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Digital Supply Chain Management:
A Review and Bibliometric Analysis

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ABSTRACT

Digital transformation in supply chain management has garnered significant attention from both industry and academia. Numerous studies have focused on the emerging concept of digital supply chain management (DSCM). In this research, the authors present a background and context of DSCM. Furthermore, they conduct a systematic bibliometric analysis encompassing a dataset of 1053 scholarly papers published from 1995 to 2021. During the literature review, various methods including network analysis, document co-citation analysis, author co-citation analysis, and journal co-citation analysis are employed. The results of the study provide an overview of the concept of DSCM and highlight key authors, affiliations, and countries in the field. Additionally, the study examines emerging research topics, including blockchain technology, digital twin, and circular economy, within the context of DSCM. Finally, limitations and potential direction for future studies are noted. The authors hope this research could provide a basic understanding of DSCM for industries and academics.

KEYWORDS

CiteSpace, Digital Supply Chain Management, Network Analysis, Systematic Review

INTRODUCTION

Market competition has gradually shifted from enterprises to their supply chains in the context of globalization (Christopher, 2000). Hence, supply chain management (SCM) can play a significant role in determining a company's competitive advantage, to a certain extent. With the development of a new generation of information technologies such as Radio Frequency Identification (RFID), the Internet of Things (IoT), cloud computing, blockchain, 3D-printing, and so on, traditional supply chain efforts would not be enough to meet the industry requirements of today (Wu et al., 2006). Thus,

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the utilization of information technologies into SCM has gained significant attention over last two decades (Subramani, 2004). In addition, the concept of Digital Supply Chain Management (DSCM) has been proposed in both industry and academic SCM research areas (Agrawal & Narain, 2018; Butner, 2010; Büyüközkan & Göçer, 2018; Garay-Rondero et al., 2019; Liu et al., 2023).

There has been a notable increase in the number of studies pertaining to DSCM in recent years. Some of this literature has conducted various overviews for the development process of SCM to DSCM (Agrawal & Narain, 2018; Iddris, 2018). Furthermore, others have concentrated on certain niche areas such as digital supply chain dynamic capabilities, which illustrates the changes of capability in digital transformation context (Queiroz et al., 2019), firm performance evaluation under the influence of digital transformation (Aimulhim, 2021), data-driven innovation in DSCM (Nica, 2019), security and trust problem in DSCM (Zhang et al., 2019), digital supply chain finance (Banerjee, 2021), and DSCM resilience and agility during the COVID-19 period (Ivano, 2021). It should be emphasized that the global supply chain suffered a serious breakdown at the beginning of the pandemic, identifying the importance of supply chain resilience. Experts in both the academic and industrial arenas are seeking ways to improve the stability of the supply chain through digital solutions (Wang, Xue, et al., 2023). The studies have illustrated deep insight into the relevance of the supply chain field. However, there is a lack of comprehensive analysis by using bibliometric tools which could provide a deeper understanding of DSCM. Bibliometric analysis refers to using mathematical and statistical methods to quantitatively identify and analyze an emerging research area (Martinez-Lopez et al., 2018). It is a comprehensive knowledge system which integrates mathematics, statistics, and quantification. It could identify researcher, affiliation, and keywords statistics. In addition, it can also conduct network analysis such as citation, co-citation, and cluster analysis, which help to explore significant research areas and major specialties with DSCM (Chen, 2017).

The rest of this paper is organized as follows. The second section illustrates the concept of DSCM and reviews related literature. The third section introduces the methodology used in this research, defines search terms, and refines literature scope. The fourth section makes a general analysis of author, affiliation, and keyword. A deep observation is conducted by CiteSpace and Hiscite tools to analyze citation, PageRank, and co-citation statistics. The fifth section explains analysis results, investigates research limitations, and proposes some directions for future studies.

Digital Supply Chain Management Background

Digital technologies have influenced various aspects of human life and has affected numerous industries. SCM is a crucial segment for these industries, and it can be defined as the integration of key business processes from end user through suppliers who provide goods, services, and information that adds value for customers (Janvier-James, 2012). The whole process of SCM would be influenced by digital technologies such as procurement, operation management, delivery, and service, which also indicates that digital technologies would have a significant impact on SCM such as efficiency, effectiveness, and vigor (Li, 2012). In addition, traditional supply chain operations lack certain attributes required for the business needs of today, as well as of the future. The digital transformation of the supply chain is aimed at breaking down these barriers and thus turning the supply chain into a seamlessly integrated system for optimal operation (Li et al., 2023). The concept of DSCM has gained much attention from the industry and academia with the bloom of digital technologies, especially after putting forward the notion of Industry 4.0 and Made in China 2025 (Lasi et al., 2014; Li, 2018).

DSCM remains a relatively novel concept, and there are some terms synonymous with DSCM such as smart supply chain management (Wu et al., 2016), intelligent supply chain management (Yan et al., 2014), and supply chain 4.0 (Alicke, 2017). Butner (2010) illustrates that supply chain must be a lot smarter to meet business requirements by introducing new technology. In terms of DSCM, six distinctive characteristics are identified by Wu et al. (2016) which are instrumented, interconnected, intelligent, automated, integrated, and innovative. This research provides a comprehensive introduction of DSCM. Agrawal and Narain (2018) state in their study that DSCM relies on innovative technologies

to transform the conventional processes of SCM, thereby facilitating process optimization. Investing in digital technology and having managers with a digital background are both crucial for digital transformation in supply chain management (Li et al., 2023). According to Ageron et al. (2020), DSCM is composed of those information systems and innovative technologies which could improve the integration and agility of the supply chain thereby making the services and performance more powerful. It can be concluded that there is no consensus on the definition of DSCM. However, all research studies acknowledge its common concepts and agree on its basic components. The definition of DSCM, which can be summarized, involves managing and optimizing supply chain products and processes through the use of digital technologies. Additionally, it pertains to meeting customer needs and providing quick responses in a turbulent global business environment.

