Evolution of Blockchain in Supply Chain Management: A Bibliometric Review and Outlook for Future Research

Siti Fairuza Hassam
Email: fairuza@uitm.edu.my
Faculty of Business and Management, Universiti Teknologi MARA, Kedah Branch, Kedah, Malaysia
Adila Talip
Email: adilatalip.sc@gmail.com
Faculty of Business and Management, Universiti Teknologi MARA, Kedah Branch, Kedah, Malaysia
Preecha Wararatchai
Email: preecha.wa@ssru.ac.th
Graduate School, Suan Sunandha Rajabhat University, Bangkok, Thailand

Abstract

Blockchain technology has garnered significant scholarly and professional interest as a means to advance economic, social, and environmental sustainability. This study utilized a knowledge-based visualization approach to conduct a thorough and expansive review of blockchain-based supply chains, surpassing previous examinations. To understand the current status and future paths of this field, 2090 articles from Scopus databases were analyzed spanning the years 2016 to December 2023, with specific search parameters and criteria applied. Employing bibliometric knowledge mapping visualization and statistical analysis techniques, the collected data was systematically scrutinized. Concerning the objectives, the analysis identifies key gaps and limitations in the existing body of literature on blockchain-based supply chain management. These may include issues related to scalability, interoperability, regulatory challenges, and the need for more empirical studies validating the efficacy of blockchain solutions in real-world supply chain contexts. Subsequently, the analysis aims to propose potential avenues for future research that address these identified gaps and limitations, thereby contributing to the advancement of knowledge and practice in blockchain-based supply chain management.

Keywords: Blockchain, Supply Chain Management, Bibliometric Review, Trend and Challenges

Introduction

In recent years, blockchain technology has garnered considerable attention for its potential to revolutionize supply chain management. Acting as a decentralized record-keeping system, enables secure and transparent transactions among various parties without requiring oversight from intermediaries. Through the integration of blockchain technology, supply chain management stands to benefit from enhanced efficiency, security, and cost-effectiveness. Previous research endeavors have sought to systematically explore the current state of blockchain technology in supply chain management. Chang and Chen (2020) conducted a systematic literature review, concluding that blockchain technology holds promise in augmenting transparency, traceability, security, and efficiency within supply chain operations. They underscored the necessity for collaboration and trust among stakeholders for successful implementation. Additionally, Manifavas and Karamitsos (2021) investigated the impact of blockchain technology on supply chain management through a case study approach. Their findings indicated that blockchain can bolster supply chain visibility, mitigate costs, and heighten operational efficiency, ultimately transforming supply chain practices by fostering greater collaboration and trust.

Blockchain has been seen as a promising way to solve different problems in supply chain management, leading to several studies using bibliometric analysis to understand the research better. Although this type of analysis gives helpful information about how blockchain and supply chain management connect, there are still some issues and gaps to address. Exploring blockchain's applications in supply chains is crucial for academics and practitioners alike because of the technology's unique qualities, which enable more streamlined business operations, improved stakeholder confidence, and increased transparency. In the context of supply chain management (SCM), reporting on the existing state, potential, and developing uses of blockchain across many industries appears essential.

Objectives

In this study, a set of questions was formulated to aid in establishing a logical connection between pertinent existing research and the potential for additional research in this field.

RQ1: What is the research trend on blockchain-based supply chain management evolved over time?

RQ2: What is the future research in blockchain-based supply chain management address current gaps and limitations?

This paper utilized bibliometric analysis to address all the above inquiries and gain insights into related issues. The purpose of using bibliometric analysis is to provide a comprehensive overview of recent research by systematically analysing existing literature. In this way, the study establishes a better understanding of related research interests and topic distributions to outline the research path. The remainder of this paper is structured as follows: Section II outlines the methodology and procedural steps used in this review, and Section IV identifies the potential implications, future research gaps and limitation and the conclusion is presented in Section V.

Methodology

The study utilized bibliometric knowledge mapping visualization and statistical analysis techniques. The software and application programs of Microsoft Excel, Harzing Publish or Perish, Visual of Similarities (VOS) viewer, and Open refine were employed to analyse a sample dataset of blockchain supply chain research in various fields. This enabled the researchers to visually present information on various aspects such as country/region collaboration, research organization impact, author collaboration and co-citation, journal and reference co-citation, keyword co-occurrence and clustering, and keyword timelines.

