Environmental Science and Pollution Research (2023) 30:14029–14049
https://doi.org/10.1007/s11356-022-24844-2

REVIEW ARTICLE

A bibliometric study on blockchain-based supply chain: a theme analysis, adopted methodologies, and future research agenda

Muhammad Shoaib[1] · **Shengzhong Zhang**[1] · **Hassan Ali**[2]

Received: 8 August 2022 / Accepted: 14 December 2022 / Published online: 26 December 2022

Abstract

The emergence of the underlying blockchain technology of bitcoin has gained extensive attention from researchers and practitioners. As distributed ledger technology, blockchain widely finds its applications in the supply chain to mitigate issues related to transparency, information sharing, process efficiency, and traceability. This study employed a knowledge-based visualization technique to create a vision beyond other review studies on the blockchain-based supply chain. We used bibliometric and network analysis to synthesize the previous literature. In total, 431 articles in the timespan of 2017 to April 2022 from Scopus and Web of Science (WOS) databases were analyzed after applying search string, inclusion, and exclusion criteria. Basic information was extracted from initial data screening; then, data was analyzed on the grounds of co-occurrence, bibliographic coupling, citation, co-authorship, and co-citation analysis. In addition, thematic analysis was performed to analyze the content of the previous studies, adopted research methods, and dynamic industries in the literature. Besides all these, we identified various research gaps and proposed research directions for future study. We believe that this study provides adequate knowledge to academic scholars and supply chain practitioners to fast-track the current research in the supply chain domain using blockchain technology.

Keywords Blockchain · Supply chain · Bibliometric analysis · Theme analysis · Research methodology · Dynamic industries

Introduction

Satoshi Nakamoto introduced blockchain for a peer-to-peer electronic cash transaction system, bitcoin (Nakamoto 2008). Over the decade, it has been believed that blockchain is far beyond cryptocurrencies and is the main reason for the growth of digital currency and other non-cryptocurrencies. As a decentralized technology, blockchain provides users with a platform to send and receive transactions without third-party involvement (Dasaklis et al. 2022). Blockchain involves an immutable chain of blocks containing data connected chronologically using the hash function. This function secures the blocks against any tempering and plays a vital role in verifying transactions (Pandey et al. 2022). Blockchain technology makes the process automatic, minimizes cost, and improves the business model. Blockchain technology is snowballing, and its market share is estimated to surpass USD 39 billion by 2025 (Vailshery 2022). Blockchain enables a wide range of applications in the field of management (Tandon et al. 2021), health (Tagde et al. 2021), IoT (Shammar et al. 2021), economics (Treiblmaier 2021), and supply chain operations (Wamba and Queiroz 2022). Blockchain in the supply chain ensures the best solution for transferring transactions and facilitates traceability, transparency, security, and resource management within the network. Blockchain, with the integration of IoT, including RFID, laser scanners, and sensors, improve the traceability of supply chain operations. During logistics operations, this

Responsible Editor: Arshian Sharif

✉ Shengzhong Zhang
szzhang@chd.edu.cn

Muhammad Shoaib
shoaibch.127@gmail.com

Hassan Ali
hassanali.22448800@hotmail.com

[1] School of Economics and Management, Chang'an University, Xi'an 710064, China

[2] School of Management, Northwestern Polytechnical University, Xi'an 710072, China

system notices the vehicle's location, temperature, humidity, and speed every 2 s and uploads the data on a cloud-based system.

