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ORIGINAL

Trends in research on the implementation of artificial intelligence in supply chain management

Tendencias de las investigaciones sobre la implementación de la inteligencia artificial a la gestión de cadenas de suministro

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ABSTRACT

Supply chains play a critical role in the functioning of the global economy. The integration of information systems and emerging technologies, such as artificial intelligence and the Internet of Things, improves visibility, decision making and responsiveness throughout the supply chain. The objective of the research is to analyze research trends on the implementation of artificial intelligence to supply chain management. The research paradigm was quantitative, based on a descriptive, retrospective and bibliometric study, in the SCOPUS database, during the period from 2019 to 2024, without language restriction. The trend of research was positive and towards increase with a maximum peak in the year 2023 of 214 researches, research articles in the area of computer science predominated. The top producing country was the United Kingdom with 127 research papers and four lines of scientific research were identified around the implementation of artificial intelligence in supply chain management. In the business environment, the ability of supply chains to adapt to change is crucial; their management includes planning and coordination, logistics process management and customer relationship management. The integration of information systems and emerging technologies, such as artificial intelligence, has had a great impact on the improvement of all the processes involved in management.

Keywords: Bibliometric Analysis; Supply Chain; Value Chain; Artificial Intelligence; Disruptive Technologies.

RESUMEN

Las cadenas de suministro desempeñan un papel fundamental en el funcionamiento de la economía global. La integración de sistemas de información y tecnologías emergentes, como la inteligencia artificial y el Internet de las Cosas, mejora la visibilidad, la toma de decisiones y la capacidad de respuesta a lo largo de la cadena de suministro. El objetivo de la investigación es analizar las tendencias de investigación sobre la implementación de la inteligencia artificial a la gestión de cadenas de suministro. El paradigma de la investigación fue cuantitativo, a partir de un estudio descriptivo, retrospectivo y bibliométrico, en la base de datos SCOPUS, durante el período de 2019 a 2024, sin restricción idiomática. La tendencia de las investigaciones fue positiva y hacia el incremento con un pico máximo en el año 2023 de 214 investigaciones, predominaron los artículos de investigación en el área de las ciencias de la computación. El país más productor fue Reino Unido con 127 investigaciones y se identificaron cuatro líneas de investigación científica en torno a la implementación de la inteligencia artificial en la gestión de cadenas de suministro. En el entorno empresarial, la capacidad de las cadenas de suministro para adaptarse a los cambios es crucial, su gestión incluye la planificación y coordinación, la gestión de procesos logísticos y la gestión de relaciones con el cliente. La integración de sistemas de información y tecnologías emergentes, como la inteligencia artificial ha manifestado gran impacto en la mejora de todos los procesos que intervienen en la gestión.

Palabras clave: Análisis Bibliométrico; Cadena de Suministro; Cadena de Valor; Inteligencia Artificial; Tecnologías Disruptivas.

INTRODUCTION

Supply chains play a critical role in the functioning of the global economy.[1] These networks of suppliers, manufacturers, distributors, and retailers are responsible for bringing products and services from their origin to end consumers.[2] An efficient and well-managed supply chain can provide companies with a significant competitive advantage.[3,4] By optimizing logistical processes,[5,6] reducing delivery times[7] and minimizing costs.[8,9]

In an increasingly volatile business environment, the ability of supply chains to adapt to change and recover from disruptions is crucial.[10] Companies must implement risk management strategies and develop the resilience of their supply chains.[11] Supply chains can take various forms and structures depending on industry characteristics,[12] product type,[13] and company strategies.[14] Among the simplest are linear supply chains,[15] circular supply chains,[16,17] and complex supply chains.[18] Also, depending on the nature of the resulting good in the chain, they are classified into production or service supply chains.[19,20,21,22]

Supply chain management includes a set of elements that ensure business competitiveness,[23] including planning and coordination,[24] which involves the integration of processes such as demand forecasting,[25] inventory management,[26] production scheduling,[27] and product distribution.[28] Other studies allude to the importance of integration between the different actors in planning and as a higher stage of collaboration or collaborative planning.[29]