Data required for a comprehensive literature review and bibliometric analysis were collected from the Scopus database platform on the 15th of January 2024. TITLE-ABS-KEY ("blockchain" AND "supply chain management") AND PUBYEAR > 2016 AND PUBYEAR < 2023 were the keyword search used to select the articles. All languages were considered during the

selection process and articles were categorized based on their respective subject areas. The analysis resulted in the selection of 2090 publications which are described in detail in the subsequent sections. The data collection process is illustrated in Figure 1 using the PRISMA flow diagram.

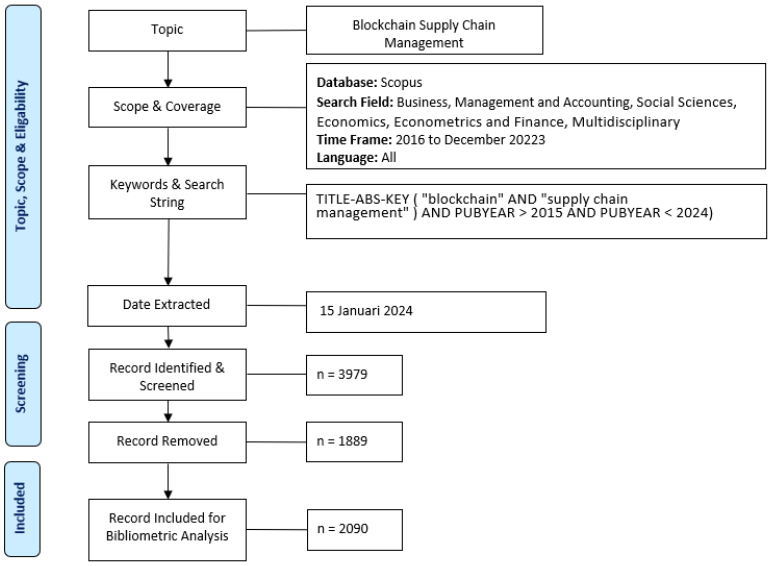

Figure 1: Prisma Flow

Results and Findings

The results of this analysis reveal insights into the patterns and trends of scholarly publishing across various fields of study. The dominance of articles as the primary form of scholarly publication aligns with previous findings, underscoring their central role in scholarly discourse. The analysis primarily aims to achieve both objectives: to understand the research trend on blockchain-based supply chain management as it has evolved over time, and to identify future research directions that address current gaps and limitations in this field.

Evolution of Published Studies

The analysis examines the trajectory of research on blockchain-based supply chain management across different years, assessing how the volume and focus of publications have changed over time. By analyzing trends in publication counts, citation patterns, and thematic shifts, the study seeks to provide insights into the evolving landscape of research in this area.

Table 1: Year of publications

Year	Total Publications	Percentage (%)
2016	1	0.05
2017	6	0.29
2018	62	2.97
2019	150	7.18
2020	266	12.73
2021	375	17.94
2022	547	26.17
2023	683	32.68
Total	2090	100.00

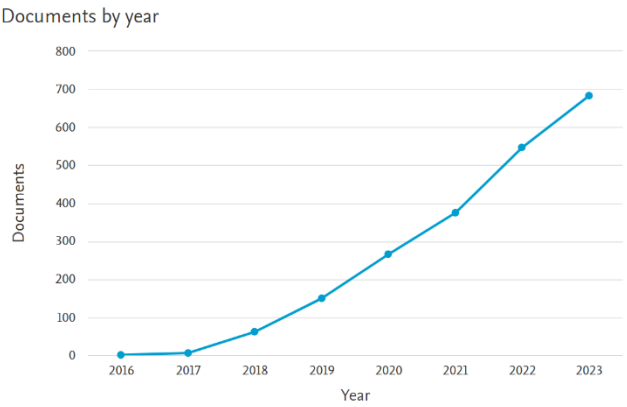

Figure 2: Document from year 2016 – 2023

The table (Table 1) illustrates the publication trends over the years from 2016 to 2023, along with the corresponding percentages of total publications for each year. It reveals a clear escalation in the number of publications over this period, indicating a progressive growth in scholarly output. In 2016, there was a minimal contribution of only one publication, constituting 0.05% of the total. However, this number steadily increased in subsequent years, with a noticeable surge starting from 2018. In 2017, there were six publications, accounting for 0.29% of the total. This figure continued to rise significantly in the subsequent years, with 2019 seeing 150 publications (7.18% of the total) and 2020 witnessing 266 publications (12.73% of