Many prior studies discussed the different aspects of the blockchain-based supply chain. For example, Tapscott and Tapscott (2017) discussed transparent transactions within the blockchain network. Saberi et al. (2019) illustrated blockchain's sustainable relationship and adopting factors. However, to strengthen the success factors of blockchain, the authors also mentioned the challenging factors that need to be investigated. Furthermore, previous studies also discussed the adoption of blockchain technology in organizations. In this regard, Pournader et al. (2020) and Li et al. (2021) studied the adoption of blockchain technology in the supply chain and aviation industries. For instance, it cannot only streamline the process but also provide a cost-effective solution. Mobi (2020), in his study of "adoption of blockchain technology," emphasized that sharing components and information with a stakeholder makes the supply chain more transparent, smooth, efficient, and cost-effective. Logistics industries also adopt blockchain technology as it increases transparency and information sharing. Customers can easily find the origin of the food within 2 s. Walmart implemented this for transparency; Maersk and IBM use this to mitigate cross-border issues. In addition, Queiroz and Wamba (2019), in their study, discussed the recent blockchain applications. Lohmer et al. (2020) analyzed the resilience strategies, and Kshetri (2018) depicted the value and objectives of blockchain technology in the supply chain. Likewise, Wamba and Queiroz (2020) explored the themes used in blockchain-based supply chain studies and future research agendas. Moosavi et al. (2021) provided a short analysis using bibliographic coupling (citation, co-citation, co-occurrence analysis) and network analysis of the blockchain-based supply chain. Lim et al. (2021) provided the detail of the themes, dynamic industries, and methodology in their literature review. However, their proposed work did not provide any network analysis to cover other essential aspects of blockchain-based supply chain. Regarding recent studies related to bibliometric research, Kuzior and Sira (2022) selected 1842 documents published from 2007 to 2021 using the Scopus database. They performed citation and co-occurrence analysis using VOSviewer software. In another study on blockchain technology in the food supply chain, Pandey et al. (2022) used the Scopus database to perform general citations, bibliometric coupling, and co-word analysis. Jin and Chang (2022) conducted bibliometric research on blockchain in environmental management. They extracted data from WOS, and for description analysis, they adopted the R-package and VOSviewer for visualization. In conclusion, these articles discussed applications, values, recent trends, and future goals related to the blockchain-based supply chain. Still, no previous study focuses on other areas related to the blockchain-based supply chain that our paper tries to fulfill.

This research aims to reveal a comprehensive bibliometric literature review of the blockchain-based supply chain, to fulfill the gaps left by the prior studies. The results of this study can provide the hotspots of published articles to explore research opportunities. It can also provide deep knowledge of a research field, influencing authors' region and mapping its boundaries. To achieve research knowledge, it is compulsory to know the existing limitations (Tseng et al 2021). This provides an ease to identify new trends and expose the research agenda, as this is our primary motivation. To the best of the authors' knowledge, no prior study examined the detailed bibliometric literature review and software-based thematic analysis. Furthermore, this paper also discusses the adopted research methods, dynamic industries, and future agendas, to which the prior studies have not given much attention. It also provides a thematic analysis framework so that academic researchers and industrial practitioners can consider these for further research. Based on these factors, this study aims to answer the following questions:

Q1. What are the research hotspots in the existing literature on blockchain-based supply chains?
Q2. What are the most influential countries, articles, authors, and journals related to the blockchain-based supply chain?
Q3. What are the dominant themes and trends on the site of blockchain-based supply chain research?
Q4. Which critical methodologies and dynamic industries were discussed in blockchain-based supply chain literature?
Q5. What are the research gaps and future agendas in light of the blockchain-based supply chain?

Subsequently, this research tries to make the following contributions to the existing literature:

1. This study conducted a comprehensive bibliometric literature review using an R-based tool and VOSviewer. A descriptive analysis was performed to determine the prominent subject domains and number of publications per year. We also executed co-occurrence, bibliographic coupling, citation, co-authorship, and co-citation analyses to find the influencing articles, authors, countries, and organizations.
2. This research constructed a thematic framework after performing software-based thematic analysis to categorize the previous literature, which provides ease in checking the main research directions.
3. We also categorized the previous literature based on the adopted methodologies. The result provides insight into

implemented research methods and the missing ones that have not gained much attention.
4. We subdivided the articles based on dynamic industries, which provides help in examining which industry has been discussed by the previous literature and which industry needs to be discussed.
5. Furthermore, we also proposed research agendas for future studies based on the acquired results.

The remaining article is structured as follows: The bibliometric analysis section briefly discusses the history of bibliometric analysis. The research methodology section discusses the methodology used in this study. The network analysis section outlines the network analysis. At the same time, blockchain-based supply chain themes are provided in the next section. Likewise, adopted methodologies and dynamic industries are present in the following sections. Subsequently, the discussion section discusses the acquired results. Theoretical, managerial, and policy-related implications are provided in the implication section. The conclusion, limitations, and future agenda section conclude the paper and highlight the main areas for future research.

