

Article

AI-Enabled Supply Chain Management: A Bibliometric Analysis Using VOSviewer and RStudio Bibliometrix Software Tools

Mihaela Gabriela Belu  and Ana Maria Marinoiu * 

Faculty of International Business and Economics, Bucharest University of Economic Studies,
010404 Bucharest, Romania; mihaela.belu@rei.ase.ro

* Correspondence: ana.marinoiu@rei.ase.ro

Abstract: Artificial intelligence (AI) is fundamentally transforming the management of supply chain activities, offering companies the opportunity to configure resilient, transparent, and sustainable supply chains. Given its importance, this paper presents aspects of the implementation of artificial intelligence in supply chain management by performing a bibliometric analysis of 400 scientific papers published between 2010 and 2024 and indexed in the Scopus database. The analysis was based on the Bibliometrix 4.4.2 and VOSviewer 1.6.19 software to identify the most important authors and journals of interest for the researched topic. Keyword co-occurrence and co-citation analyses were used to map intellectual networks and highlight themes of interest. The research results confirm the increase in scientific interest in the field of applying AI in supply chain management, highlighting the advantages of implementing this technology in supply chain management. At the same time, the recommendations and conclusions of this paper will be useful to both academic researchers and business professionals to identify potential areas of collaboration with the aim of developing supply chain strategies that contribute to the competitiveness of companies that are part of the network.

Keywords: artificial intelligence; supply chain; supply chain management; bibliometric analysis; VOSviewer; Bibliometrix



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1. Introduction

The global business environment is currently characterized by complexity and dynamism, making it increasingly difficult for companies to cope with both internal organizational and external factors. Factors such as globalization and technological changes represent challenges that they must take into consideration to respond to dynamic consumer preferences in order to maintain competitiveness in the market [1].

As a result of the globalization of economic activity and the rapid development of information technology, companies are developing and configuring global networks through which to integrate the sources of supply, production, and distribution of finished products to final consumers. Thus, globalization of economic activity has had the effect of increasing the complexity of supply chains, and their management focused on resilience and sustainability [2]. Management of supply chains plays an important role in controlling the costs and agility of a company in the face of market opportunities and uncertainties [3].

In this context, streamlining supply chain management is a constant concern that must align with these changes and address a paradigm shift toward innovative management strategies that offer a user advantage by adopting decisions characterized by speed and complexity [4]. Companies are paying increasing attention to optimizing global supply

chains, aiming to obtain supply chains (SCs) that offer end-to-end visibility, traceability, resilience, and cost optimization [5].

The pandemic crisis and the development of new technologies have created the necessary conditions for the transformation of traditional logistics chains into digital logistics chains [6]. Currently, companies are engaged in a continuous process of adaptation to new technologies that includes the digitalization of activities, a phenomenon known as Industry 4.0 [7], with a particular focus on digital production, the “smart factory” or “factory of the future” [8]. This principle represents the application of digital technologies within corporate management, facilitating the recognition of connections between systems, operations, production capacities, finished products, and customers, the aim being real-time processing of information and its efficient use [9]. In essence, Industry 4.0 has allowed the automatic creation of goods and services without human intervention [10]. This capitalizes on the trend toward automation and the use of data exchange based on cyber-physical systems (CPSs), the Industrial Internet of Things (IIoT), cloud computing, cognitive computing, and artificial intelligence (AI).

This paper aims to conduct a systematic analysis of the scholarly work focusing on how artificial intelligence has emerged as a disruptive technology with the potential to revolutionize the way corporations orchestrate their supply chains [2]. The generating potential has attracted significant attention among researchers, business communities, and regulatory bodies. Ensuring collaborative research between these entities can provide several advantages, including cost savings related to research facilities and resources, the exchange of information and expertise, and the increase in skills determined by teamwork. Therefore, academia is an important player in streamlining supply chains through the use of artificial intelligence [11].

We decided to investigate the research potential for streamlining the implementation of artificial intelligence to ensure a lean and productive supply chain because AI-based applications can contribute to the coordination of logistics activities in real time, ensuring better resilience at the supply chain level [12]. At the same time, the implementation of AI in supply chain management offers support in risk management, offering more resilience at the supply chain level [13], and generative AI influences the sustainability of supply chain management [14]. AI’s ability to drive efficiency, resilience, and sustainability underscores its critical role in shaping the next generation of supply chain ecosystems, ensuring long-term success in an ever-changing world. Eyo-Udo [15] notes that AI is transforming supply chain management by optimizing procedures, increasing decision-making, and improving overall efficiency [16]. Digital supply chain transformation enables end-to-end visibility, real-time insights, and seamless business and process integration [17].

This article provides a structured and comprehensive overview of the application of artificial intelligence in supply chain management with the objective of understanding the current state of academic research. The complex, multi-faceted nature of the implementation of AI in supply chain optimization can be seen in the large number of academic works that address this complex topic identified following a bibliometric analysis, used both to highlight prevailing trends and influential works as well as to collect clues regarding future research and discussions regarding the application by corporations of artificial intelligence in supply chain management.

As we explore the scholarly literature throughout this work, the challenges posed by the implementation of artificial intelligence in supply chain management represent a rapidly developing field that can increase the efficiency, accuracy, and agility of the supply chain. Carrying out the research led us to identify some recent studies that showed that there are still research gaps regarding the full potential of using artificial intelligence in supply chain management. Goswami et al. identified the weak integration of AI with other

technologies such as blockchain, IOT, and big data analysis that is not explored on a large scale, ethical and sustainability issues, human–machine collaboration, inter-organizational collaboration, etc. Topics to be addressed in the research performed [4].

According to Counsell, well-formulated research questions can lead to an adequate systematic review of the analyzed specialized literature [18].

To achieve the objectives proposed in this article, we resorted to three research questions presented in Table 1.

Table 1. Research questions.

	Research Question	Scope
RQ1	What are the important/relevant keywords for the field of AI application in SCM, keywords that can be used in future research to identify relevant articles in this field?	It provides support to researchers in identifying relevant articles using keywords.
RQ2	What are the current topics in the specialized literature that can be used in conducting in-depth analyses?	It analyzes topics in the field of AI application in SCM.
RQ3	What are the future research directions we should address, starting from the application of AI in SCM?	It offers new future research directions in the field of applying emerging technologies in SCM.

The questions were used as a supporting framework to carry out the review of previous research, identified based on a bibliometric analysis. The goal was to carry out a descriptive analysis, the results of which can be used by practitioners or theoreticians in future activities related to the implementation of AI in SCM.

The paper is structured in five distinct sections. In the Section 2, the theoretical framework and specific information on supply chain and artificial intelligence are presented, with the objective of identifying how artificial intelligence can contribute to better supply chain management. The Section 3 of the paper presents the research methodology based on bibliometric analysis. This method allows exploring the evolution of research in the field, identifying major influences and connections between different topics and concepts related to AI and supply chain management [19]. The Section 4 of the paper is dedicated to the results and discussion section, in which the results obtained are analyzed. The Section 5, “Managerial recommendations”, presents the implications of the results obtained and offers recommendations for logistics practitioners. The Section 6 presents the conclusions and mentions the limitations and future research directions.

2. Theoretical Framework

2.1. Overview of Supply Chain Management and Artificial Intelligence

This section presents the concepts underlying the study and presents the implications of adopting artificial intelligence in supply chain management. Supply chain management has experienced a transformation process influenced by various factors. Numerous corporations face challenges in augmenting operational efficiency, reducing expenses, and meeting the increasing demands of consumers.

A supply chain is a complex logistical system in which raw materials—factors of production—are transformed into finished products and then distributed to end users (individual consumers or companies). It includes suppliers, processing centers, warehouses, distribution centers, and retail outlets [20].

SCM is an essential part of every business entity. It refers to the planning, design, implementation, and control of a firm’s logistics activities, including sourcing, warehousing, inventory control, manufacturing, distribution, and order fulfillment [21].

As traditional supply chains have grown in complexity, the necessity for improved efficiency has become more pressing, particularly concerning the reduction in costs and the fulfillment of expectations for accelerated deliveries. Within the framework of Industry 4.0, the innovation process within logistics has catalyzed significant transformations in supply chain management [2]. Artificial intelligence, along with other emerging technologies, plays an important role in the digital transformation of the supply chain [3]. Several authors have highlighted the role of new technologies in the supply chain transformation process [4–6].

Artificial intelligence is an innovative and complex science in continuous evolution based on systems that can perform human cognitive functions, including thinking, learning, and problem-solving [22,23]. The economic contribution of AI technologies is estimated to be approximately USD 13 trillion to global GDP by 2030, generating an annual growth rate of approximately 1.2% [23].

The pace of applications using artificial intelligence has increased significantly since 2010, generating competitive advantages in business management but also government concerns about the evolution and future of the labor force [24]. At the same time, technological progress and the advantage of digitization are key factors implemented by companies in order to reduce production and operating costs, thus investing in AI solutions for improving the supply chain. Artificial intelligence (including machine learning) and generative AI (GenAI) are the main investment priorities in the digital supply chain, according to a survey conducted by Gartner, Inc. [25]. The branch of machine learning develops algorithms by identifying patterns based on large data sets [26], and representation learning algorithms are designed to identify and learn abstract features of the identified and analyzed data [27].