the total). The upward trajectory persisted, with 375 publications in 2021 (17.94% of the total), 547 publications in 2022 (26.17% of the total), and 683 publications in 2023 (32.68% of the total. The data portrays a progressive trend characterized by a consistent increase in the number of publications each year, culminating in a substantial contribution in 2023. This pattern suggests a growing interest and engagement in scholarly research within the field over the specified timeframe.

Meanwhile, table 2 shows the geographical distribution of publications for the most influential countries top 20 countries that contributed to the publications related to blockchain in management and economics. The data were retrieved from the Scopus and analysed using bibliometric methods. The study found that China has the highest number of publications with 228 (17.87%), followed by the United States with 219 (17.16%), and India with 169 (13.24%). The United Kingdom and Australia ranked fourth and fifth with 139 (10.89%) and 75 (5.88%) publications, respectively. Other countries that made significant contributions to the field include Germany (73 publications), Italy (73 publications), and France (60 publications).

The high number of publications from China and the United States indicates their strong research capabilities and investments in blockchain technology. The participation of India in blockchain research is notable, given its potential to adopt and apply blockchain to support its economic and social development. The top countries' contributions show that blockchain research in management and economics is a global phenomenon, with countries from different regions of the world participating actively.

Table 2: Top 20 Countries contributed to publications

Country	Total Publications	Percentage (%)
China	228	17.87%
United States	219	17.16%
India	169	13.24%
United Kingdom	139	10.89%
Australia	75	5.88%
Germany	73	5.72%
Italy	73	5.72%

Country	Total Publications	Percentage (%)
France	60	4.70%
Canada	37	2.90%
Malaysia	35	2.74%
Hong Kong	32	2.51%
South Korea	32	2.51%
United Arab Emirates	32	2.51%
Turkey	30	2.35%
Russian Federation	27	2.12%
Indonesia	25	1.96%
Brazil	24	1.88%
Sweden	23	1.80%
Finland	22	1.72%
Netherlands	21	1.65%

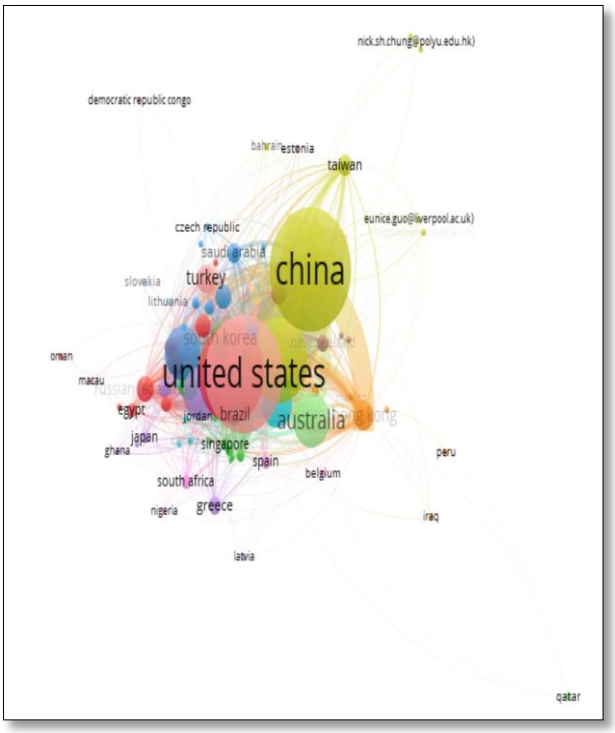

Figure 3: Network visualization map of the citation by countries

Further gap and keywords analysis

The analysis identifies key gaps and limitations in the existing body of literature on blockchain-based supply chain management. Subsequently, the analysis aims to propose potential avenues for future research that address these identified gaps and limitations, thereby contributing to the advancement of knowledge and practice in blockchain-based supply chain management. Table 3 presents the top keywords in the literature related to blockchain technology and its application in supply chain management. The table includes a list of 20 keywords, ranked by the number of publications in which they appear and the percentage of total publications.