On the other hand, there is supplier relationship management,[30] logistics process management or internal processes such as transportation, storage, and material handling,[31] and customer relationship management (CRM).[14] The incorporation of sustainable and responsible practices in supply chain management, such as reducing emissions and respecting labor rights, contributes to long-term value creation.[32]

The integration of information systems and emerging technologies (disruptive technologies), such as artificial intelligence (AI) and the Internet of Things, improves visibility, decision-making, and responsiveness throughout the supply chain.[33]

AI is a field of science and technology that focuses on the development of systems capable of performing tasks that normally require human intelligence, such as learning, reasoning, perception, decision-making, and problem-solving. Through the use of advanced algorithms and techniques, AI seeks to replicate and enhance human cognitive capabilities in artificial systems.[34]

The importance of AI for business quality improvement lies in its ability to optimize processes, make more informed decisions, and adapt quickly to market changes; this tool has been implemented for the improvement of supply chain management.

Among the main implementations of AI in improving supply chain management are the automation of logistics processes by reducing human errors,[35] improvement of demand forecasting by analyzing large volumes of historical and real-time data,[36] problem identification and decision-making by analyzing patterns in the data to detect potential problems in the supply chain,[37] such as bottlenecks or disruptions, in addition, it uses machine learning algorithms to recommend solutions and support decision making and sustainability integration by measuring and optimizing the environmental and social impact of its logistics operations, facilitating the implementation of sustainable practices such as the circular economy.

The study of the different implementations of AI and the impacts on supply chain management is the starting point for the generalization of good practices; in this sense, the objective of the research is to analyze the research trends on the implementation of artificial intelligence in supply chain management.

METHOD

The research paradigm was quantitative[38,39] based on a descriptive, retrospective, and bibliometric study[40,41] with the purpose of analyzing trends and indicators around the implementations of artificial intelligence in supply chain management and, from this analysis, identifying possible lines of research.

The review was conducted in the SCOPUS database (https://www.scopus.com/) during the period from 2019 to 2024 without language restriction; only research and review articles found in open access were taken into account. A ".RIS" file format was downloaded and analyzed in the EndNote X8 bibliographic manager by two researchers independently,[42] where the selection criteria for inclusion were adjusted to the topic, relevance, and quality of the research, as well as least explicit evidence of the implementation of artificial intelligence at some point in the supply chain management.

Search strategy

In the preparation of the search strategy, two main thematic descriptors were taken into account: "supply chain" and "artificial intelligence" in English language, and their use in combination with the inclusion and exclusion criteria resulted in the structured formula: TITLE-ABS-KEY ("supply chain" AND "artificial intelligence") AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (OA, "all")) Conducted on June 25, 2024 and collected a total of 679 investigations (n=679).

Bibliometric indicators

Five bibliometric indicators were analyzed, including four production-related indicators and one trend indicator. The description of the indicators is shown below:

Trend indicator

- Trend of investigations per year: the number of investigations per year and their trend were analyzed based on the representation of the trend line and its level of fit (R2).

Production indicators

- Scientific production by type of document: an analysis was made of the number of research and review articles identified.
- Scientific production by area of knowledge: an analysis was made of the number of articles by area of knowledge.
- Scientific production by country: an analysis was made of the number of articles by country and the levels of introduction of results based on a density map.
- Scientific production by institutional affiliation: an analysis was made of the number of articles by institutional affiliation.

Source of information: the indicators were obtained from the SCOPUS database. XLSX files were downloaded in Excel format. The country map was created on the Lens platform (https://www.lens.org/).