In the context of integrating artificial intelligence into supply chain management, numerous scholars contend that supply chain management constitutes one of the domains with the most significant potential for the implementation of artificial intelligence across operations, ranging from sourcing and production to storage, transportation, and the distribution of products to final consumers [16–19].

Min et al. [28] authored an initial publication in the domain of artificial intelligence applications within supply chain management. Through a comprehensive literature review encompassing 28 articles, they identified the AI-specific tools most appropriate for application in supply chain management.

There are authors who present the potential of implementing artificial intelligence in supply chain management [20–22] and authors who highlight the advantages of implementing AI in supply chain management [23–25]. According to Toorajipour et al. [29], an advantage of implementing AI in SCM is given by the possibility offered to companies to manage a very large volume of data, performing analytics at a faster speed than the people involved, as well as interpreting results more accurately than warranted.

Another advantage of implementing artificial intelligence tools in SCM, according to Sharma et al. [30], is the fact that it offers the possibility for supply chain participants to identify patterns in historical data and determine how those patterns will play out in the future, which in turn allows them to plan for discounts during the demand pause. By integrating AI into decision-making processes, companies can gain a significant competitive advantage by quickly adapting to market changes and optimizing supply chain performance [5].

As noted by various authors [19,21,27,28], artificial intelligence has the potential to enhance transparency and traceability, thereby furnishing the supply chain with comprehensive visibility from end to end. Supply chains are becoming more visible due to the increased use of artificial intelligence and machine learning. AI-powered tracking systems enable real-time location of commodities and stock levels. Such transparency gives busi-

nesses the freedom to monitor their supply chains in real time, no matter how far they are in the chain, be it production or even delivery.

Straight [31] shows that the adoption of artificial intelligence in SCM providing quality customer service has now become a necessity for any business operating in the contemporary market. With artificial intelligence and machine learning, it is possible for businesses to make their supply chains more customer-centric. In addition, companies can offer contrasting offers that are in line with buyers' expectations, anticipating who will most likely buy which item at what time and customizing promotions accordingly.

Wong et al. [32] contend that supply chain management is exposed to a spectrum of risks, including natural disasters, war, and political or economic instability. According to Riahi et al. [33], AI tools that manage risks can be trained to assess factors deemed likely to affect the supply chain and develop means to prevent them.

According to Hoffman [34], the concept of "supply chain sustainability" is expected to receive increasing attention among stakeholders as the sustainability phenomenon is expected to grow in intensity. Sustainability will become a multidisciplinary concept based on technical operating regulations, such as compliance with fire extinguishing regulations or pollution regulations regarding carbon emissions or labor legislation [35].

In recent times, sustainability and environmental considerations have become key drivers in the development of corporate strategies. Social pressure and strict government policies have led companies to increase sustainability actions and ensure a sustainable supply chain [36]. The sustainability process can only be achieved through the simultaneous contribution of three factors: (1) increasing the social well-being of the various stakeholders (employees, customers, suppliers, etc.), (2) minimizing the effects on the environment, and (3) the economic growth of the company [37]. Sustainable supply chain management practices encompass various aspects, such as environmentally sustainable design, efficient inventory management, planning and control of remanufacturing, recycling of resulting products, reverse logistics, waste management, energy use, and emission reduction [38].

Artificial intelligence, along with a limited series of emerging technologies such as robotics, digitalization, the Internet of Things (IoT), etc., contribute to ensuring the desideratum of business sustainability, including the supply chain [39].

2.2. Research Gaps

The published articles dealing with the application of artificial intelligence in supply chain management present aspects related to supply chain digitalization through the integration of emerging technologies, managerial challenges, and risks of implementing artificial intelligence in SCM; this study presents a recent analysis of the existing research trends in the research field (application of AI in supply chain management) and tries to identify new research directions.

Following the bibliometric analysis of the 400 articles, we identified the following research gaps: (a) we identified a relatively low collaboration between authors who published papers in the field of AI research in SCM; (b) we have not identified research papers that develop models and strategies for the application of artificial intelligence in supply chain management for a specific industry.

3. Methodology

Starting from the objective of understanding the current state of academic research in the field of applying artificial intelligence in supply chain management, we used bibliometric analysis, as it provides a systematic framework for evaluating scientific papers, identifying research trends, and structuring research collaborations in a given field [40]. Considering previous research carried out in the field [41–43], the research methodology

involves going through several stages (Figure 1). Thus, the research methodology includes four stages: in the first stage, “Research development”, we establish the research objectives; in the second stage, “Data extraction”, we select the data from Scopus; in the third stage, “Bibliometric analysis”, we analyze data using of Bibliometrix and VOSviewer; in the fourth stage, “Findings”, we present the map visualization and results and discussions, in which the conclusions, research limits, and future research directions are presented.

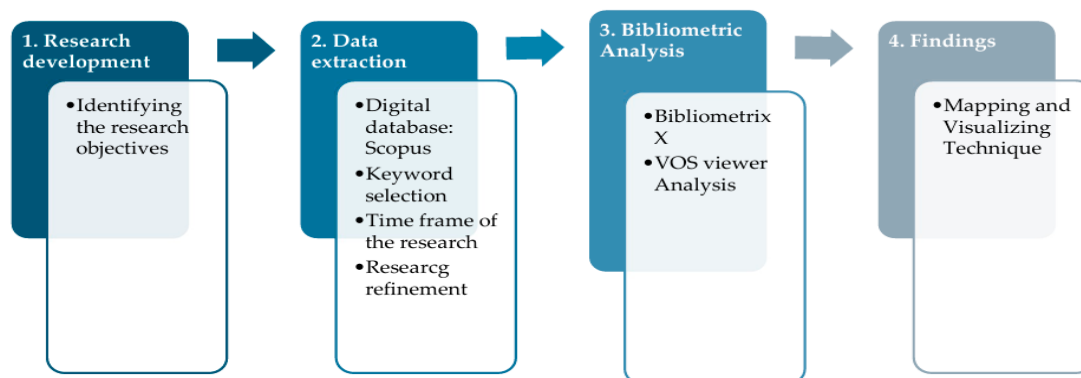


Figure 1. Flow chart.

3.1. Database

To carry out the bibliometric analysis, researchers have at their disposal several databases: Scopus, Web of Science, Google Scholar, IEEE Xplore, ERIC, PubMed, ScienceDirect, etc. To collect bibliometric data, we opted for the Scopus database, which allows for the obtaining of large amounts of bibliometric data. We used the Scopus electronic database as the main data source for the bibliometric analysis for this study due to the large number of publications in our field of research, the large number of journals in the field of social sciences being much higher compared to WOS databases [42–44].

3.2. Data Collection

Following the query of the Scopus database, a number of 1743 documents were identified that satisfy the query keywords: TITLE-ABS-KEY (“supply chain management” AND “artificial intelligence”).

The period 2010–2024 was selected for analysis because, starting in 2010, significant events and processes related to the development of artificial intelligence took place, which led to a considerable increase in research in this field. For example, Watson, the IBM supercomputer designed to understand and answer questions formulated in natural language, was developed and perfected. The Computer Vision Group at Microsoft Research, Cambridge, launched Kinect for Xbox 360, the first gaming device to track the movement of the human body, using only a 3D camera and infrared detection. During the same period, remarkable progress was observed in the use of convolutional neural networks, especially in image recognition, and the concept of deep learning began to gain attention. More sophisticated robots were introduced, which demonstrated advanced navigation and manipulation skills, relying on advanced AI algorithms. Research and testing of autonomous vehicles has also advanced, involving numerous companies and academic institutions in the development and testing of the necessary technologies. All these innovations have had direct effects on supply chain management. Crises such as the COVID-19 pandemic have highlighted the need for more resilient supply chains. During this period, AI and advanced analytics have been critical criteria for quickly adapting to unforeseen disruptions and continuously optimizing operations.

3.3. Inclusion and Exclusion Criteria

In the data collection process, we applied the inclusion and exclusion criteria used to select relevant articles for analysis [45] (Table 2). The selected articles were journal articles, review articles, proceeding papers, and early access because they contribute to the foundation of the theory by providing a comprehensive, holistic view of the field and future research directions. Considering the volume of the research, book chapters and reports were excluded. In addition, we selected articles published between 2010 and 2024 in English-language academic journals with open access due to their accessibility at a global level, especially in the academic environment. Also, the exclusion criteria included subjects such as industrial engineering, production engineering, interdisciplinary applications of computer science, and civil engineering. This is because the present article aims to approach the research questions predominantly from an economic perspective rather than technically describing the component phenomena and processes.

Table 2. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Journal articles, conference papers, review articles, book chapters	Reports, proceeding papers, early access
Subjects: Business management and accounting, Economics, Econometrics and Finance	Subjects: Decision Science, Computer Science, Engineering, Mathematics, Energy, Material Science, etc.
Published from 2010 January to 2024 December	Outside the selected time
Written in English	Non-English papers

The search was conducted in February 2025 and led to $n = 1743$ results, to which a series of exclusion and inclusion criteria were applied. Subsequently, following successive refinements, the final number of documents analyzed was 400 documents.