Bibliometric analysis

Bibliometric analysis was first introduced by Pritchard in 1969 and later was used by many scholars as a research method to understand the study background and to find the research gaps (Khanra et al. 2021; Tandon et al. 2021). This technique has been used in different fields, such as manufacturing (Bhatt et al. 2020), economics (Bonilla et al. 2015), big data (Khanra et al. 2020), and software development (Moral-Muñoz et al. 2020). This method provides the best intellectual structure of any domain without any fuzziness (Xue et al. 2018)**.** Many scholars have suggested mapping and thematic analysis of different research fields. Subsequently, our research addresses the application of blockchain technology in the supply chain and understanding its related fields from the start to the present.

Research methodology

This research mainly focuses on the bibliometric analysis of blockchain technology in the supply chain. The proposed research assesses the published articles using different statistical tools (VOSviewer, R-based tool) to extract a quantitative result from pictorial data. Initially, data was collected using various search engines and then analyzed to evaluate published articles per year and relevant research areas. Also, it provides detail about the influential authors, countries, organizations, and relevant journals that belong to the blockchain-based supply chain field. Furthermore, the most impactful subject areas and articles are highlighted based on the selected data. Hence, our proposed bibliometric study includes articles related to blockchain technology in the field of the supply chain since the origin of this technology. Mainly selected articles were associated with technology adoption, success factors, barriers, and applications in different supply chain operations and industries.

Data collection

Search strings were used to collect data for mining purposes in the selected databases (Scopus and WOS). The data was extracted on April 30, 2022. After this, these articles were reviewed and analyzed based on the titles, abstracts, and other inclusion–exclusion criteria proposed by various scholars.

Identification of search terms

Several articles from the previous literature were reviewed to identify the relevant keywords. For this purpose, we also searched "blockchain" and "supply chain" on Google Scholar to find suitable keywords. Based on the review process, the following critical terms were identified: Ethereum, hyper ledger fabric, distributed, decentralized, smart contracts, transport, logistics, and cross-border trade. After removing the duplication, the final search string was created by 1st and 2nd authors, which was ("blockchain" OR "Ethereum" OR "Hyperledger Fabric") AND ("Supply chain" OR "transport" OR "logistics" OR "cross-border trade"). This search string was used to scan the articles from Scopus and WOS databases on April 30, 2022.

Article selection

The selection of a database is essential for carrying out good research. For this purpose, we mainly used Scopus (www.scopus.com) and WOS (www.webofscience.com) databases. Compared to the other databases, Scopus provides extensive exposure, and its advanced search option allows scholars to aggregate references and citation arrangements from the articles (Maflahi and Thelwall 2016). Also, the Scopus database includes numerous journals published by different publishers, such as Springer, Elsevier, Taylor and Francis, Emerald Insight, and the IEEE (Foncubierta-Rodríguez et al. 2014). WOS was also used to account for articles and journals not present in the Scopus database.

Firstly, key terms were searched in both databases. Based on the abstract, title, and keywords, the total result for the Scopus and WOS databases were 3256 and 1398, respectively. Secondly, the subject area was limited to business management and accounting, decision sciences,

social sciences, economics, and finance, in which priority was given to only journals and review articles published in English.

Scopus also provides an option for selecting an appropriate journal. After selecting related journals, the third step is to thoroughly scan and review articles based on title, abstract and critical terms. In total, we extracted 564 articles from Scopus and 273 from the WOS database in BibTeX (bib) and plain text (txt) format. Finally, we applied a fourth and last step in which Bibliometrix, an R-based software, was used to combine both files after removing the duplicate articles. As a result, 431 articles were exported in comma-separated value (CSV) and research information system (RIS) format for bibliometric analysis.

Initial data screening

A total of 431 articles were extracted from Scopus and WOS databases, containing 175 journal publications from 2017 to April 2022. Table 1 shows the preliminary information about the data, which mainly included three types of articles, namely, research, review, and early access papers, where the maximum percentage goes for research articles. Furthermore, we also checked the variation of authors in which the collaboration index value was significant. The collaboration index value is the ratio of authors of multi-authored articles to the total multi-authored articles.

Table 1 Preliminary information derived from descriptive analysis

Description	Results
Timespan	2017–2022[a]
Database	Scopus, WOS
Sources (Journals)	175
Documents	431
Average years since the publication	1.4
Average citations per document	28.67
Average citations per year per doc	9.241
Article	383
Early access	19
Review	29
Authors	1185
Author appearances	1532
Single-authored documents	22
Documents per author	0.364
Authors per document	2.75
Co-authors per documents	3.55
Collaboration index	2.89[b]

[a]Publication year from June 2017 to April 30, 2022.

