El papel de la innovación y la economía social como instrumentos para la recuperación económica y sostenible en un escenario post pandemia

Libro de actas del V Congreso Iberoamericano de Jóvenes Investigadores en Ciencias Económicas y Dirección de Empresas (AJICEDE)

14 al 16 de diciembre de 2022
Universidad Loyola, Córdoba, España

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Edita, Asociación de Jóvenes Investigadores en Ciencias Económicas y Dirección de Empresas (AJICEDE)

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ISBN: 978-84-09-49033-2

Córdoba, 14 al 16 de diciembre de 2022

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THE SCIENCE AND TECHNOLOGY PARK PHENOMENON: WHERE THE LITERATURE IS GOING?

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Palabras clave:

Science and technology parks; Clusters; Innovation; Knowledge management; Bibliometric study

Área temática propuesta

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THE SCIENCE AND TECHNOLOGY PARK PHENOMENON: WHERE THE LITERATURE IS GOING?

1. INTRODUCTION

Science and technology parks are infrastructures designed to accommodate and stimulate the growth of tenant companies by managing the flow of knowledge and technology between universities, R&D institutions, business and markets (Link, 2019). Link and Scott (2006) define a science park as "a cluster of technology-based organisations that locate on or near a university campus to benefit from the university's knowledge base and ongoing research. The university not only transfers knowledge, but expects to develop it more effectively by partnering with the research park tenants" (p. 44).

In a less academic sphere, although strongly inspired by its postulates, the definition proposed by the International Association of Science Parks (IASP) stands out, defining a science park as one that meets the following characteristics:

- It maintains operational links with universities, research centres and other higher education units (e.g., Guadix et al., 2016).
- It is designed to foster the formation and growth of knowledge-based industries or high value-added tertiary enterprises, typically hosted in its infrastructure (e.g., Nauwelaers et al., 2019; Fukugawa, 2006).
- It has a stable management team that is actively engaged in promoting technology transfer to tenant organisations (e.g., Lecluyse et al., 2019).

Inspired by the evolution of industrial districts in the United Kingdom during the industrial revolution, this phenomenon of science and technology parks originated in the United States in the 1950s, with Stanford Research Park (California), Research Triangle Park (North Caroline) and Cummins Research Park (Alabama) being the main exponents of this model of territorial agglomeration of companies (Zhang, 2005).

The above examples, together with the development of other successful infrastructures of a markedly spontaneous nature such as Silicon Valley or Route 128 in Boston or the Cambridge phenomenon in the United Kingdom, encouraged agents in other economies (mainly those responsible for regional development and innovation policies) to favour the promotion and establishment of these park infrastructures, thus adopting a more planned approach to their development. According to Castells and Hall (1994) there are three main motivations that explain the strong commitment to the promotion of these infrastructures: reindustrialisation, regional development, or the creation of synergies with the rest of the actors that make up a regional innovation system.

In the case of developed economies, science and technology parks play a key role in the conjunction of science-technology-industry systems due to their special multiplier effect on regional innovation and development results (e.g., Hernández-Trasobares & Murillo-Luna, 2020). In developing countries, science and technology parks have proven to be an excellent catching-up strategy through the imitation of technological progress developed in more advanced economies (e.g., Fazlzadeh & Moshiri, 2010).

Thus, beyond the phenomena in the United States or the United Kingdom (e.g., Wonglimpiyarat, 2016), it is possible to find theoretical and empirical academic literature of this typology of territorial agglomeration of firms in places such as Italy (e.g., Corrocher et al., 2019), Spain (e.g., Arauzo-Carod et al., 2018), Japan (e.g., Fukugawa, 2006), Greece (e.g., Bakouros et al., 2002), Australia (e.g., Phillipmore, 1999) or Portugal (e.g., Ratinho & Henriques, 2010). Other examples of the rise of these infrastructures in emerging economies include Taiwan (e.g., Chen et al., 2006), Brazil (e.g., Etzkowitz et al., 2005), Iran (e.g., Fazlzadeh & Moshiri, 2010) or Singapore (e.g., Koh et al., 2005), among others.

The abundant theoretical and empirical literature on the phenomenon of science and technology parks (e.g., Lecluyse et al., 2019) makes it necessary to conduct a systematic evaluation of published research to identify the main factors studied, to understand the evolution of research paths, and to detect possible gaps to be filled in the future (Forés et al., 2021). Bibliometric analysis is an excellent empirical tool for this purpose.

