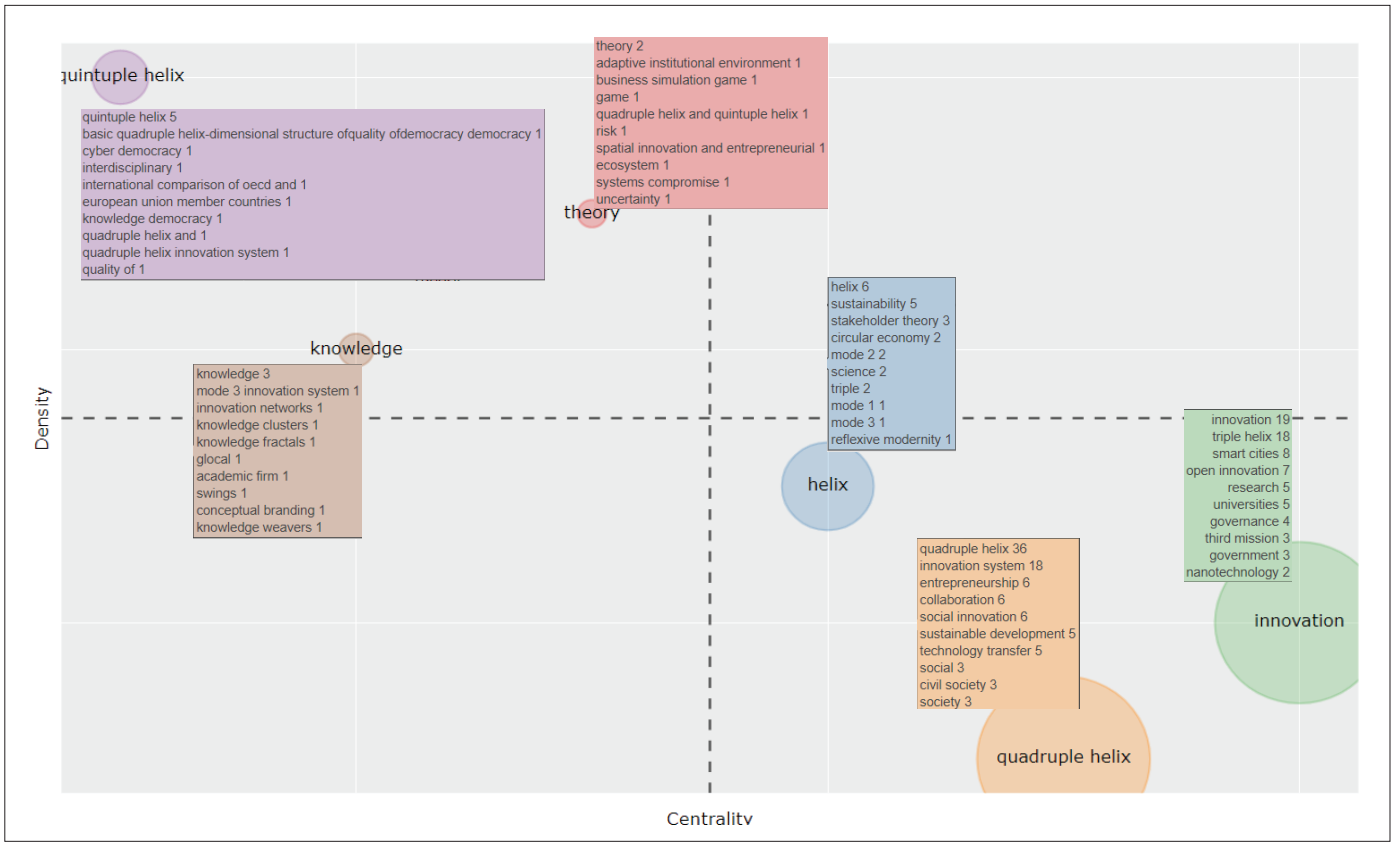


Figure 6 shows the strategic map of the research. It is interesting to note the evolution during the analysis time. This visualization technique shows the clusters detected in a two-dimensional space according to their centrality and density range values. As established by (Callon et al. 1991), centrality measures for a cluster the intensity of its links with other clusters; that is, it measures the degree of interaction of a network with other networks, while density measures the internal strength of the network, characterizing the strength of the network. The links that unite the words that form the group. As expected, one of the most developed concepts is the quadruple helix. Additionally, the concepts of innovation and knowledge mark the axes on which the quadruple helix field has been developed. This situation is related to the impacts expected in the quadruple helix framework, which establishes the innovation model in the relationship between companies, universities, and government to explain the development of knowledge-based economies, focusing on users (Etzkowitz and Leydesdorff, 2000).

Figure 6. Strategy Map



The bibliometric review carried out and presented in the previous sections sustain that the triple helix is neither sufficient nor exclusive to explain the growth of innovation in the long term. It is important to integrate the citizens' perspective, so the quadruple helix adds a helix to the innovation system: civil society. During the last few years, a growing number of publications have discussed the quadruple helix in different contexts, where civil society is integrated with various forms, the most developed being that which considers regional innovation systems and the synergies that these systems generate (Grundel & Dahlström, 2016; Ivanova, 2019; Porto-Gomez et al., 2019; Ranga, 2018). It is also included for the development of smart cities (Ardito et al., 2019; Grimaldi & Fernandez, 2017; Mora et al., 2019) and dynamic innovation micro-macros with quadruple helix approaches (Yun & Liu, 2019) (Paniccia & Baiocco, 2018) (Cunningham & O'Reilly, 2018). However, there are antecedents on which there is still some way to go; the existing relationship between the quadruple helix model and civil society evidence one of the relevant challenges when connecting innovation with society. In addition to establishing the participating actors of civil society and the role, they play in participating in the 4H model.

3.2. Content Analysis