[b]Ratio of authors of multi-authored articles to total multi-authored articles

The result from Fig. 1 indicates an annual number of articles. The graph reveals the fact that there is a significant increase in the number of articles. The first article was published in June 2017. In 2018, research outputs accelerated particularly to 93% growth. Two more research methods were introduced in that particular year: case studies and content analysis in the blockchain-based supply chain field. Furthermore, in 2018, blockchain was introduced in the food supply chain for traceability purposes. Marsek and IBM also adopted blockchain technology for their supply chain network. The number of articles in 2019 goes beyond 46 plus, which shows an approximately 67% significant increase. That year, the research method shifted from case studies to content analysis. In 2020 total gain is calculated to be 55% as questionnaire surveys, action research, and mixed methods were the main research methods for that era. In 2021 38% growth was calculated, the lowest growth rate compared to the previous years. The COVID-19 epidemic might be one of the reasons behind this. A total of 79 articles were published in the first quarter of 2022, and the expected number of articles in this year will be 316, with an expected growth rate of 47%.

Articles were also categorized based on their subject domains. Table 2 shows that decision sciences (39%), operations management (27%), and business and accounting (15%) are the significant subject areas for blockchain application in the supply chain. However, the application of

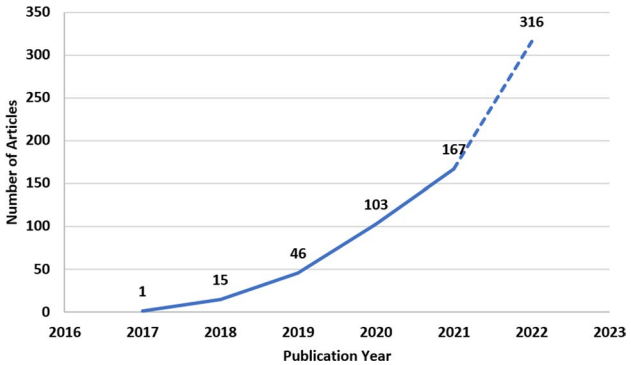

Fig. 1 Annually published number of articles related to blockchain-based supply chain

Table 2 Categorization based on subject domains

Subject area	Count (percentage)
Operations management	118 (27)
Decision sciences	167 (39)
Business and accounting	64 (15)
Environmental sciences	17 (4)
Social issues	54 (13)
Economics, econometrics, and finance	11 (3)

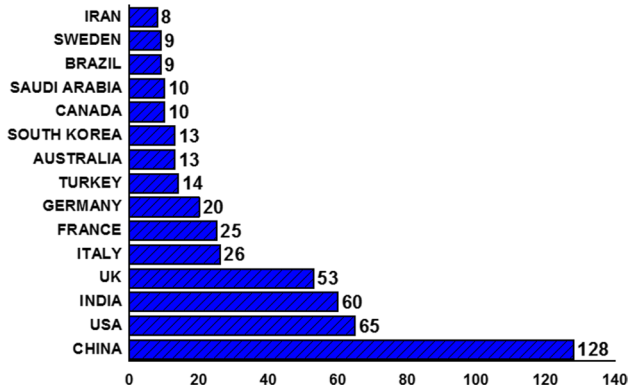

Fig. 2 Number of articles published by each country

blockchain also seems to be dominant in the field of social issues (13%). Environmental sciences (4%) and economics, econometrics, and finance (3%) got a comparatively lesser intensity.

The statistics also show that China (128) and the USA (65) are the leading countries in terms of published articles. Approximately 45% of total articles are reported by these two countries, followed by India (60) and the UK (53). The number of articles published by each country is shown in Fig. 2

Network analysis

Researchers have used various tools to conduct a bibliometric analysis, such as Bibliometrix, an R-based tool for literature mapping (Aria and Cuccurullo 2017), Gephi (Cherven 2015), CiteSpace (Van Eck and Waltman 2017), Pajek (Mrvar and Batagelj 2014), VOSviewer (Kuzior and Sira 2022), HistCite (Zhang et al. 2018), and Bibexcel (Pilkington 2018). We employed bibliometrix, an R-based tool for literature mapping, and VOSviewer for network visualization of scientometric data. We mainly performed co-occurrence analysis, bibliographic coupling, co-authorship, citation, and co-citation analysis in data analysis. To analyze the data and report the result, we referred to the software manuals of Guleria and Kaur (2021) and the research by Moosavi et al. (2021) and Oyewola and Dada (2022).