Recent studies highlight the significance of DSCM as proposed by scholars and practitioners (Barykin et al., 2021; Garay-Rondero et al., 2019; Khan et al., 2021; Nasiri et al., 2020; Shao et al., 2021). The focus on DSCM indicates the growing attention on this area (Wang, Peng, et al., 2023). However, present research on DSCM is not systematic. Thus, this paper employs a systematic review method to analyze the studies on DSCM. Ultimately, it could offer a comprehensive overview of DSCM, aiding others in quickly grasping the field. In addition, network analysis could help identify authoritative studies, current research focuses, and future promising directions of study, all of which are highly significant for both academia and within the industry.

METHODOLOGY AND DATA SOURCE

Performing a literary review is important in understanding a specific field of research. It can provide a general understanding of a field including what is known and what is unknown, what the current research status is, the level of research difficulty, and the parameters of the research gap. There are many tools that can be used in presenting a literature review; however, it is difficult to determine which studies are valuable from within the enormous database of existing research. Instead of just summarizing a reference list, in this case, information visualization shows a useful role in the process. CiteSpace is a visualization software developed by Chaomei Chen (2006) and based on the JAVA programming language. It could help users identify valuable research, explore potential evolution patterns, and detect the frontier of the development of the discipline by analyzing and visualizing citation and co-citation networks.

Research Methodology

We intend to conduct a systematic review through five steps. First, we choose a suitable database. The *Web of Science* (*WoS*) is one of the largest databases of peer-reviewed literature which covers more than 8,000 peer-reviewed journals (Mongeon & Paul-Hus, 2016). In addition, it is a high-quality database for quantitative research (Falagas et al., 2008). Thus, we chose it as the research database for this study. Second, we defined a set of suitable keywords. Appropriate keywords are extremely crucial for systematic review. This element of study is expanded upon in the third section, which illustrates how to define the search terms. Thirdly, a confirmation of publication scope was established. "Journal articles" was chosen as the research scope. Forth, data processing and analysis was determined. In this step, author co-authorship network, co-authors' institutions network, keywords statistics, author co-citation, journal co-citation, and document co-citation analysis were conducted using CiteSpace software to visualize these results. Fifth, a comprehensive analysis was developed to explain the current status of DSCM and future research directions.

Defining the Search Terms

Research on "Digital Supply Chain Management" is still in its infancy. There are many different terms used when discussing DSCM, for instance, it is also referred to as "Intelligent Supply Chain Management," "Smart Supply Chain Management," and "Supply Chain 4.0." Keywords

such as "Supply Chain Management," "Digital," "Smart," "Intelligent," and "4.0" are used for researching literature on this topic. Thus, four combinations for these keywords are summarized: "Digital AND Supply Chain Management," "Intelligent AND Supply Chain Management," "Smart AND Supply Chain Management," and "Supply Chain Management 4.0." These keywords cover the concept of DSCM.

Search Results

Using the "Topic" (title, abstract, author, and keywords) search in the *Web of Science Core Collection* database, which covers the world's leading academic journals since 1900, 2,899 articles were collected. Then, book series and conference papers were excluded, as were articles with unknown authors. Furthermore, the language was selected as "English." Finally, 1,503 articles were kept after filtering and cleaning the dataset, which included almost all journal articles related to DSCM, and it also contained the titles, authors, counties, affiliations, keywords, abstracts, and cited reference information.

Analysis Results

Analyses are developed from two aspects. One is the social structure of the DSCM field, which includes the quantity of published papers by year, co-authorship network analysis, co-authors' institutions network statistics, and co-occurring keywords. The second is the intellectual structure of DSCM, which includes an analysis of the author co-citation network, journal co-citation network, and document co-citation network.

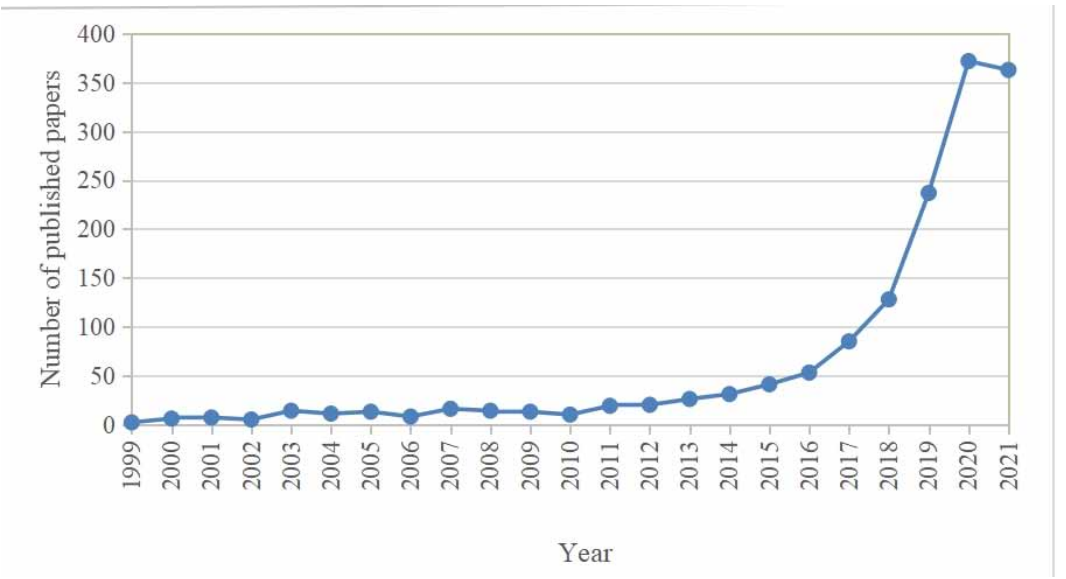
Initial Statistics

The quantity of published paper trends by year, co-authorship network, co-authors' institutions network, and keywords analysis were conducted in this section.