Knowledge maps

- Collaboration map between countries: the objective was to analyze the main collaboration clusters between countries and possible knowledge transfers between regions.
- Keyword cooccurrence network: an analysis of keyword cooccurrence was carried out based on the bibliometric network map. An analysis of the main clusters was carried out to identify possible lines of research.
- Keyword cloud map: a keyword frequency analysis was carried out to identify the words that appear most frequently in the research.
- Collaboration network between authors: an analysis of collaboration between authors was carried out.
- Citation map: an analysis was made of the main citations in the period, according to the level of access to the publications and the comparison between the levels of citations in open access or not.

Source of information: Vosviewer software and the Lens platform were used to create knowledge maps.

RESULTS AND DISCUSSION

The research trend was positive and increasing, with a maximum peak in 2023 of 214 research, characterized by a polynomial function with a confidence level of 73,74 % (Figure 1). In the year 2024, already in the first semester, there are 127 investigations; if this trend continues, it is expected that the number of investigations from the previous year will be surpassed.

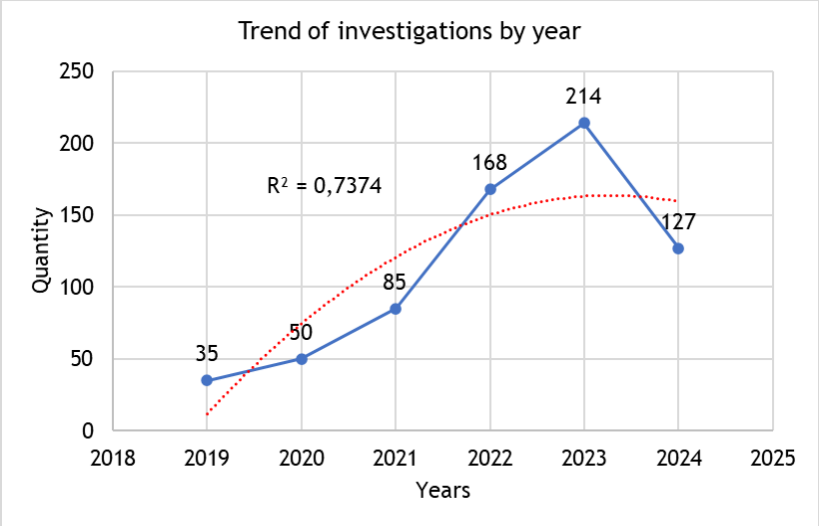

Figure 1. Trend of investigations by year

Figure 2 shows an analysis of the scientific production by type of documents, where research articles predominated, with 536 articles representing 79 % of the total, while the remaining 21 % were review articles.

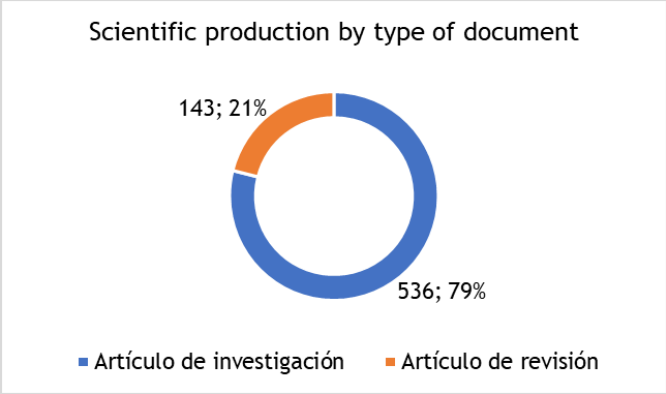

Figure 2. Scientific production by type of document

The research was identified in 26 areas of knowledge; an analysis of the areas of knowledge with more than 50 researches showed that research in the area of computer science predominated with 302 articles, followed by Engineering and Business, Management and Accounting with 269 and 178 researches respectively.