In network visualization of scientific data, the representation of the various items such as authors, publications, keywords, countries, and organizations has been performed by mentioning significant nodes (Akinlolu et al. 2020). Mainly one map contains only one item, as it is uncommon to get two things in a single map, e.g., the authors and publication in one map (Ali and Shoaib 2023). The node size (circle) in network mapping depicts the measured value of those items. The greater the numerical value, the more significant the node will be. The numerical value mainly represents the citation of an article or the number of occurrences. The link (edges) between the nodes represents the relationship between them. Connections determine the strength (weight) value; the greater the total link strength (TLS) value, the stronger will be the relationship between two nodes (Moosavi et al. 2021). Hence, if the node indicates the number of occurrences of the article, then links show the number of references shared between them. So greater the nodes greater will be the TLS value (weight). The position and color of nodes in a network map also provide essential information. If the article (nodes) lies closer to each other, it seems that they are related and share more references. The same color depicts that the article falls into the same category.

The bibliometrix R-based tool provides a wide variety of literature mapping. As compared to the other tools, it screens the data more efficiently. VOSviewer offers a broad view of visualization in different categories. VOSviewer mainly provides three types of visualization, e.g., "network visualization," "overly visualization," and "density visualization."

Co-occurrence analysis (co-word analysis)

Co-occurrence analysis was performed to understand the intellectual terms mentioned by various scholars. In total, 1322 author keywords and 1243 index keywords were identified. Table 3 depicts the TLS value of the top 10 authors and index keywords. "Blockchain" and "supply chain" were considered the most critical keywords in both categories. Figure 3a reveals the network visualization of all keywords. Blockchain and the supply chain are the most prominent nodes. In addition, the search terms used for scanning articles were also popular keywords, which shows the blockchain potential in supply chain management (Chang et al. 2019).

The success factors of pure blockchain technology, e.g., smart contract, trust, information management, and digital

Table 3 Co-occurrence analysis results for author and index keywords

Author keyword	TLS	Index keyword	TLS
Blockchain	322	Blockchain	258
Supply chain	303	Supply chain	277
Traceability	44	Food supply chain	39
Sustainability	34	Internet of things	35
Smart contract	31	Decision making	31
Transparency	26	Transparency	29
Logistics	22	Information management	26
Internet of things	20	Sustainable development	26
Trackability	20	Smart contract	25
Trust	19	Digital storage	23