Publishing Trend by Year

Figure 1 is the initial statics and shows the number of published papers in the area of DSCM by year. It can be seen from Figure 1, a total of 1,503 DSCM papers were published from 1995 to 2021.

Figure 1. Publishing trend by year in DSCM



In addition, there were two papers published before 1999; one paper was published in 1995 and is the oldest published paper on the topic we could track in this research. The other was published in 1999. The quantity of DSCM literature was stable before 2010; however, the number of literary publications shows a steep increase in DSCM field science in 2014. Industry 4.0 and Made in China 2025, meanwhile, were proposed since 2014 (Wubbeke et al., 2016). The trend did not decline from 2020 to 2021 because the research only included publications from January to October in 2021, and there are still more than 100 articles not published, according to the statistics.

Co-Authorship Network Analysis

Table 1 outlines the top 10 authors in DSCM field research. Top 10 refers to the number of published papers they authored and co-authored. However, information of co-authorship network is not easy to read from Table 1. Thus, we utilize the CiteSpace software to visualize these authors' co-authorship network. We can combine Table 1 with Figure 2 to gain an insight into the authors' network. It can be seen from Figure 2 that Luthra, S., Mangla, S. K., and Bag, S. have co-authored several papers. Gunasekarea, A. and Jabbour, C. J. C. also cooperate closely in this field. Most of these authors have backgrounds in supply chain and logistics management or industrial and systems engineering.

Co-Authors' Institutions Network Analysis

Table 2 outlines the top 10 affiliations and number of their published papers. It can be seen from Table 2 that 10 affiliations account for 15% of the total papers. Cooperation among different organizations is very common in academic research, and it also helps to develop the DSCM discipline. However, Table 2 does not show related information directly. Figure 3 shows the affiliation co-authorship network, and the size of circles represents the number of published papers while the link represents their cooperation. It can be seen from Figure 3 that Hong Kong Polytechnic University (HK POLYU), the University of Hong Kong, and Shenzhen University have a deep cooperation relationship, and they contribute the most papers in the area of DSCM. There are several reasons for this. The first reason is their location. All are located in the Greater Bay Area (GBA). In addition, the GBA is also the international innovation and technology center if the country. Both the Global Digital Supply Chain Conference and the Global Innovation Conference are located in the GBA. Smart ports and more than 4,000km of highway have taken shape in the GBA (CCTV NEWS, 2023). It is well-known that digital technology forms the foundation of DSCM, and the transportation infrastructure was also crucial during its implementation. In addition, the 2021 Global Industry Chain Supply Chain Digital

Table 1. Top 10 authors and number of published papers

Author	Number of Published Papers
Choy, K. L.	18
Luthra, S.	11
Mangla, S. K.	11
Gunasekaran, A.	10
Gupta, S.	10
Ivanov, D.	10
Bag, S.	9
Huang, G. Q.	9
Jabbour, C. J. C.	9
Jayaraman, R.	9

Figure 2. Author co-authorship network

Table 2. Top 10 institution affiliations and number of published papers

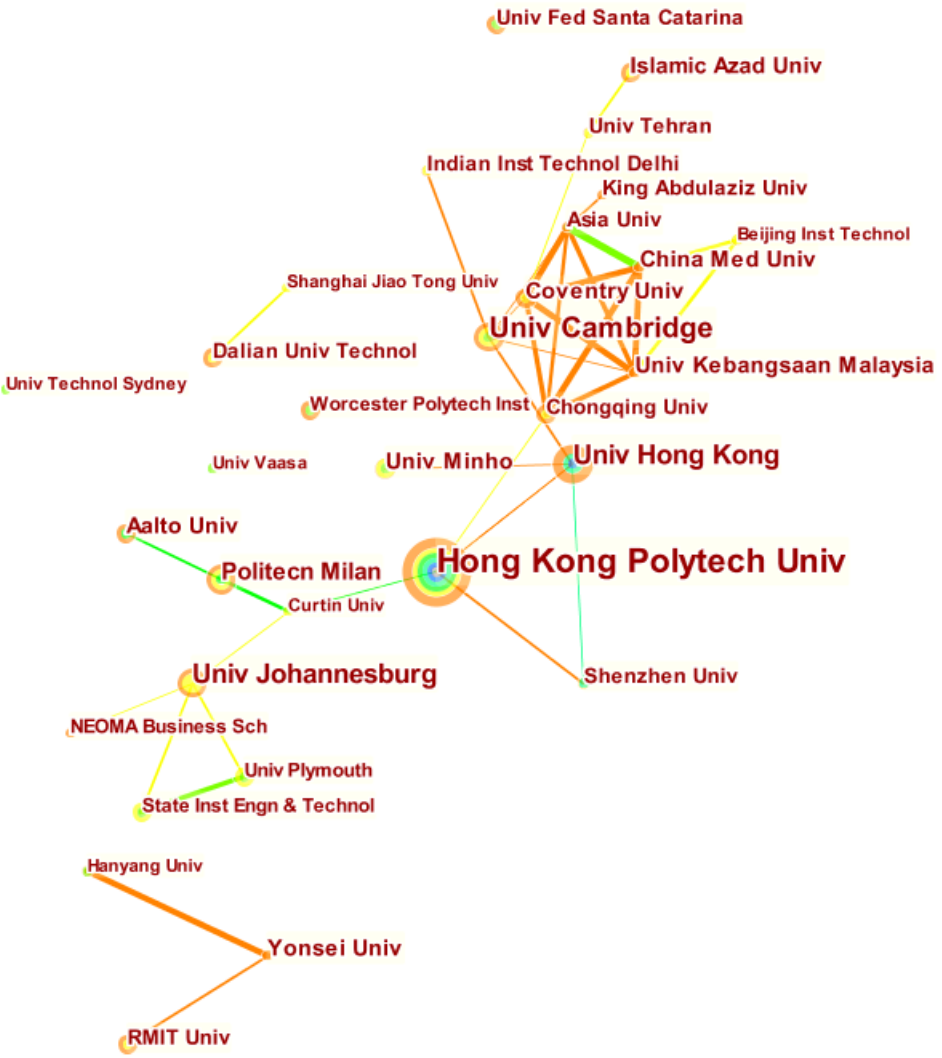
Affiliations	Number of Published Papers
Hong Kong Polytechnic University	42
University of Hong Kong	26
Indian Institute of Technology System IIT System	23
University of Cambridge	22
National Institute of Technology NIT System	20
Centre National de la Recherche Scientifique CNRA (National Center for Scientific Research)	18
University of Johannesburg	17
State University System of Florida	16
University of California	16
Aalto University	15

Economy Conference was held in Shenzhen, located in the Guangdong-Hong Kong-Macao Greater Bay Area, which shows that the digital supply chain is relatively advanced in the region.