Table 3: Top 20 Keywords

Author Keywords	Total Publications	Percentage (%)
Blockchain	1106	86.68%
Supply Chain	604	47.34%
Supply Chain Management	393	30.80%
Blockchain Technology	211	16.54%
Sustainability	124	9.72%
Traceability	96	7.52%
Internet Of Things	84	6.58%
Sustainable Development	76	5.96%
Transparency	71	5.56%
Smart Contract	68	5.33%
Industry 4.0	60	4.70%
Distributed Ledger	58	4.55%
Smart Contracts	58	4.55%
Food Supply	56	4.39%
Technology Adoption	50	3.92%
Logistics	49	3.84%
Decision Making	48	3.76%
Information Management	45	3.53%
Technology	44	3.45%
Food Supply Chain	43	3.37%

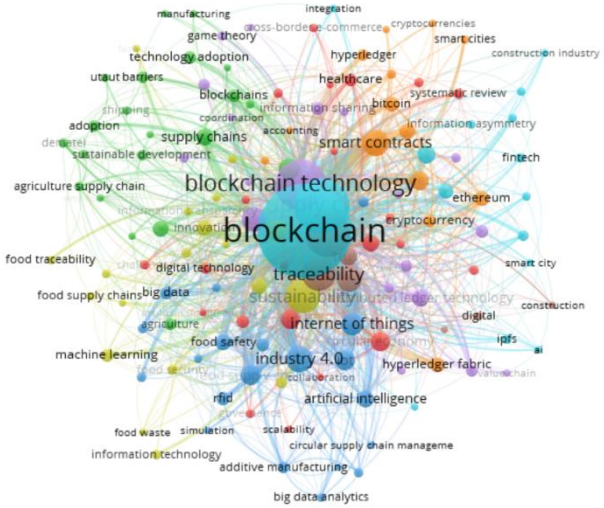

Figure 4: Network visualization map of the author keywords

The most prevalent keyword is "Blockchain," which appears in 86.68% of the total publications, indicating a widespread interest in the technology within the academic community. The second most common keyword is "Supply Chain," with a frequency of 47.34%, followed closely by "Supply Chain Management" with a frequency of 30.80%. These keywords suggest that blockchain technology is primarily studied within the context of supply chain management. Other frequently used keywords include "Blockchain Technology" (16.54%), The keyword "Distributed Ledger" (4.55%) highlights the importance of the decentralized nature of blockchain technology, while "Technology Adoption" (3.92%) and "Decision Making" (3.76%) suggest that researchers are studying the factors that affect the adoption and implementation of blockchain technology in supply chain management. In summary, Table 3 provides insight into the current research trends in the use of blockchain technology in supply chain management, highlighting the importance of sustainability, transparency, and automation. The prevalence of the keyword "Blockchain" suggests that this technology has become a major focus of research in the field. The findings presented demonstrate the importance of blockchain and related technologies in supply chain management research. As supply chains become more complex and globalized, there is a growing need for innovative solutions that can improve transparency, traceability, and sustainability. Future research should explore the practical implications of blockchain technology for supply chain management and identify the key challenges and opportunities associated with its adoption.

In addition, table 4 presents a list of highly cited articles related to the use of blockchain technology in supply chain management. The table includes 20 articles and provides information on the authors, title, year of publication, total number of citations, and average number of citations per year for each article. The articles in the table are ranked according to the total number of citations they have received, with the most highly cited article at the top. The first article on the list, by Saberi et al. (2019), has received 1199 citations since its publication, with an average of 299.75 citations per year. The articles on the list cover a range of topics related to blockchain technology and its application in supply chain management, including traceability systems, adoption challenges, cybersecurity, and sustainability.