3.4. Bibliometric Analysis

We used bibliometric analysis because it allows the mapping of scientific knowledge and the analysis of the existing relationships between academic disciplines, research fields, researchers, and published articles [46]. According to Dubey et al. [47] there has been a significant increase in the prevalence of bibliometric analysis within the domain of business research. This trend can be partially ascribed to the availability of bibliometric software tools, including VOSviewer 1.6.19, Bibliometrix 4.4.2, CiteSpace, Bibexcel, and Pajek, and the existence of databases (Web of Science, Scopus, PubMed, Eric, etc.), and on the other hand by the transdisciplinary approach of bibliometric analysis from information science to business research.

For bibliometric analysis, we used two bibliometric software programs: VOSviewer and Bibliometrix R (<https://www.bibliometrix.org/home/>, accessed on 18 January 2025). After data collection, the search results were imported into the Bibliometrics 4.4.2 R-package and VOSviewer 1.6.19. These softwares allow for comprehensive bibliometric analyses compared to other major software tools [48]. VOSviewer is a free software used for generating and visualizing bibliometric maps (author or journal maps based on co-citation data or keyword maps based on co-occurrence data), with special attention to the graphical representation of bibliometric maps [49]. The Bibliometrix R software package is an open-source tool used in quantitative research in scientometrics and bibliometrics. It is developed in the R language, an open-source environment, and statistical algorithms, access to high-quality numerical routines, and the provision of integrated data visualization tools are core features of the software.

Content analysis was used to identify future research directions in the field of supply chain management, which allows for research work in subdomains specific to the SCM digitalization process.

The results of the analysis were interpreted and visualized using various tables, graphs, and charts generated by the Bibliometrix 4.4.2 R-package and VOSviewer 1.6.19. These helped us identify trends and synthesize the information in an easy-to-understand way.

4. Result and Discussion

4.1. Result

4.1.1. Bibliometric Analysis: Overview of the Literature Landscape and Knowledge Structure of AI Application in Supply Chain Management

Below are presented bibliometric graphs and maps generated using the Bibliometrix.

4.1.2. R-Package

The data used in the bibliometric analysis are presented centrally in Table 3. Thus, the collected data cover the period 2010–2024, and 400 documents were found, identified in 138 different sources. The annual growth rate of publications is 13.85%, which indicates an increase in interest in the researched topic, the application of artificial intelligence in supply chain management. The analyzed documents were developed by 1143 different authors, and 44 of them contributed to single-authored docs. Of the collected documents, 47 are single-authored documents, and on average, each document has 3.3 co-authors. A total of 33.75% of the documents have international co-authorship, which shows an important collaboration at a global level in this field of research. If we refer to the type of documents, most of the documents are articles (267), followed by conference papers (104) and reviews (26).

Table 3. Main information about the extracted papers.

Description	Results	Description	Results
Main information		Author collaboration	
Timespan	2010:2024	Single-authored docs	47
Sources (journals, books, etc.)	184	Co-authors per doc	3.3
Documents	400	International co-authorships%	33.75
Annual growth rate%	13.85	Document types	
Document average age	4.77	Article	267
References	20,144	Book chapter	2
Document contents		Article conference paper	1
Keywords Plus	2298	Conference paper	104
Author's keywords	1264	Review	26
Authors			
Authors	1143		
Authors of single-authored docs	44		

Source: By the authors using Scopus.

The query of the Scopus database led to the identification of several of the 400 scientific documents in which the terms “supply chain management” AND “artificial intelligence” were found at least in their title, abstract, or keywords. The 400 documents analyzed refer to articles (66.75%), conference papers (26%), reviews (6.5%), and book chapters (0.5%). Regarding the temporal distribution of the selected works, the analyzed period is 2010–2024. From the analysis of the information, it is observed that until 2019, the topic of applying AI in supply chain management was not at the center of concerns, with values between 1 and 5 recorded annually, and starting with 2019, there has been an increase in the number of works dealing with this issue, which shows an increase in interest in the field of using AI in supply chain management (Figure 2). Therefore, following the results obtained from

Scopus, we can state that a considerable number of articles have been published in recent years, with a notable increase in the last three years. The annual growth rate was 13.85%, according to data obtained from Bibliometrix.

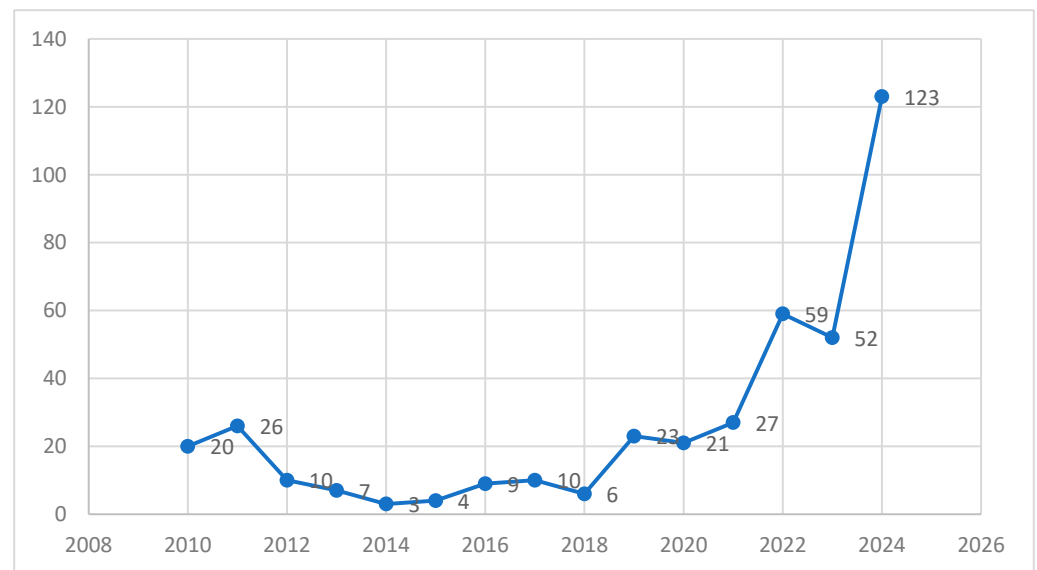


Figure 2. Distribution of publications over time. Source: By the authors using Scopus.

As illustrated in Figure 3, the highest number of citations can be observed in 2020, followed by 2021, 2023, and 2024. The increase in the number of citations in recent years shows that the application of AI in SCM as a research topic has been, in the context of recent years, increasingly important.

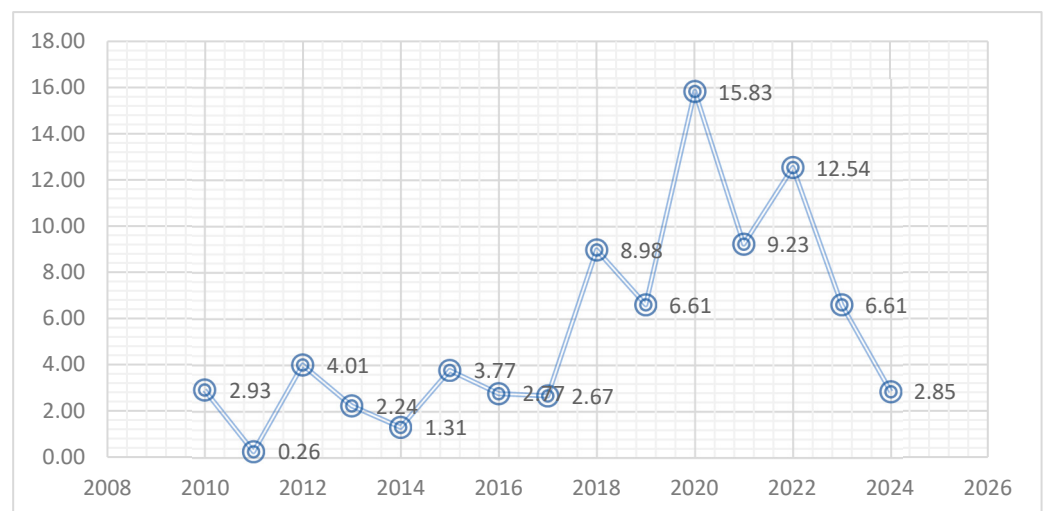


Figure 3. Annual citations of publications over time. Source: By the authors using Biblioshiny.

In the context of academic research, it is essential to know the top authors in a particular field. The works of these authors represent reference sources for the academic environment but also for the business environment and constitute valuable landmarks in the literature review stage. Figure 4 presents the top 10 authors with contributions in the researched field.

The top three countries with the highest number of published works are India, with 110 publications, followed by China, with 82 publications, and in third place is the U.K., with 80 publications (Table 4).