In the first instance, it is relevant to dwell on the importance of sustaining the incorporation of this helix in the regional innovation model. Some authors have concluded that the partnership is important because it develops links between scientists, science, and strategies for education (Iqbal et al., 2018). On the other hand, it is indicated that the fourth helix represents the perspective of the dimension of democracy or the context of democracy for knowledge, knowledge production, and innovation (Casaramona et al., 2015). The fourth helix, to different extents, adds the knowledge of human life to the innovation process, together with scientific and technological knowledge (Nordberg, 2015). On the other hand, civil society can become a resource for markets, companies, and business activities and a means

for companies to adapt to market demands without the risks involved in product development (Grundel & Dahlström, 2016). Thus, it is understood that, depending on the increasing level of societal involvement in the quadruple helix model, innovation practices can be performed for, with, or by end-users (Del Vecchio et al., 2017). Society and community members are linked to business, technology, services, and science (Mahr, 2017), contributing to the construction of innovation pathways, and promoting the socio-economic growth of the territory (Charalabidis et al., 2019). Additionally, it is possible to extract that the fourth helix is human-centered and focused on democratic knowledge and in favor of arts, artistic research, and arts-based innovation (Hasche et al., 2020).

The definition made by Del Vecchio et al. (2017) points out that from an innovation perspective, the civil society approach: when the innovation practice is performed "for" or "with" users we speak of user-driven or user-centered innovation, i.e., the end-user has a very influential role in the innovation process and actively participates in all its phases, they act as co-designers and co-producers of innovation, playing as important a role in the innovation process as universities and research centers. This first definition differs from innovation "by" users, which is an emblematic case of user-driven innovation.

Consequently, users in the quadruple helix framework can be defined differently depending on the context (Hasche et al., 2020). Ponchek (2016), in his analysis, indicates that:

- From the classical point of view, the fourth pillar is the public, defined more specifically as the public and civil society based on media and culture.
- From the point of view of organizations that favor innovation, the fourth pillar refers to intermediate organizations that act as intermediaries and networks between HT organizations.
- From the point of view of coordinating emerging fields of knowledge, the fourth pillar refers to independent non-profit organizations.