This technique has also been used previously in the analysis of the literature on science and technology parks, although it is true that five years have passed since the last publication on this topic (Mora-Valentín et al., 2018). Other research (e.g., Bengoa et al., 2021) on topics closely related to the science and technology park literature, such as technology transfer, addresses the study of this business agglomeration model, albeit very succinctly. All this makes it necessary to carry out a new bibliometric analysis to answer our research question: where the literature on science and technology parks is going? To this end, the following section includes the methodology and results of this bibliometric analysis. This extended abstract will close with a section on conclusions and future lines of research.

2. METHODOLOGY AND RESULTS

In order to assess the contribution that previous literature has made to the state of the art on science and technology parks in the field of management, a bibliometric analysis based on keyword co-occurrence will be used here (Lou & Qiu, 2014). This type of word co-occurrence analysis reveals the structure of a certain topic in a discipline, as well as the most relevant related key concepts (Waltman et al., 2010). Bibliometric analysis is a widely used technique in the business organisation and strategic management disciplines in general (e.g., Forés et al., 2021), but also in the agglomeration literature in particular (e.g., Fuentes-Barrera et al., 2021).

For the identification and collection of scientific articles following previous articles in the literature (e.g., Forés et al., 2021) we have chosen to use and combine the results of two of the most prestigious academic databases in the world: Clarivate Web of Science (WOS) and Scopus. The last data retrieval was carried out in July 2022. To obtain an overview of the literature on science and technology parks in the field of management, we entered the following search instruction in the Clarivate WOS search engine: **TS=("science and technology park*" OR "technology park*" OR "research park*" OR "technopole*" OR "science park*")**. Filters were applied so that the search engine only returned scientific articles in the subject area of management. The result obtained after applying the above filters was 433 records.

We repeated the process in the Scopus database, replicating the search instruction, for those scientific articles that contained any of the words included in the instruction in the title, abstract or keywords. Again, the results were filtered only for the category of management, business and accounting, and for publications of scientific articles. The result obtained was slightly higher with 573 records. The specific instruction for the Scopus database was as follows: **TITLE-ABS-KEY (("science and technology park*" OR "technology park*" OR "research park*" OR "technopole*" OR "science park*")) TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "BUSI"))**. Therefore, without performing any additional procedure for the time being, a total of 1006 results have been obtained between the two databases.

The above summation of records does not take into account that there may be some duplicate records. In order to solve this problem, to facilitate the review of the records and to integrate the output of both databases into a single file for further processing, Zotero software has been used. This software allows sorting and organising bibliographic records, detecting duplications and exporting the researcher's entire library in Research Information System (RIS) format, useful for the use of other bibliographic and network analysis software (Ahmed & Dhubaib, 2011). In addition, it also allows export in other formats useful for research purposes such as .CSV. Thus, after dumping both databases, we were able to detect with the software that there was a total of 223 duplicate records. After this first cleaning, the resulting database remained at 783 records.

Occasionally, the Scopus and Clarivate WOS databases, due to the high volume of records they handle, can make errors in their categorisation. With Zotero we were also able to verify that, in the databases integrated in our library, book chapters were catalogued as scientific articles. Specifically, 15 records were removed from our library because they were incorrectly identified as scientific articles when in fact, they were book chapters. After this filtering process, our library with the two integrated databases has a total of 767 records.

Likewise, in order to ensure that the results are as reliable and aligned with our objectives as possible, the 767 records are exported in .CSV format so that, from a spreadsheet, each of them can be reviewed in depth[1]. In this spreadsheet we have marked records to be deleted for one of the following five reasons: (I) the language is not English (we find articles in Spanish, Portuguese, Russian, or German, among others); (II) because they are introductions to special issues and, therefore, do not provide disruptive knowledge to the research; (III) because they are studies that address parallel but differentiated realities such as industrial districts or incubators; (IV) because although some of the search terms are included, they are not the object of study or are not linked to business management; or, (V) because their information records were incomplete and could therefore be misleading. Using the spreadsheet, a new process of double-checking duplicate items could be carried out. Subsequently, the records flagged in the spreadsheet (a total of 381) were removed from the Zotero library, resulting in a final base of **386 records**.