Keyword Statistics

Figure 4 and Table 3 outline the top 40 keywords identified by frequency out of 4,030 keywords from 1,503 articles. The most cited keywords (which represent the name of the research field) were "supply chain" (with a recurrence of 356 times), "management" (recurring 352 times), and "supply chain management" (recurring 295 times). The top 40 cited keywords can be summarized into five

Figure 3. Affiliation co-authorship network



directions of study. The first direction is research; "supply chain," "management," and "supply chain management" are search terms with a research direction. The second direction is that of digital technologies or information technologies, which are the foundation of DSCM. This direction encompasses search terms "big data" (172 occurrences), "internet of things" (144 occurrences), "artificial intelligence" (34 occurrences), "block chain technology" (33 occurrences), and "digital twin" (19 occurrences). In addition, "digital twin" only shows a frequency of 19 recurrences because it is a relatively new concept. However, it can help to do predictive analysis in the maintenance in manufacturing industry, and there are several studies about digital twin supply chain and predictive risk management in the COVID-19 age. The third direction represents the purpose of implementing DSCM and encompasses the following keywords with their respective recurring frequencies: "performance" (171), "optimization" (46), "service quality" (43), "decision making" (39), and "capability" (35). The fourth direction involves the research methodology of these articles and includes the following

Figure 4. Keywords co-authorship network

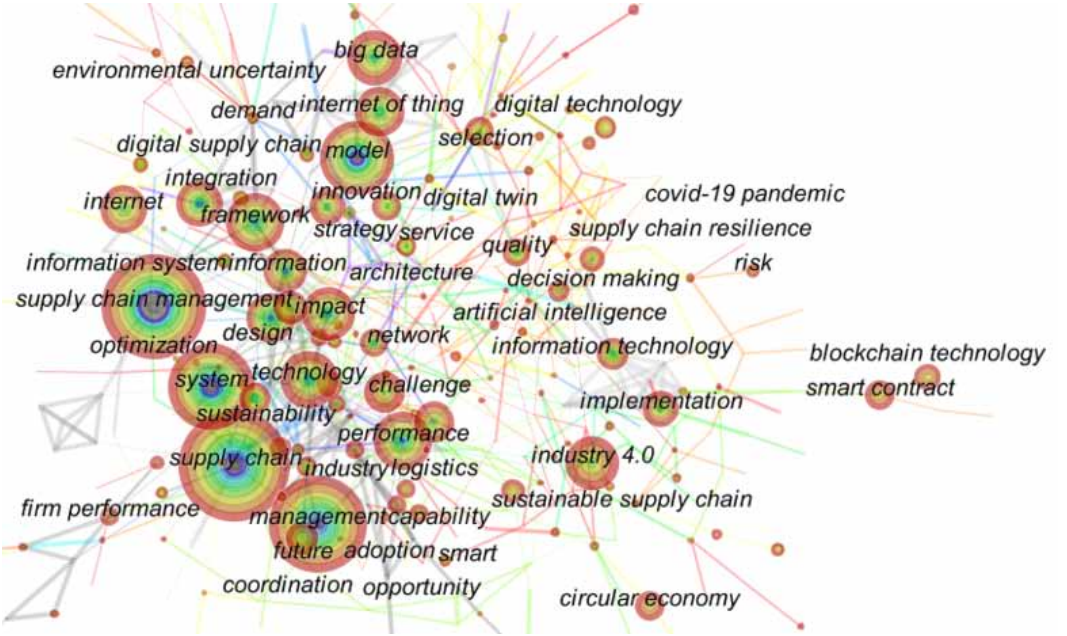


Table 3. Top 40 keywords

Keyword	Frequency	Keyword	Frequency	Keyword	Frequency
Supply chain	356	Design	102	Quality	43
Management	352	Future	82	Decision making	39
Supply chain management	295	Logistics	79	Service	39
Industry 4.0	226	Integration	75	Capability	35
System	215	Information	72	Artificial intelligence	34
Model	175	Innovation	70	Opportunity	33
Big data	172	Smart contract	68	Blockchain technology	33
Technology	172	Circular economy	65	Demand	33
Performance	171	Implementation	59	Information system	32
Framework	167	Sustainability	56	Firm performance	32
Impact	145	Information technology	51	Coordination	30
Internet of thing	144	Network	47	Digital twin	19
Internet	131	Optimization	46	Digital transformation	16
Challenge	116	Selection	45	Digital supply Chain	15

keywords (with their respective recurring frequencies): "model" (175), "empirical research," and "literature review" are. The fifth and final direction represents the current focus of research and includes keywords "innovation" (70), "digital supply chain" (15), and "circular economy" (65). For instance, innovation in the SCM field has showed its importance in recent years, also called supply chain innovation. There are some articles proposing that the introduction of advanced technology may not always improve the performance and capability of the supply chain. How to operate and utilize those technologies to lead supply chain product innovation and process innovation is a critical question (Hahn, 2019). In addition, the keywords "COVID-19 pandemic," "supply chain resilience," and "risk" are showed together in this network. The global supply chain is suffering from disruption and being impaired by the outbreak of COVID-19. Thus, it is crucial to improve supply chain resilience and supply chain risk management capability in post-pandemic era.