But then the question arises. What kind of organizations, users, citizens, etc., are the ones we should incorporate if we want to evaluate the quadruple helix? The answer considers all those civil society actors outside the family's scope, the state, and the market where people associate to promote the common interest (Aryati, 2017). And can be distinguished from academia, industry, and government in the triple helix metaphor (Yang & Holgaard, 2012), those that lack the political power and authority of government and academia and the economic power of industry (Borkowska & Osborne, 2018). Specifically, we can add that civil society actors can be defined as:

- Media
- Creative industries
- Cultural activities
- Consumers
- Entrepreneurs
- Business groups
- NGOs
- Innovation professionals
- Researchers
- Government
- Entrepreneurs
- Mentors

A review of the abstracts of the selected articles was performed to determine which should and should not be included in the systematic analysis. The criteria for this selection were defined using the authors' experience in innovation and society-based studies. Following that, the 108 articles were read and coded for the study's country, keywords, and other factors considered in the descriptive analysis.

In the last instance, the concepts found in the definitions of the different authors were grouped to make an efficient classification of the definitions of civil society possible.

Finally, in the content analysis of the works included in the bibliometric, four perspectives where the studies concentrate the concept of civil society emerged (Table 1 shows the different authors according to the perspective of the concept considered). These are:

1. Society from the demand perspective: users and consumers of innovation (Roman et al., 2020). They actively participate in the innovation process in each of its phases, and, on the other hand, there are those end users, only those who act as "consumers." Yan (2012) showed that civil society plays an important role in lifestyle, consumer behavior, and institutional social participation as a user of goods and services. This quadruple helix model puts the users of innovation at the center and encourages the development of relevant innovations (civil society). Users or citizens are the owners and drivers of innovation processes (Carayannis & Rakhmatullin, 2014). Civil society is usually the end-user of innovation and strongly influences the generation of knowledge and technologies through its demand function (Mona Roman et al., 2020). Society is usually the end-user of innovation and therefore has a strong influence on the generation of knowledge and technologies through its demand and user function (Carayannis & Grigoroudis, 2016).

2. Society from the perspective of media and culture. This fourth helix is associated with "media", "creative industries", "culture", "values", "lifestyles", "art", and perhaps also with the notion of "creative class"" (Carayannis & Campbell 2009).

3. Society from the perspective of independent non-profit organizations. The role of civil society and citizens is considered particularly valuable in strengthening social innovations in the regions (Mona Roman et al., 2020). From a more democratic perspective, the fourth helix can be defined as including citizens, NGOs, trade unions, and others to more growth-oriented perspectives such as consumers and users (Grundel & Dahlström, 2016).

4. Society from the perspective of intermediary organizations acting as intermediaries and networks between TH organizations. The intermediary organizations. In the context of university-industry research centers, these organizations can be internal to universities (i.e., technology transfer offices), external (non-profit and/or government-sponsored collective research centers), or between the two (incubator companies or science parks). (Wright et al. 2008). (Van Horne & Dutot, 2017).