Table 1. Production by areas of knowledge

Areas of knowledge	Quantity
Computer Science	302
Engineering	269
Business, Management and Accounting	178
Decision Sciences	136
Social Sciences	119
Environmental Science	100
Energy	81
Agricultural and biological sciences	56
Mathematics	54
Sample	1295

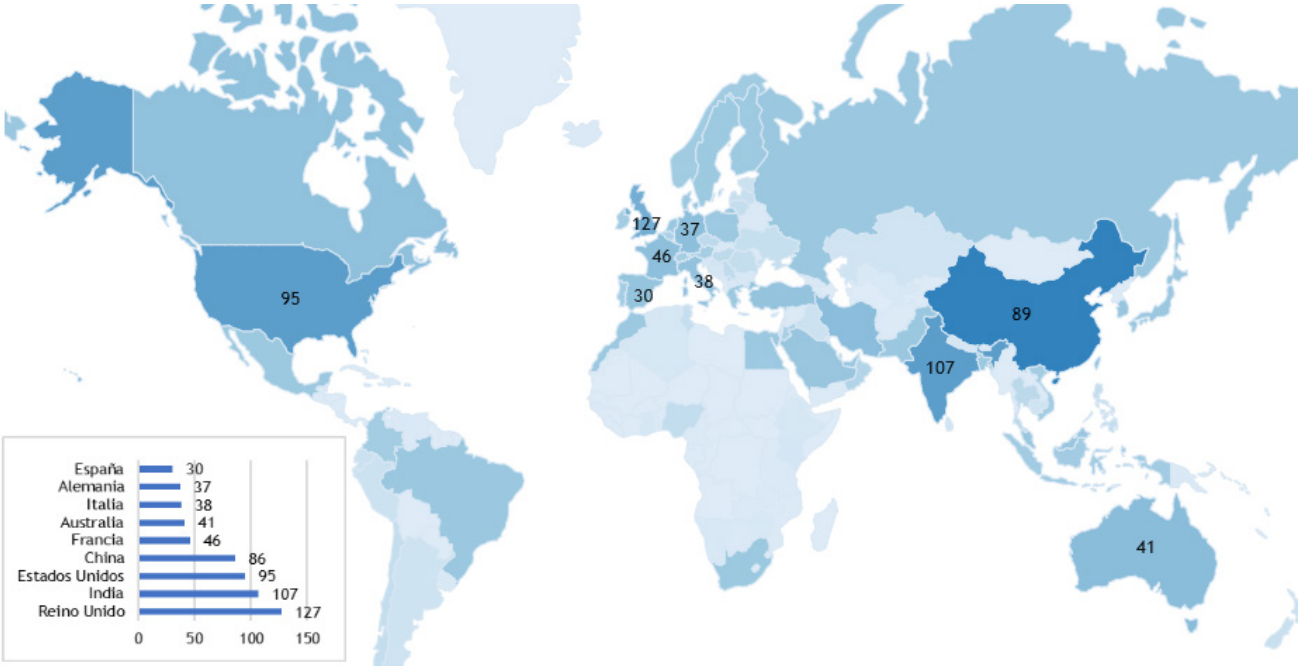

Figure 3. Scientific production by country

Research was identified in 88 countries; figure 3 shows an analysis of the countries with 30 or more research; the most producing country was the United Kingdom with 127 researches, followed by India and the United States with 107 and 95 researches, respectively. An analysis of the density on the map shows that the countries with the highest introduction of results were China, the United States, and India.

Among the main applications in China are the automation and optimization of logistics processes related to demand forecasting, warehouse and transportation management, and techniques for supplier selection.[7] In the United States, the main applications are focused on inventory management to analyze real-time data and make informed decisions, strategies that have also been implemented in India, where, in addition to data collection, the Internet of Things (IoT) and advanced analytics for demand forecasting have been implemented.[43]

Figure 4 shows the scientific production by institutional affiliation; 160 institutional affiliations with research were identified in the study, where the University of Cambridge, with 14 research, was the most productive, followed by Swansea University and the University of Oxford with 11 and 9 research, respectively.