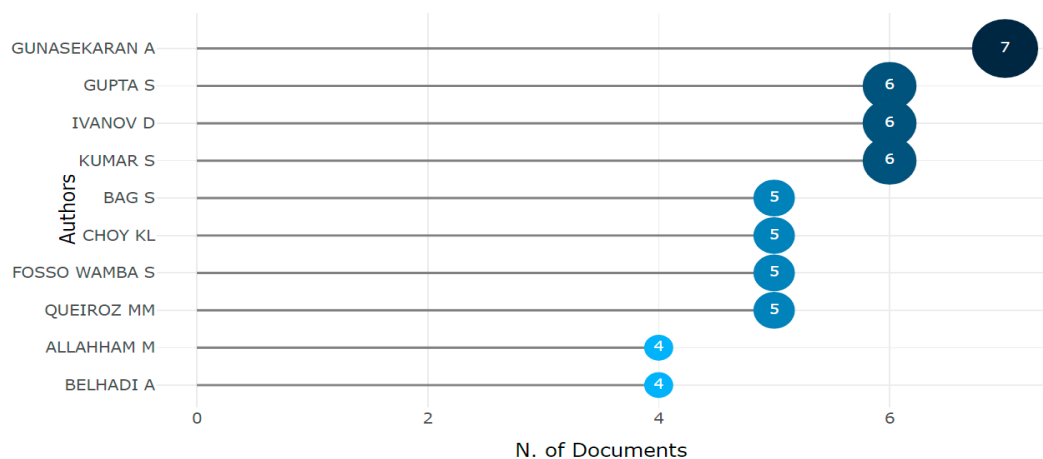


Figure 4. Most relevant authors. Source: By the authors using Biblioshiny.

Table 4. Scientific output per country.

Country	Frequency
China	131
India	121
U.K.	91
USA	72
France	52
Germany	50
Morocco	33
Jordan	25
United Arab Emirates	22
Italy	20
Brazil	17
Canada	17
Australia	14
Spain	14
Iran	12

Source: By the authors using Biblioshiny.

Most cited countries. Table 5 illustrates the citation situation for the top 10 countries, with information on the total number of citations and the average number of citations per country.

Table 5. Most cited countries' data.

Country	Number of Citations	Average Article Citations
USA	1703	60.8
United Kingdom	1605	61.7
France	1190	66.1
China	1043	19
Germany	701	41.2
India	610	15.6
Sweden	591	147.8
South Africa	505	84.2
Australia	395	79.0
Denmark	359	89.8

Source: By the authors using Biblioshiny.

The top of the most relevant sources provides an overview of the most relevant and active journals in the research field studied, ranked by the number of published articles (Table 6).

Table 6. Most relevant sources.

Country	Frequency
International Journal of Production Research	26
2011 International Conference on A.I.	22
International Journal of Production Economics	18
Decision Support System	11
Technological Forecasting and Social Change	11
Lecture Notes in Business Informations Processing	9
Logistics-Basel	9
Transportation Research: Part E	9
Production Planning & Control	8
International Journal of Information System and Supply Chain Management	7

Source: By the authors using Biblioshiny.

Figure 5 illustrates a treemap focused on the most relevant keyword combinations related to AI and its application in SCM. The treemap shows the 50 most frequently used keywords in articles, with “supply chain management” being the most frequently occurring word. This diagram facilitates the identification of pertinent articles using keywords and allows for the discernment of trends in the application of AI within supply chain management.



Figure 5. Treemap. Source: By the authors using Biblioshiny.

Table 7 illustrates the most frequently used keywords, specifically the first 10 keywords in the treemap. “Supply chain management” is the most frequently occurring keyword, with an appearance frequency of 270 times. This is followed by “artificial intelligence”, which appears 208 times, and “supply chains”, appearing 72 times.

Table 7. Data from treemap.

Terms	Frequency
Supply chain management	270
Artificial intelligence	208
Supply chains	72
Decision support systems	69
Decision making	61
Sustainable development	39
Electronic commerce	32
Competition	26
Optimization	25
Management science	24

Source: By the authors using Biblioshiny.

Quantitative analysis of citations

Table 8 provides information on the quantitative assessment of the scientific impact of each article, tracking the cumulative number of citations received from its publication until December 2024, presenting the top 10 articles with a major impact on the specialized literature. The first article, entitled “Supply chain risk management and artificial intelligence: state of the art and future research directions” [50], accumulated 569 citations; the paper has accumulated 81.29 citations annually since its publication.

Table 8. Top 10 most cited articles.

Authors	Paper	Total Citations January 2020–December 2024	TC per Year
Baryannis, G., Validi, S., Dani, S., Antoniou, G. (2018)	[50]	569	81.29
Govindan K, Mina H, Alavi B. A (2020)	[51]	492	82.00
Dubey, R., Gunasekaran, A., Childe, S.J., Bryde, D.J., Giannakis, M., Foropon, C.R., Roubaud, D., and Hazen, B.T. (2020)	[47]	486	81.00
Toorajipour, R. et al. (2021)	[29]	458	91.6
Tako, A. A. and Robinson, S. (2012)	[52]	339	24.21
Min, H. et al. (2019)	[28]	292	18.25
Kannan, D. (2018)	[53]	284	35.50
Bag, S. and Pretorius, J.H.C. (2022)	[54]	277	69.25
Attaran, M. (2020)	[55]	254	42.33
Cai, Y.J. and Lo, C.K.Y. (2020)	[56]	228	38.00

Source: By the authors using Biblioshiny.

Author collaboration network

The collaborations between the authors are divided into eight clusters, which indicates the existence of several research groups working together, and the size of the node indicates the degree of collaboration associated with an author (Figure 6). From the figure, the red, green, and blue clusters illustrate a closer collaboration between the authors. Authors with a high level of collaboration are included in red, blue, and green clusters.

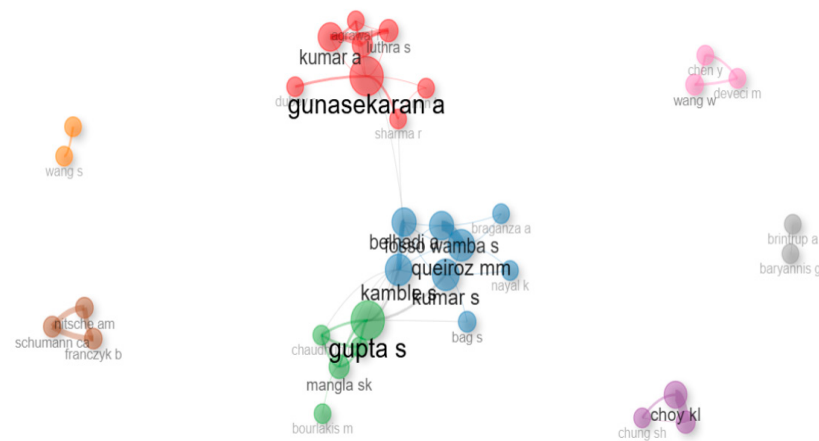


Figure 6. Collaboration network of authors. Source: The authors, using Biblioshiny.

Figure 7 provides a visual representation of the most used bigrams associated with the use of artificial intelligence in supply chain management. The word cloud highlights the implementation of AI-specific tools in supply chain management and emphasizes performance and sustainability goals at the supply chain level. It emphasizes the importance of terms such as “supply chain management”, “artificial intelligence”, “supply chains”, “decision support systems”, “sustainable development”, etc.

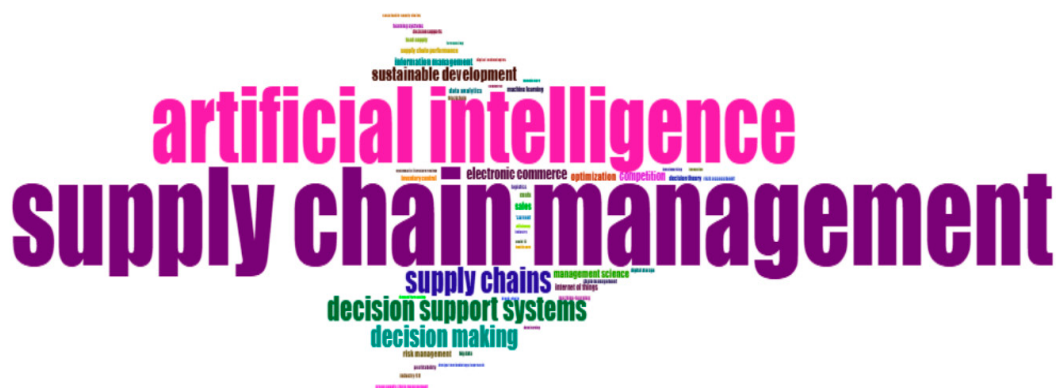


Figure 7. Word cloud by Keywords Plus. Source: By the author using Biblioshiny.

Thematic evolution. In carrying out the analysis of the thematic evolution, we chose two cutting points; thus, we obtained a map of the areas of interest for the three periods. In the first period, between 2010 and 2020 (the year of the onset of the COVID-19 pandemic), the interest was in optimizing logistics activities at the supply chain management level (Figure 8). In the second period, between 2021 and 2022 (the peak period of the COVID-19 pandemic), the interest is oriented toward innovation, sustainability, and the use of emerging technologies in logistics activities. Lately, between 2023 and 2024, we see a combination of emerging technologies with specific supply chain activities, with the aim of increasing both supply chain performance and resilience.