Intellectual Structure of DSCM Field

Author co-citation, journal co-citation, document co-citation, and cluster in the network of document co-citation in the DSCM field are conducted in this section.

Author Co-Citation Analysis on DSCM Field

Author co-citation analysis (ACA) indicates when two or more authors are cited by one or more literature together; these two or more authors are referred to as having a co-citation relationship (White & Griffith, 1982). For instance, research 1 and research 2 are co-cited if both 1 and 2 are cited by research 3 (Fahimnia et al., 2015). It could help to identify higher cited authors in the DSCM field and explore the connection between authors' research area. Figure 5 outlines the authors with no less than 40 citation times, and the size of node represents the importance of an author. In addition, Table 4 shows the top 10 most co-cited authors. As shown in Figure 5, the biggest node refers to Nakamoto,

Figure 5. Author co-citation network

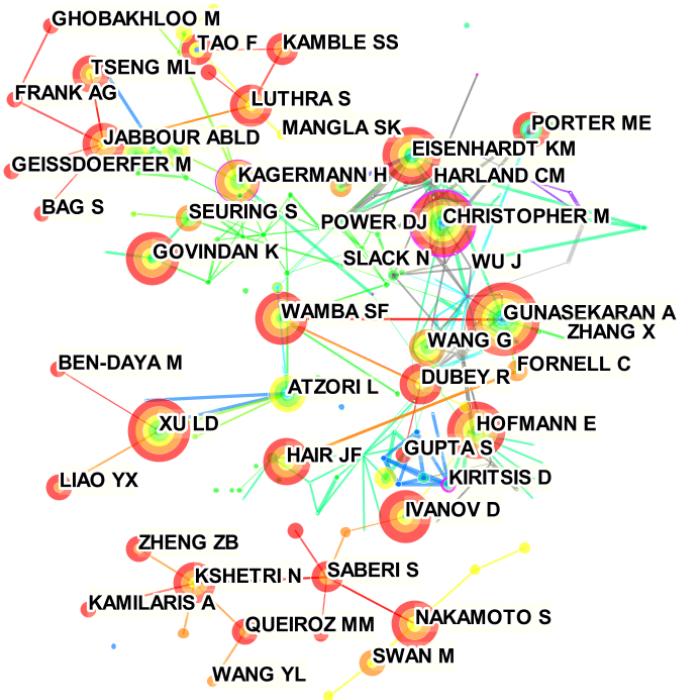


Table 4. Top 15 most co-cited authors on DSCM studies

No.	Author	Frequency
1	Gunasekaran, A.	118
2	Ivanov, D.	114
3	Hofmann, E.	104
4	Govindan, K.	90
5	Nakamoto, S.	90
6	Wamba, S. F.	89
7	Xu, L. D.	87
8	Zhong, R. Y.	87
9	Dubey, R.	84
10	Kamble, S. S.	84
11	Christopher, M.	83
12	Eisenhardt, K. M.	78
13	Kshetri, N.	77
14	Jabbour, A. B. L. D.	72
15	Luthra, S.	71

S., co-cited with Swan, M., Christidis, K., Zhang, Y., and Zheng, Z. B., who present research on the correlation between DSCM and blockchain technology. Another node refers to Hofmann, E., co-cited with Zhong, R. Y., Kagermann, H., Lee, J., Stock, T., and Lasi, H., who mainly researched on the correlation between DSCM and Industry 4.0. Circular economy and smart city are another two research directions for scholars. Gunasekaran, A., co-cited with Govindan, K., Christopher, M. (2000), and many other authors (Eisenhardt, K. M.; Teece, D. J.; Atzori, L.; and Yin, R. K.), who had large numbers of studies on SCM and also laid a research foundation for DSCM.

Journal Co-Citation of DSCM Analysis

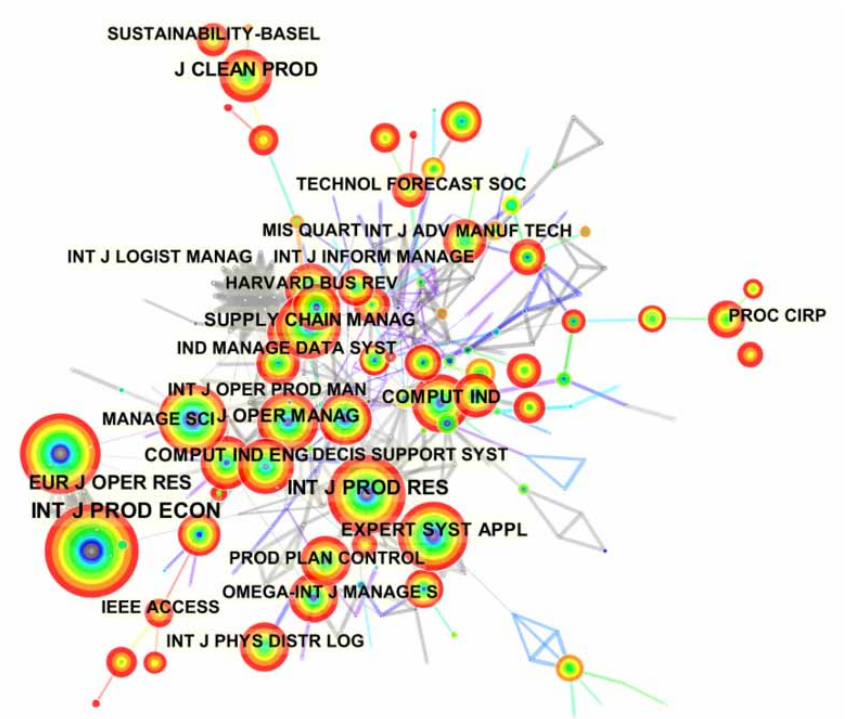
In this section, we first illustrate the distribution of papers published in various journals and then conduct a journal co-citation analysis to explore journals which are representative.