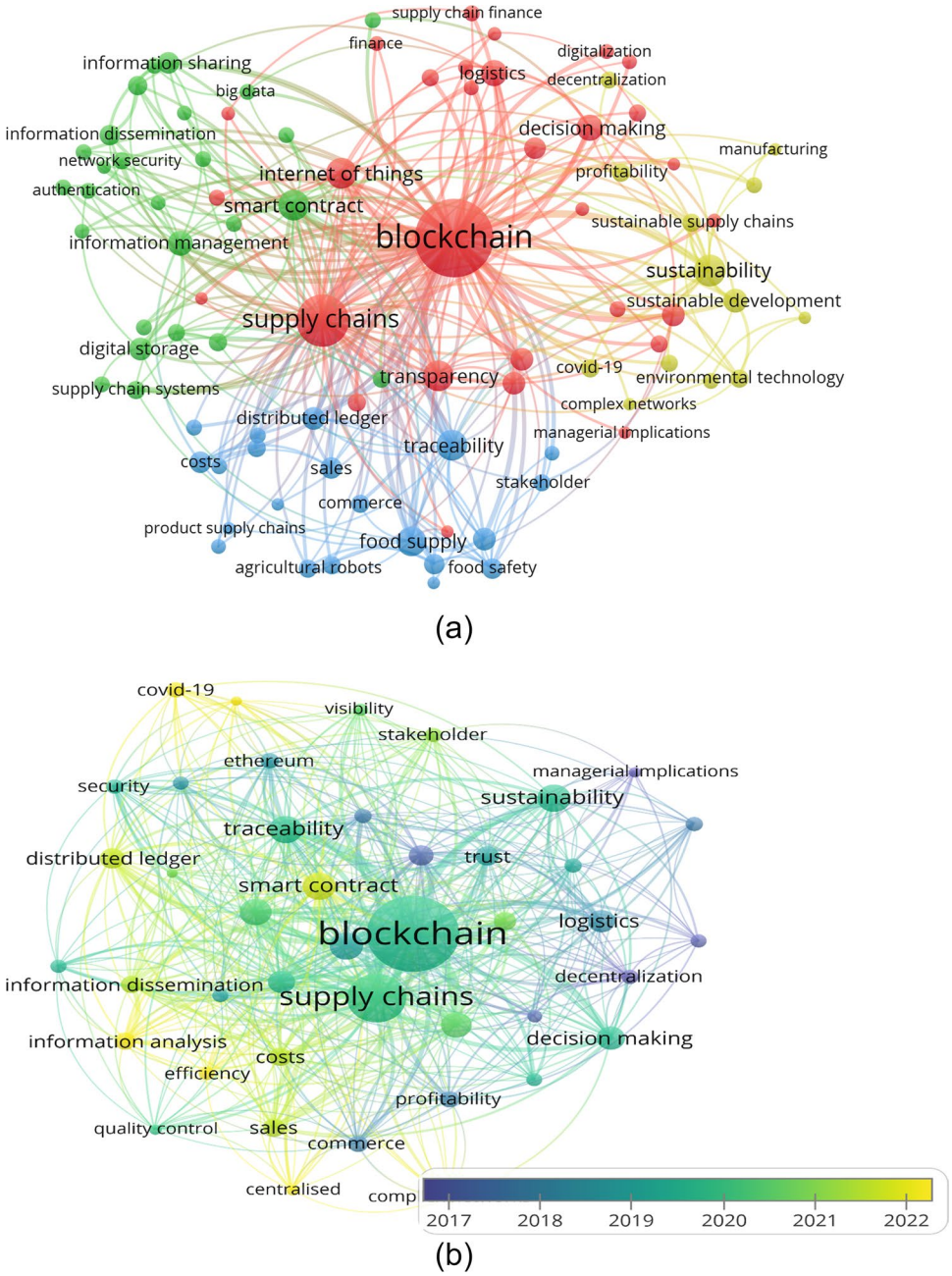

Fig. 3 **a** Network visualization of all keywords. **b** Overlay visualization of all keywords

storage, are the most prominent terms, as it is expected result because a "blockchain enables resilient and truly peer-to-peer distribution system" (Nakamoto 2008). The keyword "internet of things" also places itself in the top 10, indicating that these two technologies are used together. The efficiency of IoT-based blockchain technology is higher than that of individual ones (Yadav et al. 2021). Moreover, the supply chain characteristics, e.g., traceability, transparency, and tracking, were considered blockchain's top applications. According to prior studies, this technology has a deep root in supply chain and logistics operations (Agrawal et al. 2021).

The high numerical value of "sustainability" or "sustainable development" indicates that researchers also focus on making the supply chain more sustainable using blockchain technology. The high-frequency value for the "food supply chain" shows that this is also a hot topic in the supply chain industry. The traceability issues in food and medicines are still a challenge for the food and pharmaceutical industries, and blockchain is the only solution (Shoaib et al. 2020).

Furthermore, keywords were also analyzed based on a timespan of 2017 to April 2022. Figure 3b shows the overlay visualization of all keywords. A clear look at the graph reveals that COVID-19, information analysis, centralized,

smart contract, sales, cost, distributed ledger, and efficiency are the keywords used predominantly in early 2022. Terms, e.g., sustainability, decision-making, traceability, visibility, and stakeholder, were significant in 2020-2021.

Bibliographic coupling

Initial data screening of the top 10 journals is shown in Table 4. Journals are ranked based on fractional TLS values. As we can see, there are an excessive amount of blockchain articles on different supply chain domains, so researchers do not bind themselves to a few journals. Scholars in this domain adopted a diverse range of journals, including accounting, engineering management, information management, strategy, sustainability, applications, and operations management. Moreover, 17 journals have reported six or more articles in this area, approximately 10% of total journals. International Journal of Production Research and Sustainability are the top journals in this field, tracked by the International Journal of Production Economics and Supply Chain Management. Figure 4 depicts the bibliographic coupling for journals with the threshold of a minimum of five articles per journal and five citations per article.