Thematic map. The thematic map is divided into four areas and contains four clusters positioned according to density and centrality. Each of these clusters is made up of several keywords (Figure 9). The type of algorithm used for grouping keywords influences the number and manner of grouping clusters on the four areas of the thematic map. In our case, we used the Walktrap algorithm. The results show that in the quadrant with “motor themes”, is included a cluster with topics specific to the research field, respectively, “supply chain management”, “artificial intelligence”, and “supply chains”. They focus on how AI-specific tools are used in supply chain management. The “basic themes” are the most

important for the research field but are still insufficiently developed, with only one cluster including “electronic commerce”, “decision support systems”, and “decision making”. In the quadrant with “niche themes”, there is a cluster that includes themes specific to Industry 4.0, namely “big data” and “internet of things”, and in the quadrant with (emerging or declining themes), there is a single cluster that includes themes specific to the digitization of activities in the field of supply chain management.

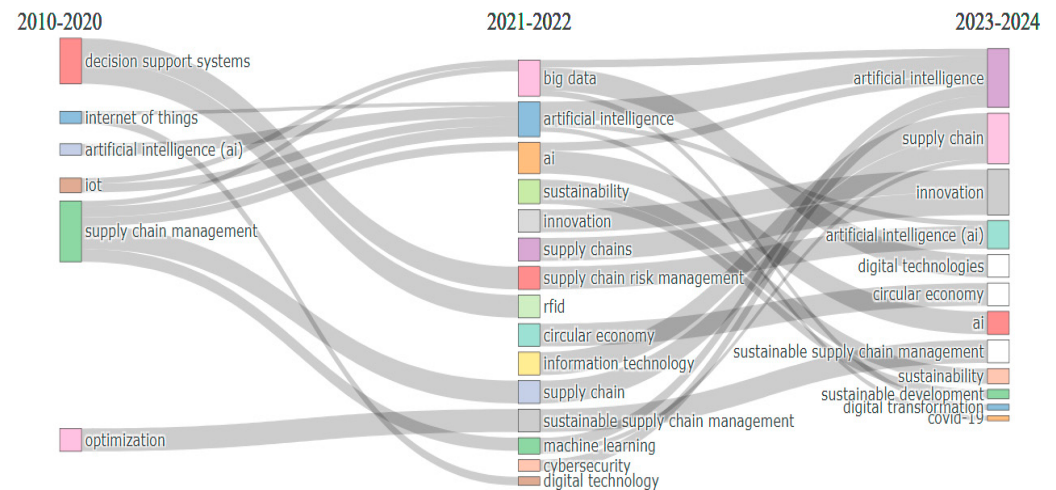


Figure 8. Thematic evolution during two periods of time. Source: By the authors using Biblioshiny.

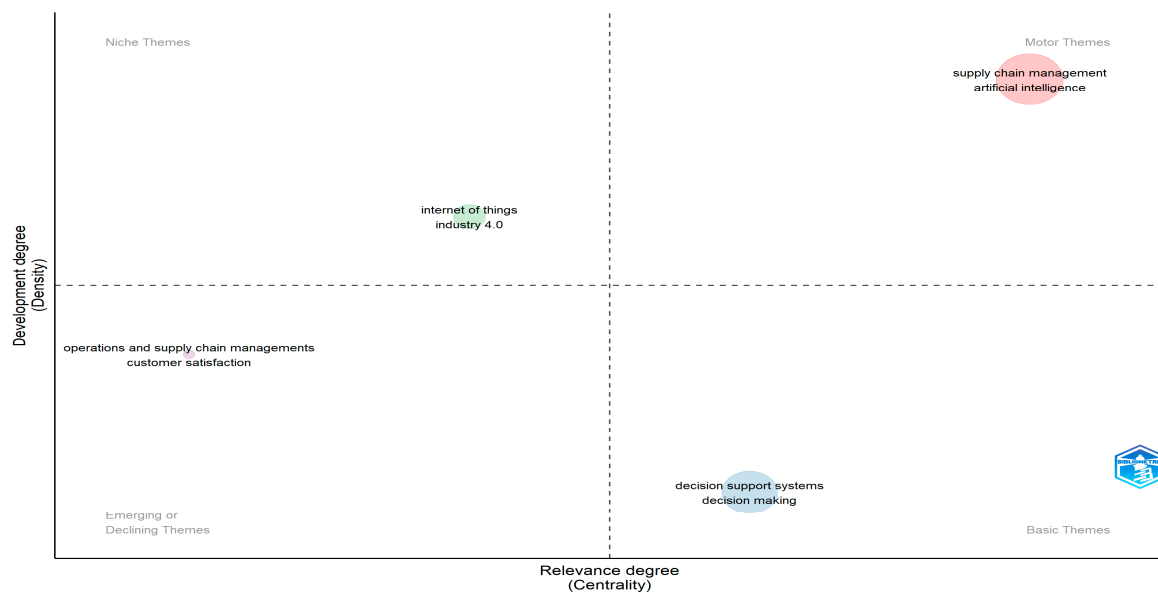


Figure 9. Thematic map. Source: By the authors using Biblioshiny.

Factor analysis is a statistical technique that aims to explain possible correlations between certain variables. In this article, we used multiple correspondence analysis, the bibliometric factor analysis method, with the aim of determining the proximity between keywords and the general topic.

The result of the multiple correspondence analysis can be seen in Figure 10, represented by a large red cluster containing keywords such as “strategy, technology, resilience, supply chain, artificial intelligence, sustainability”, which shows us a close connection between these keywords.

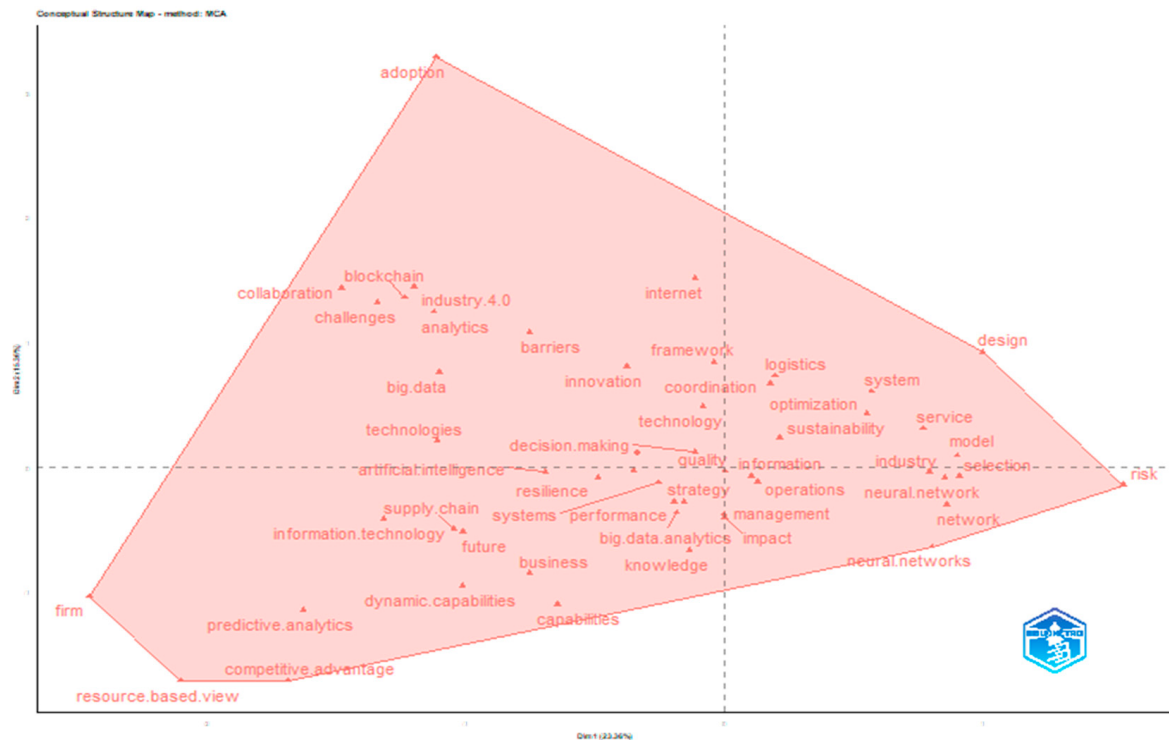


Figure 10. Multiple correspondences analysis. Source: By the authors using Biblioshiny.

4.1.3. Bibliometric Analysis: Keyword Co-Occurrence Performed Using VOSviewer

The *keyword co-occurrence analysis* facilitates the identification of principal research areas. As indicated by [56], the graphical depiction of keywords offers a comprehensive representation of a research domain, delivering insights into the covered topics and their interrelations. Utilizing VOSviewer software, a keyword co-occurrence analysis was conducted (Figure 11). The analysis was based on 400 articles sourced from the Scopus database.