This final database has been exported again in RIS format in order to be able to dump its content in the specific software for bibliometric analysis VOSviewer. As in previous research (e.g., Forés et al., 2021), we performed a treatment of the exported file before exploiting the final results with VOSviewer. Specifically, we integrated words that had similar meanings (e.g., cooperation, collaboration), acronyms (STP) and the singular and plural forms of the keywords. In this way, the results truly reflect the weight of the concepts in the literature and avoid biases (Forés et al., 2021). Subsequently, for the preparation of the bibliometric analysis,

[1] The export contains, among other publication data, aspects such as title, abstract, keywords, authors, or journal. In those records in which this information was insufficient to carry out an adequate filtering, it has been decided to directly access the complete publication.

the data linked to the 386 scientific articles obtained after the previous research process were dumped into the VOSviewer software tool. The following Figure 1 shows the whole procedure for the elaboration of the bibliometric analysis.

[Figure 1 here]

The VOSviewer programme allows the analysis of scientific literature through the visualisation of the most frequent keywords and their connecting links by weaving bibliometric networks. These bibliometric networks can be established on the basis of citation, bibliographic coupling, co-citation, co-occurrence or co-authorship relationships (van Eck & Waltman, 2010; Waltman et al., 2010). In our case, we will opt for the option of co-occurrence of keywords entered by authors when writing scientific papers (Forés et al., 2021; van Eck & Waltman, 2010; Waltman et al., 2010).

Figure 2 visualises the word networks, while Figure 3 shows the densities of the words. Finally, Figure 4 shows the evolution of the network and the terms most frequently used by scientific research over time. The above figures were drawn up by taking the 1916 keywords (entered by the authors), to which the filter was applied to obtain a minimum number of 10 co-occurrences between them. The literature specialising in the elaboration of bibliometric studies (e.g., Appio et al., 2014) suggests that a minimum of 5 co-occurrences is required to obtain reliable results. In our case, we have doubled this figure and introduced a minimum of 10 co-occurrences in order to obtain results that reflect as closely as possible the most recurrent words that make up the fundamental corpus of the literature on science and technology parks.

After applying the above minimum co-occurrence filter, VOSviewer indicates that there are 49 keywords to create the bibliometric network. Prior to the final step and allowing the software algorithm to build the bibliometric network based on a cluster analysis of the concepts (van Eck & Waltman, 2010), 7 words have been excluded due to their high degree of ambiguity or low possibility of relationship with the rest of the keywords (e.g., determinants, impact). Therefore, the bibliometric networks shown in Figures 2, 3 and 4 below are based on a co-occurrence analysis of a total of 42 keywords.

[Figures 2, 3 and 4 here]

The software has grouped these keywords into 3 clusters. The composition of each of these clusters is shown in the following Table 1. Through this process it will be easier to assess the main theoretical and empirical contributions to the literature on science and technology parks, to check the areas of further study and to detect possible gaps to contribute to future lines of research (e.g., Forés et al., 2021). From our bibliometric analysis, three main axes can be derived: (i) the classic advantages of agglomeration in these areas and the development of internal company capacities to take advantage of these externalities; (ii) the opportunities offered by these areas for the development of regional development policies; and (iii) as a meeting point for scientific, technological and business agents and a facilitator of knowledge transfer.

[Table 1 here]

CONCLUSIONS, IMPLICATIONS AND FUTURE LINES OF RESEARCH

The elaboration of this work allows us to conclude that science parks are a phenomenon of territorial agglomeration of companies that has been successful in many parts of the world. The result of this is the enormous bibliographical production that currently exists on this subject. Through this research, we have been able to find out the main factors studied in relation to science and technology parks by carrying out a bibliometric analysis, merging the results of two of the most prestigious bibliographic databases. The cluster analysis makes it possible to classify the main lines around science and technology parks into three main clusters: (i) the location as a strategic element to obtain competitive advantages; (ii) the aspects more linked to regional policy; and, (iii) the park as an element of interconnection of regional agents and knowledge transfer. However, through the literature review, some questions still arise that should be addressed in future research, through both quantitative and qualitative empirical studies:

- What is the role of science and technology parks in improving the sustainability performance of hosted companies?
- What is the best mix of services that the science and technology park should offer to improve the performance of its companies? Which of them must be provided by the park management entity?
- Do all companies benefit equally from their integration into a science and technology park, or might the advantages depend on the internal idiosyncrasies of the companies as measured by variables such as their size, type of ownership (e.g., family-owned), industry, etc.?