Table 1. Perspectives on the concept of civil society

Concept of civil society	Authors
Demand perspectives	(Johnson, 2008); (Carayannis & Campbell, 2009); (Etzkowitz & Viale, 2010); (Arnkil et al., 2010); (Afonso et al., 2012); (E. G. Carayannis et al., 2012); (Schoonmaker & Carayannis, 2013); (Björk, 2014); (Carayannis & Rakhmatullin, 2014); (Carayannis & Grigoroudis, 2016); (McAdam et al., 2016); (Miller et al., 2016); (Del Vecchio et al., 2017); (Mahr, 2017); (Carayannis et al., 2018); (Charalabidis et al., 2019); (Schütz et al., 2019); (Hasche et al., 2020); (Kang & Jiang, 2020); (Roman et al., 2020); (Terstriep et al., 2020)
Media and Cultural Perspective	(Salter & Salter, 2010); (Carayannis & Campbell, 2011); (Carayannis et al., 2012); (Casaramona et al., 2015); (Parente et al., 2015); (Distefano et al., 2016); (Carayannis & Grigoroudis, 2016); (van Waart et al., 2016); (Galvão et al., 2017); (E. G. Carayannis & Campbell, 2018); (Iqbal et al., 2018); (Galvao et al., 2019); (Carayannis et al., 2019); (Hasche et al., 2020)
The perspective of independent not-for-profit organizations	(Lindberg et al., 2012); (Klenk & Hickey, 2013); (Lindberg et al., 2014); (Nordberg, 2015); (Dameri et al., 2016); (Kolehmainen et al., 2016); (Aryati, 2017); (Yoon et al., 2017); (Charalabidis et al., 2019); (García-Terán & Skoglund, 2019); (Gedminaitė-Raudonė et al., 2019); (Mora et al., 2019); (Dhewanto et al., 2020); (Vilkė et al., 2020)
The perspective of intermediate organizations	(Cooper, 2009); (MacGregor et al., 2010); (Ahonen & Hämäläinen, 2012); (Yang & Holgaard, 2012); (Schoonmaker & Carayannis, 2013); (Kimatu, 2015); (Nordberg, 2015); (Parveen et al., 2015); (Kolehmainen et al., 2016); (Ponchek, 2016); (Aryati, 2017); (Van Horne & Dutot, 2017); (Iqbal et al., 2018); (Malva et al., 2018)

Conclusions

This paper has reviewed the literature on helix relationships and their role in them by civil society. The research has been carried out in two phases. First, a bibliometric analysis of papers analyzing the role of civil society in innovation systems was carried out, and second, a content analysis of the concept and definition of civil society was performed.

Current regional innovation systems suggest the incorporation of a fourth pillar (fourth helix) representing the actions and opinions of citizens (Carayannis et al., 2018). In this innovation model, the Triple Helix paradigm is extended by assuming that society is a key actor in innovation processes, academia, industry, and government (Carayannis & Grigoroudis, 2016). The literature uses the label "users," "citizens," or "civil society" (Kolehmainen et al., 2016). From the bibliometric analysis conducted, the following conclusions can be highlighted:

The quadruple and quintuple helix is an area of study of growing interest for researchers, managers, and decision-makers. There has been an increase in publications in recent years. A total of 258 authors are working on this topic, but only 7% of them have collaborated on more than one article. The most prominent authors are Etzkowitz, Carayannis, and Campbell.

The publications are grouped into 5 clusters, as a result of the co-occurrence analysis, and highlight the following topics: i) triple, quadruple, and quintuple helix models, ii) innovation, iii) ecosystems for entrepreneurship and technology transfer, iv) intelligent regions and v) civil society. In addition, the strategic map identifies three themes as basic topics in the study; the first is a helix whose works address triple helix models. The second theme is a quadruple helix, which incorporates research on innovation systems, collaboration, technology transfer, and the concept of society. The last theme is innovation, whose papers address Smart Cities, open innovation, research, universities, and the outcome of the triple helix. As themes under development, there are three topics. The first one is the quintuple helix, which incorporates the role of democracy in the processes. The second is knowledge, which investigates innovation networks, clusters, and knowledge management. And the last theme is the theory, which includes theoretical aspects that address the quadruple and quintuple helix models. The results are interesting for academics. They show the countries that are more likely to develop collaborative work. They could work together, highlighting the Netherlands and the United States with a large volume of cooperative research. Authors from other countries such as Italy, Spain, Sweden, China, Lithuania, and Romania visualize actions that can be taken to initiate collaborative work with other countries.

Finally, from the content analysis, the results show the great diversity of concepts and definitions existing in the literature on what is understood by the concept of civil society. From this analysis, different perspectives of the concept of civil society can be appreciated: from the demand side, from the media and culture, from independent nonprofit organizations, and from intermediate organizations.

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