Table 4: Highly cited articles

No.	Authors	Title	Year	Cites	Cites per Year
1	S. Saberi, M. Kouhizadeh, J. Sarkis, L. Shen	Blockchain technology and its relationships to sustainable supply chain management	2019	1199	299.75
2	N. Kshetri	1 Blockchain's roles in meeting key supply chain management objectives	2018	832	166.4
3	F. Tian	An agri-food supply chain traceability system for China based on RFID & blockchain technology	2016	820	117.14
4	D. Ivanov, A. Dolgui, B. Sokolov	The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics	2019	678	169.5
5	F. Tian	A supply chain traceability system for food safety based on HACCP, blockchain & Internet of things	2017	475	79.17
6	M.M. Queiroz, S. Fosso Wamba	Blockchain adoption challenges in supply chain: An empirical	2019	452	113

No.	Authors	Title	Year	Cites	Cites per Year
		investigation of the main drivers in India and the USA			
7	K. Wust, A. Gervais	Do you need a blockchain?	2018	449	89.8
8	Y. Wang, J.H. Han, P. Beynon-Davies	Understanding blockchain technology for future supply chains: a systematic literature review and research agenda	2019	447	111.75
9	H.M. Kim, M. Laskowski	Toward an ontology-driven blockchain design for supply-chain provenance	2018	372	74.4
10	S. Kamble, A. Gunasekaran, H. Arha	Understanding the Blockchain technology adoption in supply chains-Indian context	2019	354	88.5
11	H. Min	Blockchain technology for enhancing supply chain resilience	2019	350	87.5
12	S.S. Kamble, A. Gunasekaran, R. Sharma	Modeling the blockchain enabled traceability in agriculture supply chain	2020	350	116.67
13	Y. Wang, M. Singgih, J. Wang, M. Rit	Making sense of blockchain technology: How will it transform supply chains?	2019	339	84.75
14	N. Kshetri	Blockchain's roles in strengthening cybersecurity and protecting privacy	2017	333	55.5
15	H. Treiblmaier	The impact of the blockchain on the supply chain: a theory-based research framework and a call for action	2018	329	65.8
16	M. Kouhizadeh, S. Saberi, J. Sarkis	Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers	2021	328	164

No.	Authors	Title	Year	Cites	Cites per Year
17	M. Pournader, Y. Shi, S. Seuring, S.C.L. Koh	Blockchain applications in supply chains, transport and logistics: a systematic review of the literature	2020	324	108
18	S.S. Kamble, A. Gunasekaran, S.A. Gawankar	Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications	2020	322	107.33
19	R. Cole, M. Stevenson, J. Aitken	Blockchain technology: implications for operations and supply chain management	2019	318	79.5
20	K. Behnke, M.F.W.H.A. Janssen	Boundary conditions for traceability in food supply chains using blockchain technology	2020	288	96

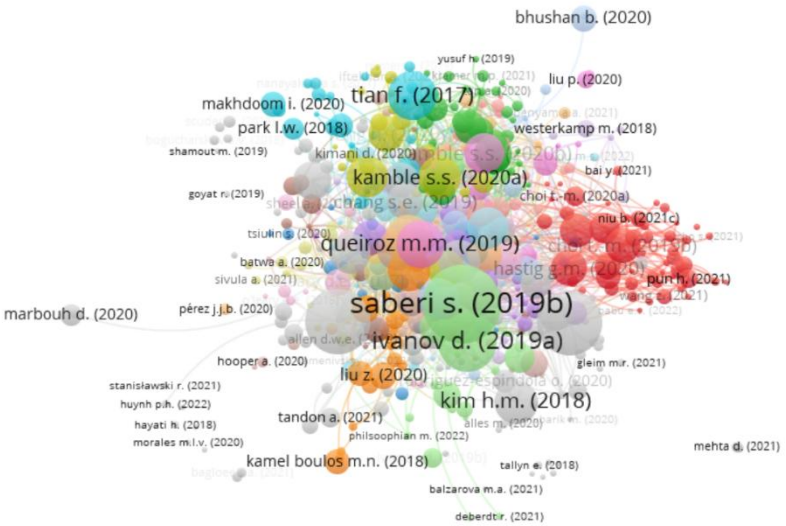

Figure 5: Network visualization map of the citation by documents Minimum number of citations of a document = 5

Visualizing citation by document publications is a technique used to clarify collaborative patterns and show the intellectual structure of published works. To create a map of a publication network using VOSviewer, this paper analyzed co-citations at the

document level and narrowed down the top twenty publications by decreasing the minimum number of citations required. Figure 5 displays the top 639 articles meeting this threshold, which VOSviewer grouped and clusters into several items. The most frequently cited article is in the center of Figure 5.