The statistical result shows that there is a total of 550 journals that contribute to the primary 1,503 articles identified for this study, and Table 5 shows the top 15 publication journals in the DSCM field. Four hundred and eighty articles are published in these 15 journals, which account for nearly 32% of all articles published. For instance, the *Journal of Sustainability* has published 74 articles and reviews since 2016. Moreover, the number of published papers does not evaluate the contributions of a journal comprehensively. Journal co-citation analysis could fill this drawback, and CiteSpace could realize this function to conduct a journal co-citation relationship map which is shown in Figure 6. It can be read from Figure 6 that journals with the top 10 cited and with over 300 citations include the *International Journal of Production Economics* (with 733 citations), the *International Journal of Production Research* (with 610 citations), the *Journal of Cleaner Production* (with 457 citations), the *European Journal of Operational Research* (with 432 citations), *Computers in Industry* (with 369 citations), *Computers & Industrial Engineering* (with 368 citations), *Supply Chain Management: An International Journal* (with 367 citations), the *Journal of Operations Management* (with 321 citations), *Expert Systems with Applications* (with 319 citations), and the *International Journal of Operations*

Table 5. The Top 15 publications in the DSCM area

Journal	Total Quantity (2001-2021)
Sustainability	74
IEEE Access	53
Journal of Cleaner Production	53
International Journal of Production Research	41
International Journal of Production Economics	39
Production Planning Control	32
Computers Industrial Engineering	28
Technological Forecasting and Social Change	24
Expert Systems with Applications	25
Computers in Industry	23
Supply Chain Management: an International Journal	19
Applied Sciences Basel	18
International journal of Operations Production Management	18
International Journal of Informational Management	17
Industrial Management Data Systems	16

Figure 6. Journal co-citation network



& Production Management (with 303 citations). Thus, we could combine the most publications with most cited journals on DSCM field to identify the most influential journals.

Document Co-Citation of DSCM Analysis

Document co-citation refers to two papers being cited in another same literature (Fahimnia et al., 2015). It can be used to identify key studies and emerging research fronts in a specific field. In general, the frequency of co-citations may change over time, so the co-citation is a dynamic network, and it is suitable for analyzing the discipline trend. We set node type as "Cited Reference" and get Figure 7, which shows the document co-citation network directly in a map. The size of the nodes represents the cited frequency of a literature. In addition, Table 6 outlines the top 10 key literatures in the DSCM field. We can investigate from Figure 7 and Table 6 that the article authored by Hofmann and Rüsch (2017) and titled "Industry 4.0 and the Current Status as well as Future Prospects on Logistic" is cited the most. This article investigates what is Industry 4.0 and its impact on logistics and supply chain management. It is followed by article, "Blockchain Technology and Its Relationships to Sustainable Supply Chain Management," authored by Saberi et al. (2019). This article illustrates how blockchain technology overcomes barriers and improves supply chain sustainability. Büyüközkan and Göçer published a literature review entitled, "Digital Supply Chain: Literature Review and a Proposed Framework for Future Research." In this article, the authors emphasize that the main point of digital supply chain is the incorporation of innovative technologies into SCM and not about whether the goods and services are digital or not. The article also discusses the impact of digital technologies such as big data and blockchain on SCM and investigates Industry 4.0 as a boost for development of DSCM.

Cluster in the Network of Document Co-Citation

We find research topic clusters based on the document co-citation network by CiteSpace software. Cluster function can outline the research focus clearly, and it also can collect the same research topic together directly. The indicators of modularity Q and weighted mean silhouette can evaluate the effectiveness of map and cluster. Generally, if modularity Q is more than 0.3 and weighted mean silhouette is over 0.7, it is considered to be the effectiveness cluster. In this case, Q is equal to 0.8554, and weighted mean silhouette is equal to 0.9385, which means the result in Figure 8 is reliable and