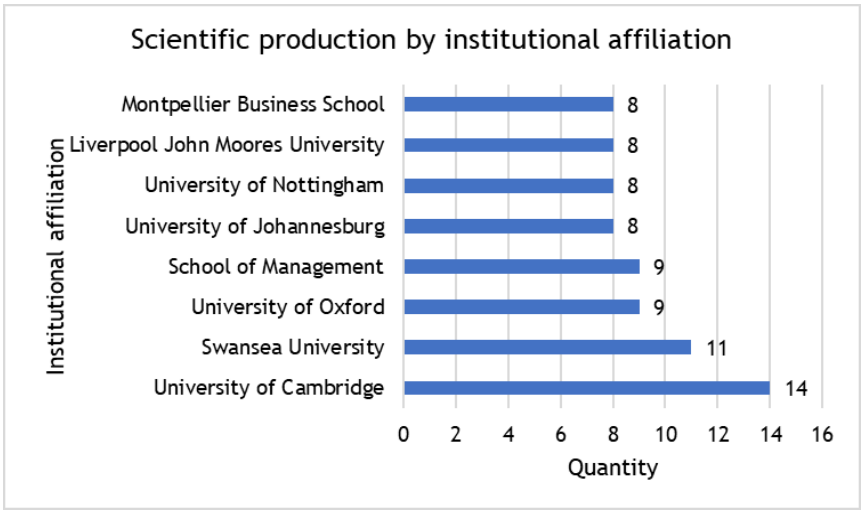

Figure 4. Scientific production by institutional affiliation

An analysis of the collaboration network between countries with a level of cooccurrence greater than or equal to 12 was carried out, where 28 items (countries) were identified and grouped into five main clusters; in cluster 1, the following countries were interrelated: Canada, France, Germany, Italy, Holland, Portugal, Spain, and the United States, in cluster 2 the following countries: Australia, Iran, Malaysia, Pakistan, and Poland, while in the center of cluster 5, the following countries collaborated: Serbia, Taiwan and the United Kingdom.

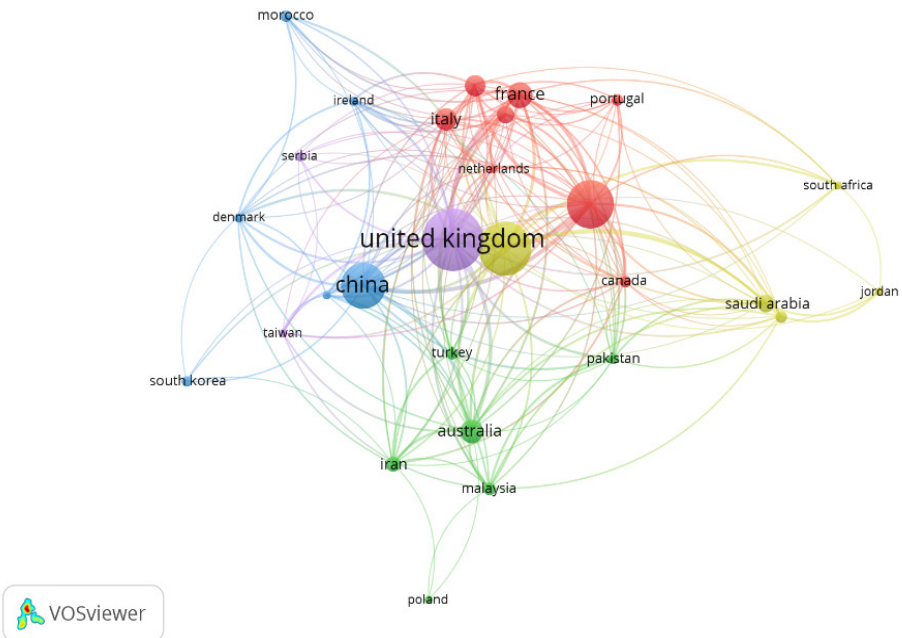

Figure 5. Collaboration network between countries

A co-occurrence analysis of keywords with a level greater than or equal to 26 was carried out, where 26 items were identified, grouped into four research clusters.