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ACKNOWLEDGEMENTS

This research was funded by “Plan de promoción de la investigación científica, el desarrollo tecnológico y la innovación (I+D+i) en la Comunitat Valenciana” of the Generalitat Valenciana (Project ref. GV/2021/155); from “Plan de promoción de la investigación de la UJI—Convocatoria 2021 de “Proyectos de investigación científica y desarrollo tecnológico” of the Universitat Jaume I (Project ref. UJI-A2021-06) and from “Plan Estatal de Investigación Científica y Técnica y de Innovación 2021-2024” of the Ministerio de Ciencia e Innovación, with the reference PID2020-119642GB-I00. The author José María Fernández Yáñez has been supported by the predoctoral grant PD-UJI/2019/13.

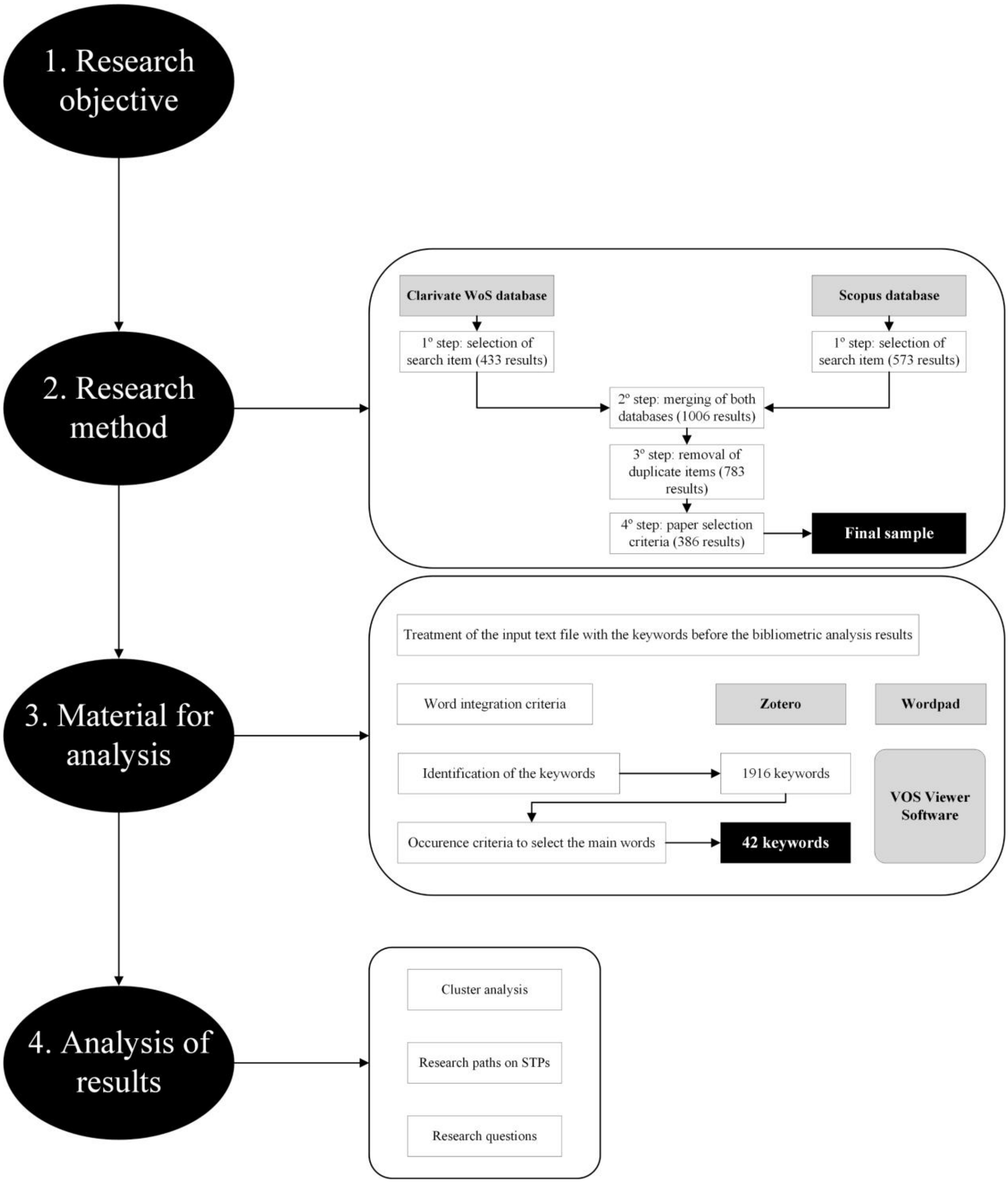
TABLES AND FIGURES

Table 1. Keyword clusters

Cluster 1 ***Science and technology parks as a strategic agglomeration***	**Cluster 2** ***Science and technology parks as a policy instrument***	**Cluster 3** ***Science and technology parks as a knowledge transference pole***
-Absorptive-capacity -Academic-industry social capital -Business incubators -Capabilities -Clusters -Cooperation -Entrepreneurship -Innovation -Innovation performance -Knowledge -Knowledge management -Proximity -Social capital -Start-ups -Structural holes -Technology parks	-China -Developing countries -Industrial economics -Industrial management -Industrial research -Public policy -Regional planning -Research and development management -Science and technology -Science parks -Societies and institutions -Strategy -Sustainable development -Technology transfer	-Commercialisation -Firms -Growth -Industry -Knowledge spillovers -Location -New technology-based firms -Patents and inventions -Performance -Research and development -Science and technology parks -Universities