Figure 7. Document co-citation network

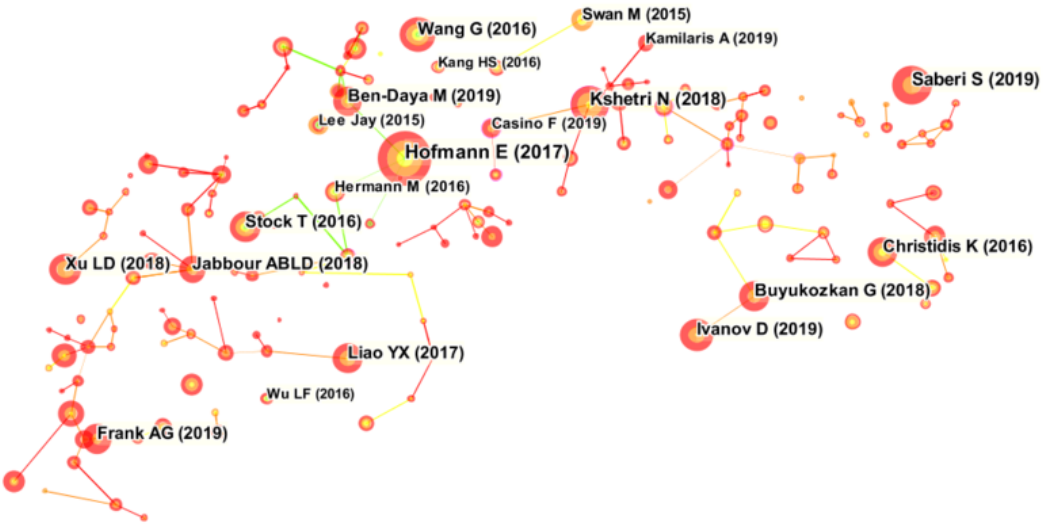


Table 6. Key literature in DSCM field

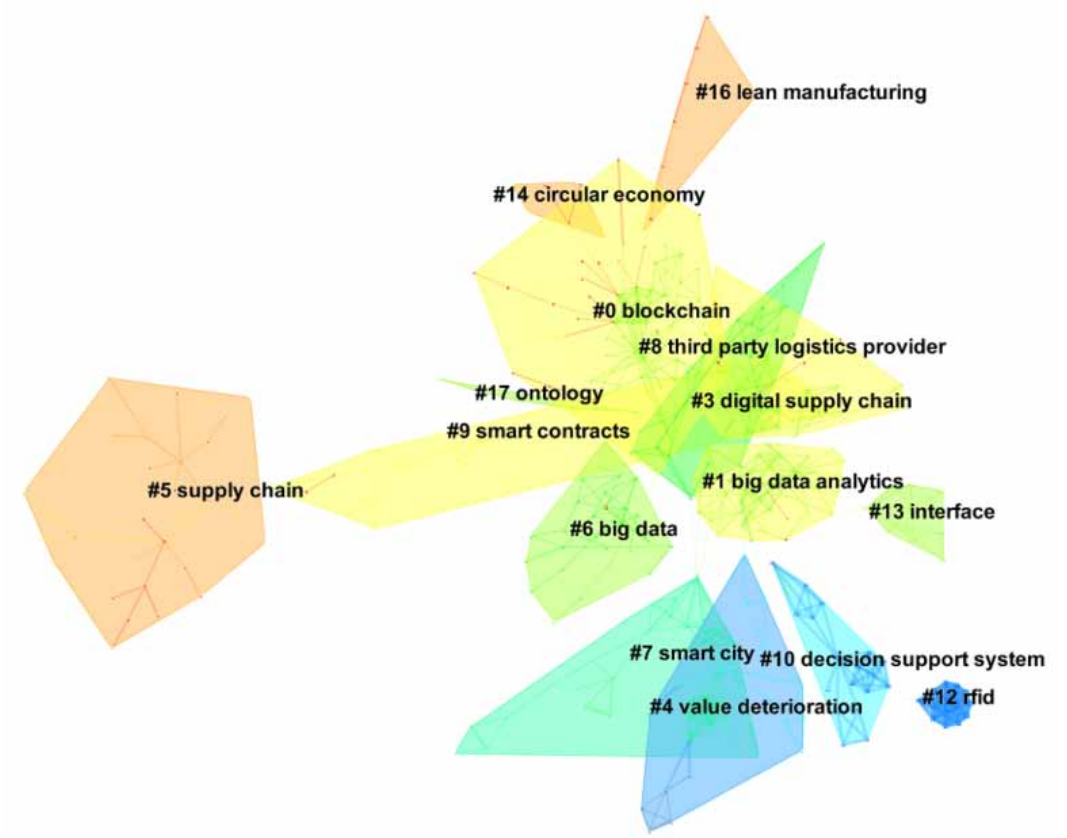
No.	Freq	Author(s)	Source	Title
1	81	Hofmann and Rüsch (2017)	*Computers in Industry*	Industry 4.0 and the Current Status as Well as Future Prospects on Logistics
2	59	Saberi et al. (2019)	*International Journal of Production Research*	Blockchain Technology and Its Relationships to Sustainable Supply Chain Management
3	56	Kshetri N (2018)	*International Journal of information management*	Blockchain's Roles in Meeting Key Supply Chain Management Objectives
4	53	Wang et al. (2023)	*International Journal of Production Research*	Big Data Analytics in Logistics and Supply Chain Management: Certain Investigations for Research and Applications
5	49	Ivanov (2021)	*International Journal of Production Research*	The Impact of Digital Technology and Industry 4.0 on the Ripple Effect and Supply Chain Risk Analytics
6	48	Xu et al. (2018)	*International Journal of Production Research*	Industry 4.0: State of the Art and Future Trends
7	46	Stock and Seliger (2016)	*Procedia CIRP*	Opportunities of Sustainable Manufacturing in Industry 4.0
8	46	Büyüközkan and Göçer (2018)	*Computers in Industry*	Digital Supply Chain: Literature Review and a Proposed Framework for Future Research
9	45	Liao et al. (2017)	*International Journal of Production Research*	Past, Present and Future of Industry 4.0 - A Systematic Literature Review and Research Agenda Proposal
10	45	Frank AG et al. (2019)	*International Journal of Production Economics*	Industry 4.0 Technologies: Implementation Patterns in Manufacturing Companies

well-structured. According to Figure 8, we can summarize 12 clusters, including #0 blockchain, #1 big data analytics, #3 digital supply chain, #4 value deterioration, #5 supply chain, #6 big data, #7 smart city, #8third party logistics provider, #9 smart contracts, #10 decision support system, #12 RFID, #13 interface, #14 circular economy, #16 lean manufacturing, and #17 ontology. The color of convex hull means the mean time of the clusters' year of publication. For instance, cluster #12 RFID is covered by dark blue, and it notes the mean year around 2013; cluster #6 big data is covered by green, and it notes the means year around 2016; cluster #0 and #9 are covered by bright yellow, and it notes the mean year around 2019; cluster #5, #14, and #16 are covered by orange, and it notes the mean year around 2020.

This research mainly investigates the following cluster, including #0 blockchain, #3 digital supply chain, and #14 circular economy in the view of cluster size and other aspect considerations.

The cluster #0 blockchain is the largest cluster which includes 63 references and lasts from 2014 to 2020. Xu et al. (2018) is considered the most cited reference, and this research clarifies the current

Figure 8. Clusters in document co-citation network



status of Industry 4.0 & Made in China 2025 and the implications from emerging new technologies. A literature review by Liao et al. (2017) illustrates the significance of blockchain technology in the industrial revolution. Kim and Laskowski (2018) talk about how ontology-driven blockchain technology can improve supply chain traceability capability and propose a model to help to achieve it. Saberi et al. (2019) discusses the relationships between blockchain technology and sustainable supply chain management in the context of globalization and is also noted as a key literature in Table 6.