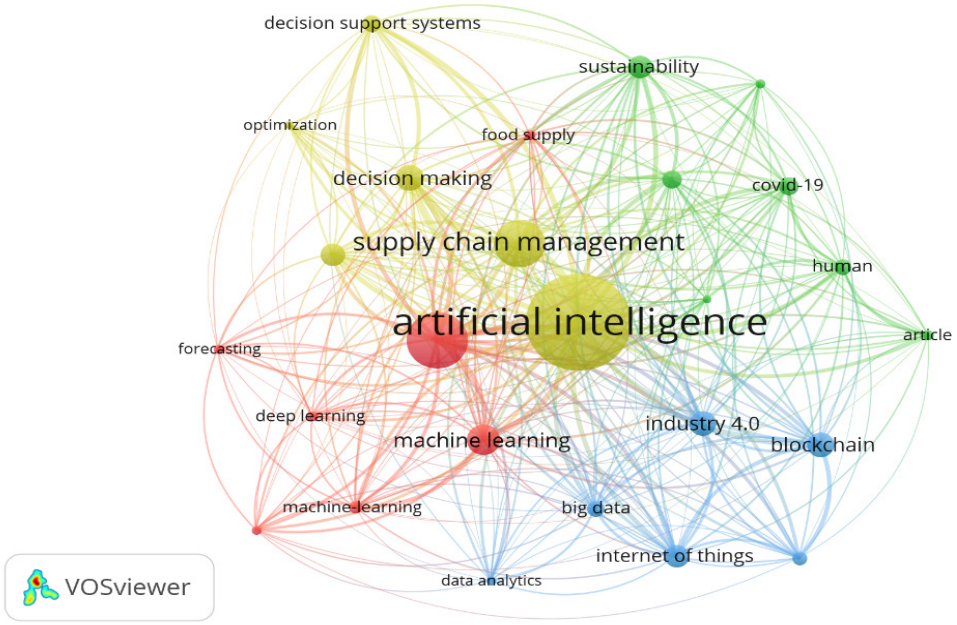

Figura 6. Keyword concurrency network (n≥26)

The main lines of scientific research were:

- Cluster 1 (7 items): predictions of food supply using deep learning systems and industry supply chains.[44,45,46]
- Cluster 2 (7 items): impact of the COVID-19 pandemic on sustainable development and human mobility from integrated supply chain management.[47,48]
- Cluster 3 (6 items): integration of big data, blockchain, and data analytics in supply chains in the framework of Industry 4.0.[49,50,51]
- Cluster 4 (6 items): artificial intelligence-based decision support systems for supply chain management optimization.[52]