Conclusion

In summary, this study highlights blockchain technology's potential to revolutionize supply chain management while acknowledging persistent challenges like scalability and regulatory compliance. Through a thorough bibliometric analysis, the research provides a comprehensive overview of trends in blockchain-based supply chain literature, shedding light on publication patterns, thematic frameworks, and emerging research directions. While offering valuable insights for scholars and practitioners, the study also acknowledges limitations such as reliance on Scopus databases and potential biases in analysis software. Notably, the scarcity of review articles and conference papers underscores the need for further exploration in these areas.

The implications of this research extend to scholars, publishers, and policymakers alike. Scholars are encouraged to engage with both traditional and innovative publishing formats, while publishers are urged to balance established practices with evolving dissemination strategies. Policymakers stand to benefit from a deeper understanding of scholarly communication dynamics, informing policies conducive to knowledge dissemination and progress. Overall, this study contributes to advancing discourse and guiding future research efforts in blockchain-based supply chain management.

References

Behnke, K., & Janssen, M. F. W. H. A. (2020). Boundary conditions for traceability in food supply chains using blockchain technology. *International Journal of Information Management, 52*.

Cole, R., Stevenson, M., & Aitken, J. (2019). Blockchain technology: Implications for operations and supply chain management. *Supply Chain Management, 24*(4), 469-483.

Dutta, P., Choi, T. -., Somani, S., & Butala, R. (2020). Blockchain technology in supply chain operations: Applications, challenges and research opportunities. *Transportation Research Part E: Logistics and Transportation Review,* 142.

Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2020). Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. *International Journal of Production Economics,* 219, 179-194.

Kamble, S. S., Gunasekaran, A., & Sharma, R. (2020). Modeling the blockchain enabled traceability in agriculture supply chain. *International Journal of Information Management,* 52.

Kim, H. M., & Laskowski, M. (2018). Toward an ontology-driven blockchain design for supply-chain provenance. *Intelligent Systems in Accounting, Finance and Management, 25*(1), 18-27.

Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics,* 231.

Kshetri, N. (2018). 1 blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management, 39,* 80-89.

Liu X., Bollen J., Nelson M.L., Van de Sompel H. (2005). Co-authorship networks in the digital library research community. *Inf Process Manag, 41*(6), 1462–1480.

Min, H. (2019). Blockchain technology for enhancing supply chain resilience. *Business Horizons, 62*(1), 35-45.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine, 6*(7), e1000097.

Pournader, M., Shi, Y., Seuring, S., & Koh, S. C. L. (2020). Blockchain applications in supply chains, transport and logistics: A systematic review of the literature. *International Journal of Production Research, 58*(7), 2063-2081.

Queiroz, M. M., & Fosso Wamba, S. (2019). Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in india and the USA. *International Journal of Information Management,* 46, 70-82.

Tian, F. (2017). A supply chain traceability system for food safety based on HACCP, blockchain & internet of things. *Paper presented at the 14th International Conference on Services Systems and Services Management, ICSSSM 2017 - Proceedings*, doi:10.1109/ICSSSM.2017.7996119. from www.scopus.com.

Treiblmaier, H. (2018). The impact of the blockchain on the supply chain: A theory-based research framework and a call for action. *Supply Chain Management, 23*(6), 545-559.

Wang, Y., Han, J. H., & Beynon-Davies, P. (2019). Understanding blockchain technology for future supply chains: A systematic literature review and research agenda. *Supply Chain Management, 24*(1), 62-84.

Wang, Y., Singgih, M., Wang, J., & Rit, M. (2019). Making sense of blockchain technology: How will it transform supply chains? *International Journal of Production Economics, 211,* 221-236.

Wamba, F. S., & Queiroz, M. (2020). Blockchain in the operations and supply chain management: Benefits, challenges and future research opportunities. *International Journal of Information Management,* 52.

Yang, J., Ma, C., Li, D., & Liu, J. (2022). Mapping the Knowledge on Blockchain Technology in the Field of Business and Management: A Bibliometric Analysis. *IEEE Access, 10,* 60585–60596.