The cluster #3 is noted as digital supply chain, which is one of the search terms in this paper. It is a novel concept and put forward in recent years. Hofmann and Rüsch (2017) seek to detect the opportunity of supply chain and logistics in the context of Industry 4.0. This article was published in the year of 2017 when Industry 4.0 was in its infancy. Ivanov et al. (2018) explores the impact of digitalization on SCM and then the SCM on the supply chain risks. This article has a high frequency of citation, especially since 2020, which might be because of the outbreak of COVID-19 when the global supply chain met a serious disruption (Ivanov et al., 2018). Thus, how to utilize digital technologies to overcome supply chain disruption is very significant. The article published by Büyüközkan and Göçer (2018) is also a very important milestone. As mentioned in previously, this article, being a systematic literature review, is instrumental in comprehending the fundamental aspects of the DSCM field. Wu et al. (2016) investigates the current research status and future trends for smart supply chain management. It classifies the topics of smart supply chain management into five parts, including information in supply chains, IT, process automation, advanced analytics, and process integration and innovation. It also identifies six characteristics for smart supply chain management, including

instrumented, interconnected, intelligent, automated, integrated, and innovative. This article has a great deal to offer digital supply chain management research. A portion of the research is conducting the linkage between DSCM and competitive advantages of enterprises. Some research clarifies that DSCM can enhance the performance of enterprises, to some extent (Li et al., 2023; Zhao et al., 2023), providing valuable references for industry stakeholders.

The cluster #14 is circular economy. Luthra and Mangla (2018) identify the top four challenges for the integration of industry 4.0 and sustainability in supply chains which are organizational, legal and ethical, strategic, and technological challenges. Yadav et al. (2020) identifies 28 sustainability supply chain management challenges and proposes 22 solutions in the context of industry 4.0 and circular economy. De Angelis et al. (2018) introduces the new concept of "Circular Supply Chains" (CSCs) which is the integration of circular economy and supply chain management. It also illustrates the significance of supply chain innovation in transformation from supply chain management to CSCs.

CONCLUSION

The blossom of DSCM offers new opportunities for the SCM field in the context of COVID-19 pandemic. DSCM is a novel concept, and there are still many unknowns about this field. Therefore, we conclude research and practical contributions in this section. Here, we summarize the limitations for this research and hope future studies can overcome these barriers. In addition, DSCM is a promising research area and future research directions are also explored from three aspects.

Research and Practical Contributions

The research contributions of this article are illustrated from three aspects. First, DSCM is a relative new concept, thus, the historical study process, current status, and development trend are crucial to investigate. This information is also the foundation for further research. Second, digital transformation shows its greatest significance in the digital age (Ivanov et al., 2019). Classic supply chain management has a few limitations and needs to combine with advanced digital technologies to improve SCM capabilities. Third, research focus and hotspots are detected in this research. The IoT, big data, and blockchain are the most cited technologies in the DSCM field. Supply chain risk management and supply chain resilience are the current focuses in the post COVID-19 period. How to incorporate digital technology into supply chain management and enhance the resilience of DSCM are the current focuses in both academia and the industrial sectors (Zhang et al., 2021).

For practical business, this research makes several contributions. First, this research clarifies the importance of applying digital transformation into SCM. As Qiangdong Liu, the founder of JD.com, states, the key point for achieving optimal solution in user experience, cost, and efficiency is digital transformation in the SCM field (Zheng et al., 2021). However, the degree of investment is the pivotal concerns for enterprise. Digital technology can take certain benefits to the enterprise, however, an excessive investment in digital devices without concurrently nurturing corresponding talents can have negative impacts. Second, global supply chains are facing unprecedented challenges in the context of COVID-19. An outbreak of COVID-19 in one country or region could influence the entire supply chain. In the most serious case, it could cause supply chain disruption. How to overcome these difficulties and barriers is a major problem. Third, low carbon economy, low carbon supply chain, closed-loop supply chain, carbon cycling, and circular economy show big progress when introduced into DSCM (Kusi-Sarpong et al., 2019).

Limitations and Future Research Directions

This research still has some limitations. First, DSCM is in its infancy, and there is not a great deal of research. In addition, we chose *Core Collection* and *Web of Science*. Other scholars could select more database such as *Scopus*, *Elsevier*, and *CNKI* in future research, which can enrich research literatures to some extent. Second, the reference type that we chose was limited to journal articles and literary

reviews and excludes conference papers and other types of articles. Future research could include other types of research such as conference papers and book chapters and in other languages such as Chinese. Third, many of the analysis we conducted in this research are based on CiteSpace software, which is a master at visualizing emerging trends and patterns. Future research could explore the use of various other software platforms for more in-depth research.

For the future research, three directions are proposed based on this literature review. First, DSCM-related research mainly focuses on the manufacturing industry. It is true that supply chain management in manufacturing industry is very important; however, other industries such as transportation, healthcare, and agriculture are also facing the global supply chain management problems (Beaulieu & Bentahar, 2021; Kamilaris et al., 2019). Second, blockchain, big data, and artificial intelligence are the most cited technologies in the DSCM field. However, the new concept named, digital twin, has been noticed in the DSCM field since 2018. Digital twin is a virtual representation that serves as the real-time digital counterpart of a physical object or process (Barykin et al., 2021). And how digital twin technology is applied to supply chain management and then demonstrate predictive risk management in the COVID-19 and post-pandemic-age(Ivanov & Dolgui, 2020; Rasheed et al., 2020). Global supply chains are facing serious risks and disruption problems, and many scholars and industries are seeking relevant solutions. Thus, this research, along with digital twin technology, might inspire them with new ideas. Third, the topic of supply chain innovation is receiving a great deal of attention with the bloom of the digital transformation. Instead of investing advanced technologies into supply chain processes, how to make use of these technologies is a key point. Seyedghorban et al. (2020) also argues that digital technology is not the pass card to current difficulties. How to implement supply chain processes and product innovation by using new generation technology is crucial going forward.

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CONFLICT OF INTEREST

The authors of this publication declare there are no competing interests.

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