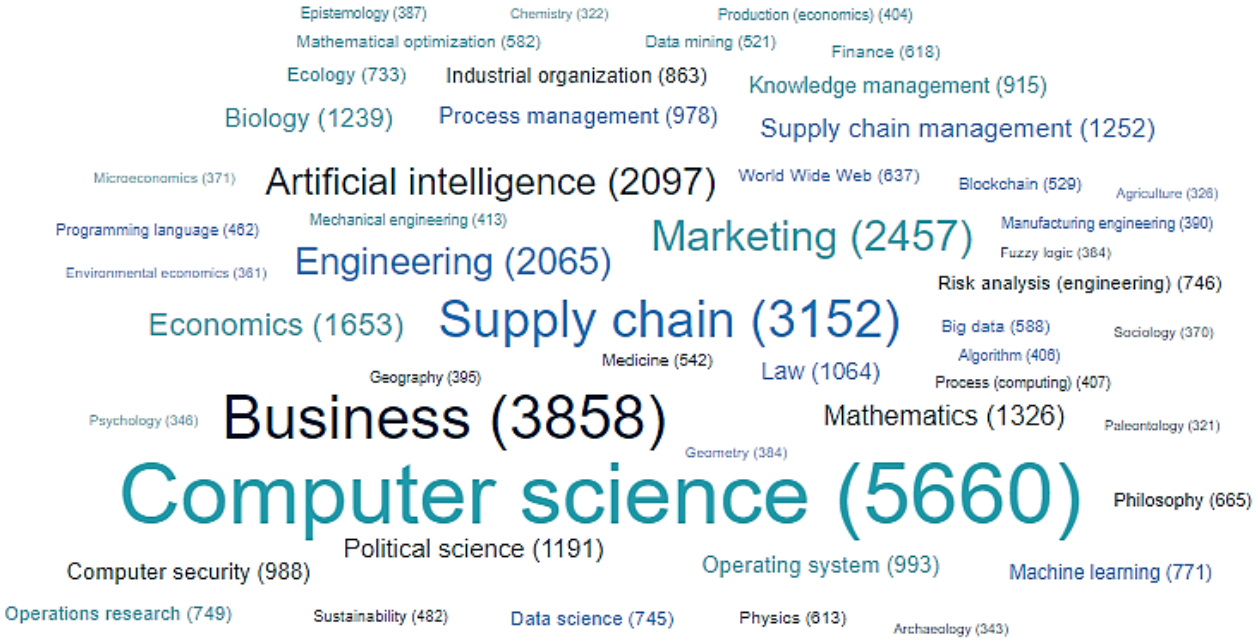

Figure 7. Keyword cloud map

When analyzing the keyword cloud map (Figure 7), it was evident that the keyword with the highest frequency of occurrence was computer science, which was repeated 5660 times, an element that coincides with the most relevant knowledge area, followed by business (3858), supply chain (3152), marketing (2457), artificial intelligence (2097) and engineering (2065).

Figure 8 shows the network of collaboration between authors, where the most representative authors were Brintrup, A., with seven investigations, followed by Allahham, M., Dwivedi, Y.K., and Kumar, A., all with six investigations published during the period.

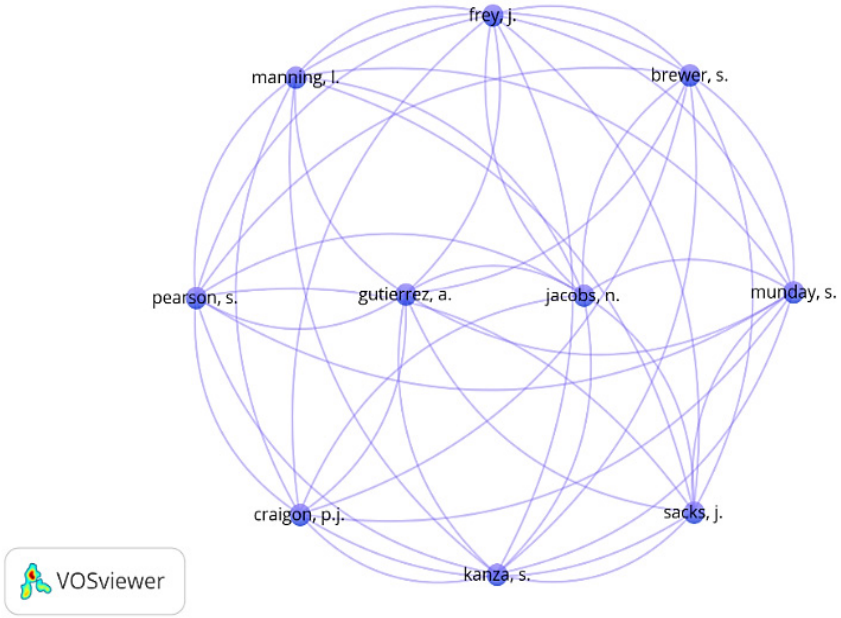

Figure 8. Collaboration network between authors

When analyzing the citation map (Figure 9), it was evident that the highest number of citations was in the range of 0 to 250, with a maximum peak of open access citations in January 2021 of 3400 citations and in the year 2022 of 1600 citations. Citations in open-access journals predominated.