Source: own elaboration

Figure 1. Bibliometric research procedure



Source: own elaboration

Figure 2. Co-occurence word network

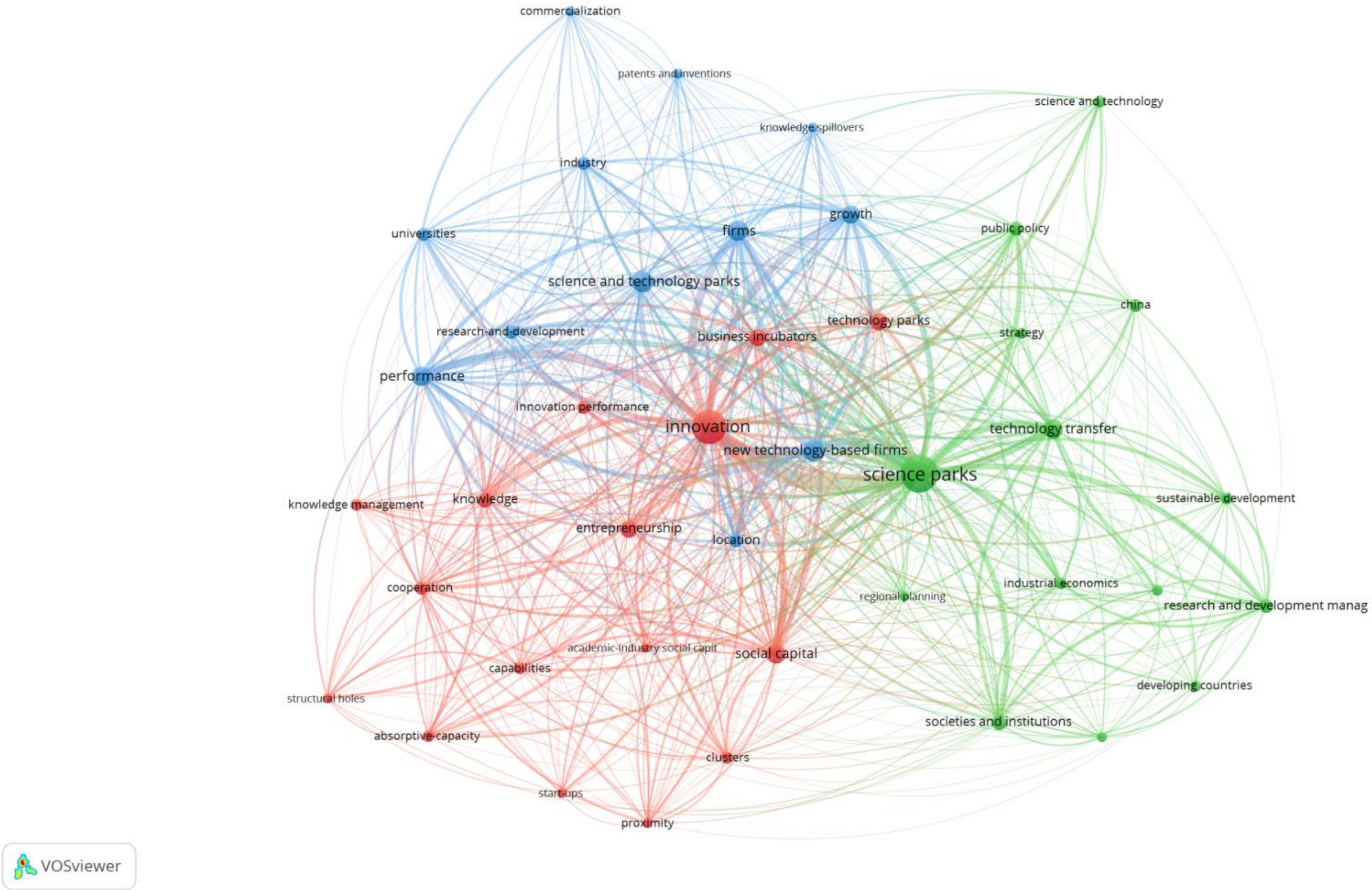


Figure 3. Density of the network

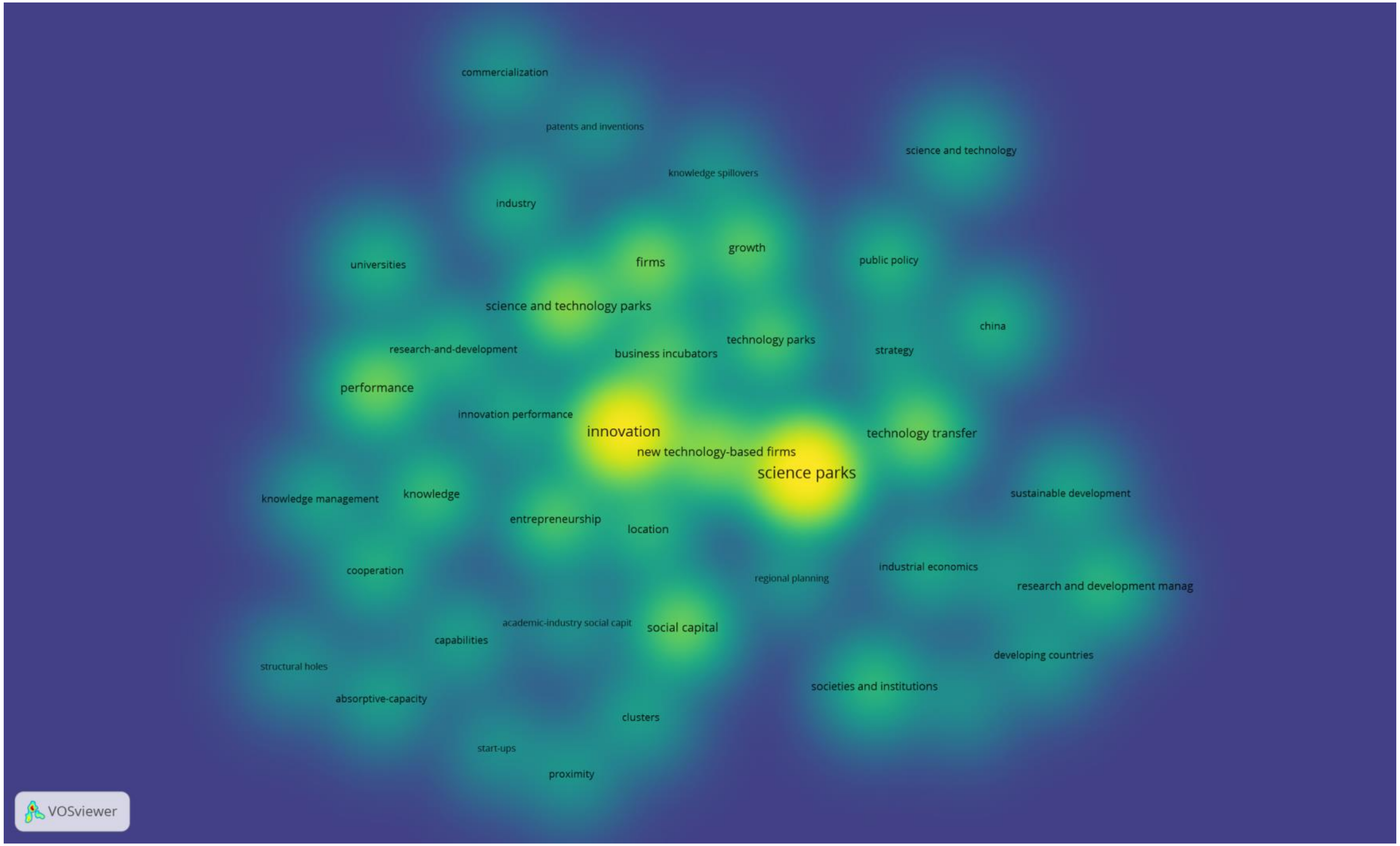


Figure 4. Network evolution