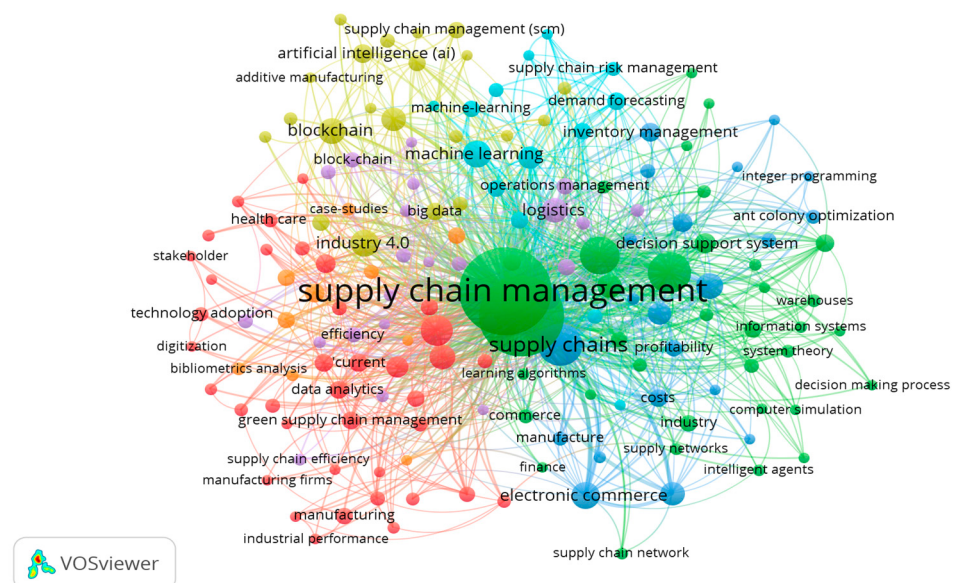


Figure 11. Keyword co-occurrence network map. Source: By the authors using VOSviewer.

Each of the seven clusters was identified using VOSviewer groups associated with keywords that appear most frequently in analyzed articles, providing a picture of the areas of interest relevant to our study.

Cluster 1 (red color): “Sustainable development & digital technologies”

Items: Contains a total of 38 items

Keywords: “sustainable development” shows the highest strength and occurrences, “green supply chain”, “digital technologies”, and “big data analytics”

Description: This group includes keywords related to sustainable development in the supply chain sphere, a process aimed at designing a green supply chain with the help of emerging technologies

Cluster 2 (green color): “Artificial intelligence & “integration”

Items: Contains a total of 36 items

Keywords: “artificial intelligence” the highest strength and occurrences, followed by “decision making”, “information management”, and “simulation”

Description: This group includes keywords related to the integration of artificial intelligence into supply chain management

Cluster 3 (blue color): “Supply chains & machine learning”

Items: Contains a total of 34 items

Keywords: “supply chains” shows the highest strength and occurrences, followed by “electronic commerce”, “competition”, and “optimizations”

Description: This group includes keywords related to innovation in the supply chain, including modern tools based on artificial intelligence

Cluster 4 (yellow color): “Industry 4.0 & blockchain”

Items: Contains a total of 32 items

Keywords: “industry 4.0” shows the highest strength and occurrences, followed by “blockchain”, “big data”, and “internet of things”

Description: This group includes keywords related to Industry 4.0, its specific technologies, and the effects of implementing these technologies on supply chain management

Cluster 5 (mauve color): “Logistics & technology”

Items: Contains a total of 26 items

Keywords: “blockchain” the highest strength and occurrences, followed by “logistics” and “competition”, “system”, and “simulation”

Description: This group includes keywords related to innovation in logistics based on emerging technologies

Cluster 6 (light blue color): Supply chain management”

Items: Contains 20 items

Keywords: “supply chains” the highest strength and occurrences, followed by “management” and “information management”

Description: This group includes keywords related to supply chain management, increasing resilience, reducing complexity, and securing supply chains

Cluster 7 (orange): “Digital transformation in supply chain”

Items: Contains 16 items

Keywords: “digital transformation” the highest strength and occurrences, followed by “systematic review”, “literature review” and “bibliometrics analysis”

Description: This group includes keywords related to digital transformation in logistics activities.

Presented in Table 9 are the top ten keywords with the highest frequency of occurrence in the analyzed articles, ranked according to the strength of the associations they establish with other keywords. Of the 2992 words analyzed, 164 keywords were retained for further analysis, each appearing no fewer than five times.

Table 9. The top 10 keywords in the research field.

Keyword	Occurrences	Total Link Strength
Supply chain management	319	1834
Artificial intelligence	267	1577
Supply chains	74	591
Decision support systems	68	492
Decision making	60	449
Sustainable development	38	290
Competition	26	234
Electronic commerce	30	221
Information management	24	212
Optimization	27	190

Source: By the authors using VOSviewer.

4.1.4. Thematic Analysis

Following an evaluation of the most frequently referenced articles within our domain of interest, specifically the application of artificial intelligence in supply chain management, we identified three topics of interest: (a) supply chain risk management and AI; (b) increasing the performance of the supply chain through digitalization; and (c) the link between Industry 4.0, supply chain management, and sustainability (Table 10).

Table 10. The top articles with highest citations.

Authors	Analysis Method/Tool	Paper
Baryannis, G. et al. (2018)	A literature review	[50]
Govindan K, et al. (2020)	Fuzzy inference system	[51]
Dubey, R. et al. (2020)	Cross-sectional data	[47]
Toorajipour, R. et al. (2021)	A systematic literature review	[29]
Tako, A. A. and Robinson, S. (2012)	A literature review	[52]
Min, H. et al. (2019)	A literature review	[28]
Kannan, D. (2018)	Fuzzy Delphi method	[53]
Bag, S. and Pretorius, J.H.C. (2022)	Qualitative research	[54]
Attaran, M. (2020)	A literature review	[55]
Cai, Y.J. and Lo, C.K.Y. (2020)	A systematic literature review	[56]

4.2. Discussions

4.2.1. Analysis of Trends and Important Contributions in the Research Field (Application of AI in Supply Chain Management)

Trend analysis: The evolution of the number of articles published from 2010 to 2024, along with the citation frequency, is illustrated in Figures 2 and 3. The surge in publications post-2018 can be ascribed to several factors, including the adoption and advancement of

emergent technologies, particularly artificial intelligence; the recognition of the increasing importance of artificial intelligence within international business domains; a focus on exploring the implications of new technologies on the business environment; and the tripartite collaboration among academic institutions, industry, and government bodies. In this framework, based on an office research study, we have identified the initiation of both national and international governmental policies that promote collaboration in the field of artificial intelligence, an imperative further intensified by the effects of the COVID-19 pandemic crisis. A factor that supports the explanation of the explosive growth of articles after 2018 is the launch of national strategies starting in 2017 regarding the implementation of artificial intelligence. Canada is among the pioneers in this field, with the Canadian government being the first to launch the “Pan-Canadian Artificial Intelligence Strategy” in 2017, aimed at collaborating between universities, industry, and authorities to promote the responsible use of AI technologies. The strategy was developed based on four objectives with a common denominator, namely research activity: (1) increasing the number of researchers and graduates specialized in the field of artificial intelligence, (2) establishing three clusters of scientific excellence, (3) developing a thought leader on the economic, ethical, political and legal implications of artificial intelligence, and (4) supporting the national AI research community [57]. Another example is the United States National Strategy for Artificial Intelligence, published in February 2020 by the Trump administration, which aimed to support research and development in this field, with a special focus on supply chain management [57]. In April 2018, the EU Commission adopted the Communication on Artificial Intelligence, a 20-page document outlining the EU’s approach to AI, a strategy that was finalized three years later (April 2021) [58]. In Asia, the Indian government has adopted a unique approach to the national AI strategy, focusing on both economic growth and social inclusion (June 2018) [59]. It was written based on a report prepared by NITI Aayog, the government think tank, which contains over 30 policy recommendations to invest in scientific research, encourage reskilling and training, and accelerate the adoption of AI across the value chain. This integrated two-tier strategy has resulted in the generation of scientific articles, increasing R&D activity in the country, as shown by our bibliometric analysis. According to the table below, India is the country with the largest number of papers published during the analyzed period in the researched field.

In 2017, China developed A Next Generation Artificial Intelligence Development Plan, among the most comprehensive national strategies in AI development and implementation, encompassing initiatives and objectives for research and development, industrialization, talent cultivation, education and skill enhancement, standardization and regulation, ethical standards, and security [60].

The increase in the number of citations after 2020 shows the increasing importance of the research topic, the application of AI in SCM, in the context of digital transformation, a process triggered in the last three years and favored by the unprecedented development of new technologies.

Top authors: A total of 864 authors were identified who published in the field of AI application in supply chain management, and 400 analyzed documents from 184 sources were identified. Thus, following the analysis performed, we can answer the research questions. The most important authors are Gupta S. (6 articles), Gunasekaran A. (5 articles), and Kumar S. (5 articles) (Figure 4).