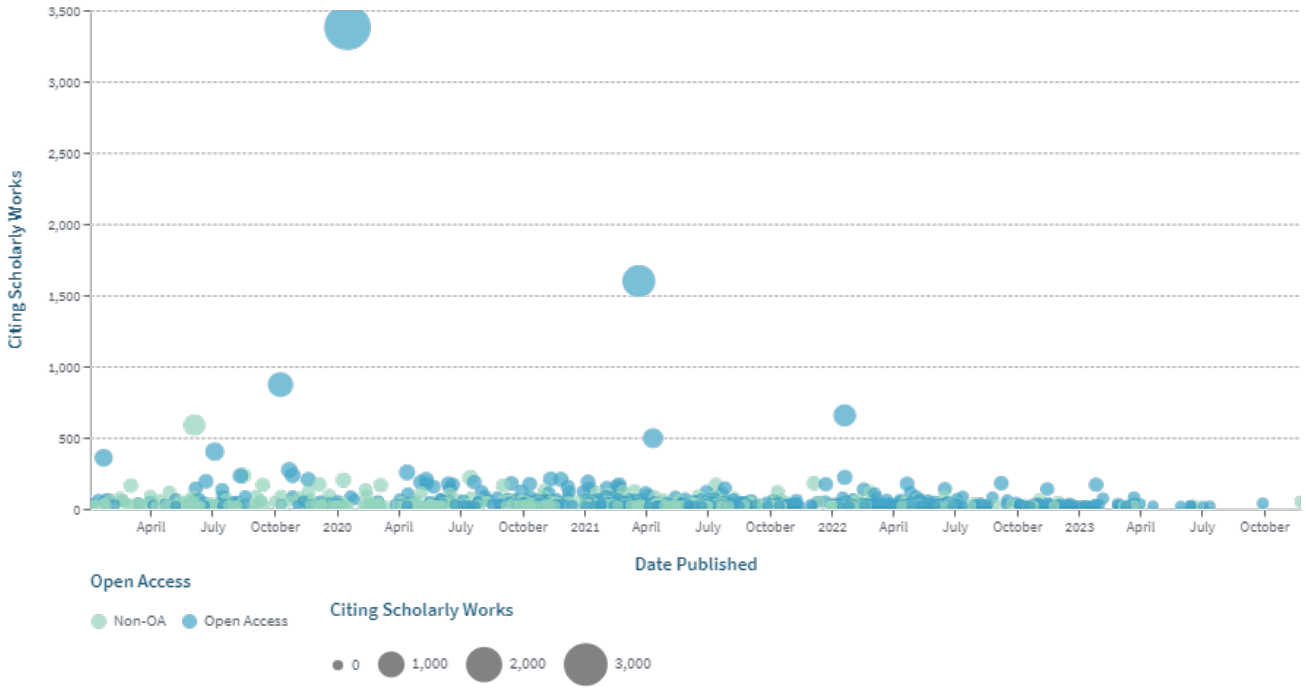

Figure 9. Map of citations

CONCLUSIONS

In an increasingly volatile business environment, the ability of supply chains to adapt to change and recover from disruptions is crucial, and their management includes a set of elements that ensure business competitiveness, including planning and coordination, logistics process management, and customer relationship management. The integration of information systems and emerging technologies (disruptive technologies), such as artificial intelligence (AI), has become a competitive advantage with a great impact on the improvement of all processes involved in management.

It was evidenced that the trends in research showed an increasing behavior. This element reflects the interest of researchers in these topics, with maximum peaks in the year 2023, where research articles in the area of computer science predominated. The most productive country was the United Kingdom, while the most representative affiliation was the University of Cambridge of this country.

A keyword co-occurrence analysis was performed where four lines of scientific research were identified: predictions of food supply by using deep learning systems and supply chains in the sector, impact of the COVID-19 pandemic on sustainable development and human mobility from integrated supply chain management, integration of big data, blockchain and data analytics in supply chains within the framework of Industry 4.0 and decision support systems based on artificial intelligence for the optimization of supply chain management.

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CONFLICT OF INTEREST

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