Top countries: The number of citations at the country level is a benchmark indicator of the scientific quality of published papers (Table 5). The USA ranks first in terms of total citations (1703 total citations and an average citation score of 60.80), followed by the U.K. (1605 total citations and an average citation score of 61.7) and France (1190 total citations and an average citation score of 66.10).

Top journals: Reference journals in the field studied are presented in Table 6. These journals represent references for researchers in the documentation phase in identifying valuable sources necessary for the theoretical substantiation of future research works.

4.2.2. Analysis of Important/Relevant Keywords for Our Research Topic

The first research question (RQ1) was approached from the perspective of keyword analysis and keyword co-occurrence analysis. These keywords are useful for researchers in identifying relevant works in the field, which can be used for conducting research papers and identifying gaps in the specialized literature. The most important keyword is “supply chain management”, with 319 occurrences, followed by “artificial intelligence”, with 267 occurrences, and “supply chains”, with 74 occurrences (Table 9). Based on the keyword co-occurrence map (Figure 11), the words “supply chain management” and “artificial intelligence” have the strongest connection and the maximum number of co-occurrences.

4.2.3. Current Topics

To address the second research question (RQ2), a review of the most cited research papers was conducted. An analysis of the current literature would help researchers identify research gaps, which they can focus on to improve the current literature. The current topics in the literature refer to the implications of implementing AI in specific supply chain activities from the point of view of supply chain optimization, resilience, and supply chain sustainability.

4.2.4. Future Research Sub-Areas

In addressing the third research question (RQ3), we conducted a review of the most highly cited articles. Based on this assessment, we identified the following sub-areas of interest for future research.

- (a) Application of artificial intelligence in supply chain risk management: AI-powered applications are revolutionizing supply chain risk management, offering unprecedented levels of visibility, optimization, and predictive capabilities. Specifically, supply chain managers can obtain a real-time view of risks across the supply network and make more informed decisions about how to manage these events. Research works in this sub-domain would be useful for stakeholders in the supply chain;
- (b) The role of emerging technologies (AI, big data, IoT, blockchain) in the development of sustainable and resilient supply chains. The supply chain digitalization process is a major concern for companies. Moving companies toward the digitalization of supply chains involves starting a process of reconfiguring the supply chain, resulting in sustainable and resilient supply chains. This topic can be of interest to both the business and the business environment;
- (c) The role of Industry 4.0 in redefining supply chains. Currently, we are witnessing a paradigm shift in the activity of companies in the logistics field under the impact of Industry 4.0. The digitization process of supply chain management allows companies to manage specific supply chain activities more easily, and I4.0 technologies improve visibility, transparency, and traceability throughout the supply chain. Research studies in this field are useful to managers in establishing SCM digitalization strategies.

4.2.5. Modern Methods for Conducting Literature Reviews in the Future

Given the current context, new methods and tools can be used to develop the research field. We will use modern tools based on artificial intelligence that can help researchers identify new research subdomains relevant to the chosen research topic. In this sense, we will use Open Knowledge Maps. Figure 12 presents the results obtained using this tool for a

search on “artificial intelligence in supply chain management”. The search results show the 100 most relevant documents for the field of AI application in supply chain management, and inside each circle, there are links to the selected articles and works that can be accessed with a simple click. Thanks to this modern tool, relevant articles for a specific research topic are accessible, which facilitates the literature review activity.

There are other AI-based tools, such as Litmaps, which is a useful tool for researchers in the literature review development stage, ResearchRabbit, etc. AI-based tools provide support to researchers in the literature review documentation and development phase or in identifying top journals in a certain area.



Figure 12. Knowledge Map for research on artificial intelligence in supply chain management. Source: Generated by the authors at <https://openknowledgemaps.org/> (accessed on 15 December 2024).

5. Managerial Recommendations

Our paper provides logistics professionals with the theoretical support necessary to implement artificial intelligence in supply chain management.

5.1. Advantages of Implementing AI in SCM

Artificial intelligence is being explored and applied in various fields and industries, including supply chain management. AI applied in supply chain management supports decision-making and allows the optimization of logistics solutions, as well as supply chain resilience [61]. Supply chain sustainability is ensured with the help of technologies integrated with AI, involving robotics [62], blockchain technology [63], Internet of Things [64], and big data analysis [49].

Even though the concept and technology underlying the development of artificial intelligence were not discovered recently, the potential of artificial intelligence, the method of searching for information and solving complex problems in the field of supply chain efficiency, has not been fully leveraged in previous studies. Nonetheless, certain disciplines, such as expert systems and genetic algorithms (GAs), have been increasingly employed

to address challenges in supply chain management, thereby enhancing efficiency and predictability and fostering collaborative efforts.

The implementation of AI-based applications helps companies configure efficient supply chains, which allows for better inventory management, reduced delivery time, and increased consumer satisfaction. Optimizing specific supply chain activities has the effect of reducing operational risks but also better adaptation to market conditions [65].

Artificial intelligence provides companies with useful tools for carrying out specific supply chain operations, such as product quality control, optimization of transport routes, demand forecasting, automation of warehousing activities, inventory management, and supplier relationship management (Figure 13).

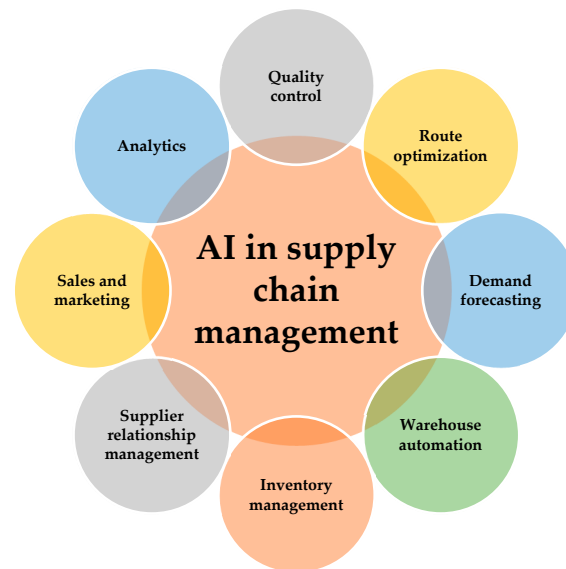


Figure 13. Artificial intelligence in supply chain.

Product quality control. AI can scan the products and thus identify any defects or situations in which the products do not meet quality standards. At the same time, thanks to artificial intelligence, information can be obtained on the appropriate type of packaging, as well as information related to the storage conditions of the goods so that they reach the final consumer in the best possible conditions. For example, in the automotive industry, parts verification systems based on artificial intelligence are used. They identify defects in real time.

Optimization of transportation routes. The optimization of transport routes with an effect on the competitiveness of the logistics solution (in terms of costs, transit time, and risks) can be achieved using machine learning algorithms. At the same time, the optimization of transport routes has an effect on the reduction in transport emissions [66]. Routing and planning algorithms are used to minimize transportation costs and reduce delivery time, as well as other related problems such as road network design, parking space utilization, traffic allocation and ramp metering in highway networks, vehicle routing, as well as the problem of determining the minimum spanning tree [67]. For example, Stanford University has implemented the “Backtracking Route Planning Algorithm and BFS Optimization” that combines search and optimization techniques to ascertain the most optimal delivery routes while taking into consideration factors such as cost, transit time, and logistical constraints. The specificity of this algorithm is that it collects and uses real-time data about traffic and transportation conditions [68].

Demand forecasting. Artificial intelligence improves the accuracy of demand forecasting based on historical data and external factors, allowing companies to anticipate market

trends, fluctuations, and customer preferences with great precision. The databases analyzed are vast, including records of previous sales, market trends, meteorological patterns, social media sentiment analysis, and the activities of competitors [69]. Artificial intelligence can analyze historical data pertaining to consumer behavior and market trends, such as seasonal variations, political influences, and current events, thereby assisting manufacturers in forecasting demand. This enables them to strategically plan their production and storage capacities in advance. For example, the Massachusetts Institute of Technology (MIT) has developed an algorithm that analyzes historical sales and external data using economic factors and seasonal events to predict future demand with greater accuracy. In addition, MIT frequently collaborates with the business community through various initiatives, such as the Center for Transportation & Logistics, which creates partnerships to test and capitalize on research [70].

Warehouse automation. More and more companies are using AI to manage inventory in warehouses. Thanks to AI combined with IoT, companies are able to monitor inventory in real time, avoiding stockouts and optimizing the costs of storing goods. [71] For example, Amazon is optimizing warehouse operations using AI-guided Kiva Systems robots, thereby enhancing the efficiency of the picking and packing processes.

Inventory management can be revolutionized thanks to deep learning algorithms. With the help of deep learning, companies can make forecasts on inventory levels, which allows them to optimize them, avoiding stockouts or excess stocks [69]. AI can help with inventory management by digitizing documentation and providing information on merchandise storage options to maintain product quality.

Supplier relationship management. AI facilitates maintaining good communication with suppliers and other business partners. Information and documents are stored and disseminated via a centralized platform, accompanied by automated notifications upon any alterations [72].

5.2. Obstacles and Risks of AI Deployment in SCM

In addition to the benefits of implementing AI in supply chain management, there are several risks and challenges related to the use of this technology in logistics activities. Several previous research studies have analyzed not only the business benefits of AI but also the barriers to AI adoption [73]. The lack of a clear strategy on how to use AI within the company will lead to a flawed implementation because the implementation of AI across an entire organization presents significant challenges when existing processes and systems are not supported by a robust technological infrastructure and a comprehensive set of collected data. Additionally, common obstacles to the current adoption of AI include the high cost associated with advanced AI technologies and the substantial expense required to secure skilled expertise in the field of artificial intelligence [74].

Although AI has immense potential for optimizing supply chain operations, there are a number of obstacles to its implementation in the logistics field: (1) the risks related to dependence on new technologies raise questions about the precautions that must be taken when an industry becomes dependent on new technologies; (2) significant investments in staff training: implementing AI in supply chain management requires employee training, which involves operational disruptions, which can be costly; (3) the costs associated with implementing AI extend far beyond the initial purchase of hardware and software: pre-built AI models can be adapted for various supply chain applications, obtaining optimal results often requires training these models on company-specific data, a process that requires significant effort; (4) challenges in system integration: AI systems in the supply chain are complex and include numerous interconnected components, such as IoT devices and sensors for real-time data collection, high-performance servers for training models,

resources for running models in production, and applications that act on the information generated by AI; (5) ongoing monitoring and maintenance: once implemented, AI systems require constant supervision, and the dynamic nature of supply chains means that AI models may require frequent changes to maintain their effectiveness; (6) data quality: the effectiveness of AI models depends largely on the quality of the data they are trained on, and at the global supply chain management level, ensuring consistent, high-quality data across all areas can be a challenge; (7) balancing automation and human oversight: although AI can significantly improve efficiency in supply chain management, human judgment remains vital in managing exceptions and making strategic decisions.

5.3. Critical Success Factor of AI Adoption in SCM

The integration of AI into supply chain management heralds a revolution in operational efficiency, forecast accuracy, and overall agility. The challenges and considerations of implementing AI in the supply chain are manifold, ranging from technical to organizational and ethical to strategic [75].

Change Management. The adoption of AI in supply chain management requires significant changes across organizations. Employees may fear losing their jobs due to automation or feel overwhelmed by the need to acquire new skills. Therefore, effective change management is crucial to foster a culture of innovation and ensure a smooth transition. This involves appropriate communication strategies, education, and training for all stakeholders.

Substantial investment in training. Integrating AI into existing supply chain processes requires proper employee training. This involves not only teaching technical skills but also overcoming potential resistance to change. The formation process often requires operational interruptions, which can be costly. To mitigate these costs, organizations should work closely with AI vendors and integrators to develop efficient and cost-effective programs.

High initial and ongoing costs. The expenses associated with implementing AI extend far beyond the initial purchase of hardware and software. While pre-built AI models can be adapted for various applications in the supply chain, achieving optimal results often requires training these models on company-specific data. This process of collecting, cleaning, and preparing data is resource-intensive and requires significant effort.

Data quality and integration. AI systems are based on comprehensive, high-quality datasets. In many supply chains, data are siloed, inconsistent, or of poor quality, making it difficult for AI algorithms to generate accurate insights. Additionally, integrating disparate data sources along the supply chain requires significant investment in data infrastructure and governance frameworks to ensure that data are accurate, timely, and accessible.

Operational complexity. Managing AI systems in a global network is an ongoing challenge. While the operational phase may put less pressure on systems than the training phase, it still requires a robust infrastructure, even if it is cloud-based. The good news is that cloud technologies are making AI even more accessible—of course, with the associated risks.

Challenges in system integration. AI systems in the supply chain are complex, comprising numerous interconnected components. These include IoT devices and sensors for real-time data collection, high-performance servers for training models, resources for running models in production, and applications that act on AI-generated information. Integrating these diverse elements into a global network is a complex task that requires careful planning and execution.

Continuous monitoring and maintenance. Once implemented, AI systems require constant supervision. This includes monitoring system performance, fine-tuning models,

and quickly resolving any issues that arise. The dynamic nature of supply chains means that AI models may require frequent changes to maintain effectiveness.

6. Conclusions

Starting from the proposed research objective of understanding the current state of academic research in the field of applying artificial intelligence in supply chain management, we have used bibliometric analysis as the main research mechanism, as it provides a systematic framework for evaluating scientific papers, identifying research trends, and structuring research collaborations in the field.

The research carried out is an important step that improves our understanding by providing an overview of how the implementation of AI-based applications helps companies build efficient supply chains. Such an understanding is essential for companies and other decision makers, researchers, regulators, and other government entities, third-party stakeholders from related industries involved in the development of artificial intelligence who together achieve the design and implementation of robust and efficient logistics chains contributing to the achievement of a sustainable economic system.

We believe that the formulation of the managerial recommendations in Section 5.2 will provide fundamental theoretical support that will constitute the support base for companies in developing strategies to streamline supply chains through the implementation of artificial intelligence. The paper provides managers with the theoretical framework necessary to gain an overview of the use of AI SCM. Companies are increasingly interested in building resilient and sustainable supply chains, and artificial intelligence can help achieve this goal by also ensuring operational optimization across the supply chain.

Research has also shown that global supply chains are a growth engine for the global economy, ensuring the delivery of goods and a diverse range of logistics options. Recently, more precisely since 2020, these global networks have been subjected to various shocks, from the COVID-19 pandemic to the war in Ukraine and tensions in the China Sea. Under these conditions, we are currently witnessing a high level of uncertainty, so securing the supply chain is a difficult goal. In this context, for companies, the study demonstrates the importance of implementing AI in supply chain management to face the challenges existing in the global business environment.

The implications of the analysis carried out are also reflected in the entities involved in carrying out the research activity on the approached theme. The increase in the number of research projects observed lately, mainly in the Asian area, demonstrates the intense concerns and the volume of research that can attract the attention of researchers to achieve possible research cooperation.

The limitations of our research relate to the fact that the bibliometric analysis was based on documents identified only in the Scopus database, and it is possible that papers were missing during the data collection stage due to the keywords used. Although Scopus is widely used for bibliometric studies and covers numerous relevant sources, other databases such as Web of Science (WoS) and Google Scholar could include publications that were not captured in this paper to provide a complex picture of the research picture related to the use of artificial intelligence in sustainable supply chains.

Also, an exclusion criterion was non-English papers, which limited the research only to works written in English, eliminating other works written in another language that could have valuable content for the topic under analysis.

Future research. Artificial intelligence is a relatively new technology with a high potential to increase its use in various fields of activity, especially in streamlining supply chain management. Based on the trends of the analyzed works, the current geopolitical context, and the novelty and importance of the subject but especially on its disruptive

potential, we believe that future research should pursue research directions that will come to the aid of stakeholders (governments, corporations, citizens, etc.) by providing comprehensive analysis and studies. Future research should consider the orientation of corporations toward the digitalization of the supply chain, the influence of emerging technologies on SCM, the status and implications of regulating the use of AI in SCM, and aspects related to ethics and sustainability.

Regarding the orientation of companies toward the digitization of supply chains, we believe that this represents a major topic of interest for both the business and non-business environment because digitalization is the central point of Industry 4.0. The research environment should pay particular attention to the importance of using AI in transforming the supply chain into a sustainable one, considering the three components: cost efficiency, responsibility to the environment, and responsibility to citizens and employees.

Within the analyzed works, an insufficient approach was observed regarding the way in which the use of emerging technologies (AI, blockchain, IoT, large databases) can be leveraged in the reconfiguration of supply chains in the context of a volatile global business environment. There is a need to investigate how these technologies can be used together with artificial intelligence to ensure an efficient and sustainable supply chain.

Another possible research direction in the future is to carry out detailed analyses related to the regulation of the use of AI in SCM. Although in its early stages, it represents a constant concern of the designated bodies, with major implications for both corporations and consumers, considering the degree of novelty and the possible subsequent implications generated by the use.

Also, within the analyzed works, an insufficient approach was observed regarding the way in which the use of emerging technologies (AI, blockchain, IoT, large databases) to be capitalized in the reconfiguration of supply chains in the context of a volatile global business environment. There is a need to research how they can be harnessed together with artificial intelligence to ensure an efficient and sustainable supply chain.

In addition, future work could discuss the practical implications of its findings for supply chain managers, such as strategies for integrating AI into existing SCM processes or the challenges of balancing AI-based automation.

We believe that the aspects presented in this paper represent a valuable source of information for all entities involved in streamlining the supply chain through artificial intelligence and a contribution to the research act. In terms of our academic contribution, the article provides a better understanding of how artificial intelligence can be applied in supply chain management. This is useful both to researchers, by presenting the results of research in the field between 2010 and 2024, and to professionals, providing them with the theoretical framework regarding the advantages of implementing AI in SCM, but also the risks and managerial implications associated with the implementation of this emerging technology in supply chain management.

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