Authors, organizations, and countries are ranked in bibliographic coupling based on the TLS values. TLS determines the strength of the link value shared between two nodes (authors, organizations, and countries). After applying the threshold criteria, the top 10 authors, organizations, and countries are given in Table 5. Sarkis J. got the highest impact value, followed by Gunasekaran A. and Choi T.M., which shows that their contributions to the blockchain-based supply chain are more significant than the other authors, and their articles are more worthwhile. As for the top ten organizations, Hong Kong Polytechnic University, Hong Kong, is considered the most impactful organization working in this domain. Four prominent authors from Hong Kong Polytechnic University, Choi

Table 4 Top 10 journals based on TLS values

Journal name	Count	Citation	TLS
International Journal of Production Research	24	2266	874.85
Sustainability (Switzerland)	37	731	841.55
International Journal of Production Economics	14	687	441.23
Supply Chain Management	10	1069	432.63
IEEE Access	26	978	384.71
Annals of Operations Research	9	116	366.62
Transportation Research Part E: Logistics and Transportation Review	11	682	334.35
International Journal of Information Management	8	1146	318.78
Computers & Industrial Engineering	12	454	309.74
Journal of Enterprise Information Management	6	86	286.82

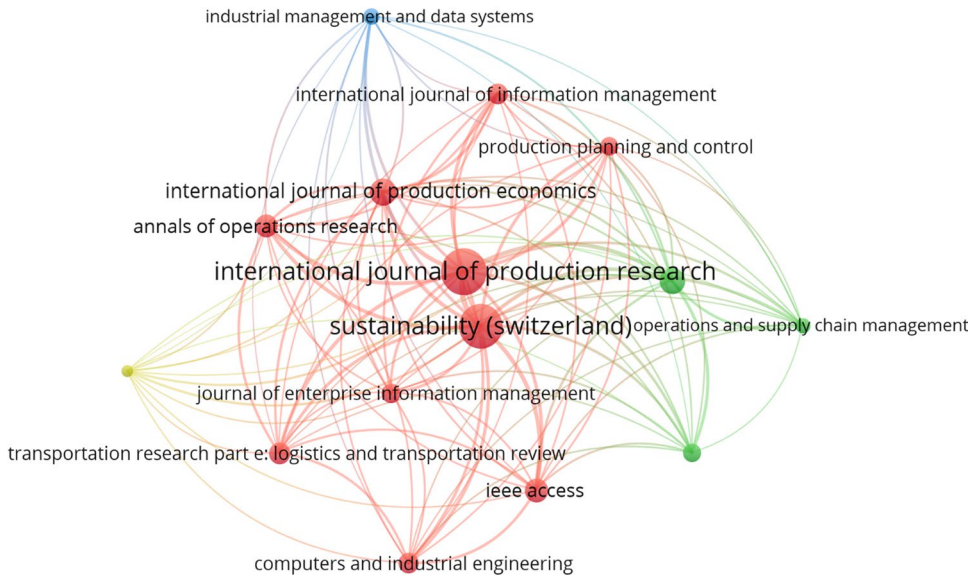

Fig. 4 Bibliographic coupling for journals

Table 5 Bibliographic coupling analysis results for the top 10 contributing authors, countries, and organizations

Authors (TLS)	Organizations (TLS)	Countries (TLS)
Sarkis J. (983.30)	The Hong Kong Polytechnic University, Hong Kong (332.66)	USA (4915.34)
Gunasekaran A. (815.77)	Toulouse Business School, France (270.26)	UK (4344.47)
Choi T.M. (695.03)	Paulista University, Brazil (270.26)	China (4221.02)
Queiroz M.M. (591.96)	California State University, USA (231.74)	India (3516.64)
Fosso Wamba S. (549.31)	Chongqing University, China (227.58)	France (2336.88)
Kumara (530.37)	Brunel University London, UK (220.86)	Australia (1428.30)
Kouhizadeh M. (488.79)	Worcester Polytechnic Institute, USA (208.83)	Turkey (1423.21)
Li Z. (468.87)	Liuc University Carlo Cattaneo, Italy (208)	Italy (1402.56)
Kayikci Y. (457.84)	Delft University of Technology, Netherlands (208)	Hong Kong (1383)
Wang Y. (455.75)	Emlyon Business School, France (205.36)	Pakistan (1186.49)

T.M., Lui J., Kumar A., and Wang Y., are on the list of top blockchain-based supply chain authors. The table also depicts TLS values for countries. The sequence of the most impactful country is the USA, UK, China, and India (Refer to Fig. 2). It is stated that China published more articles than UK and USA, but the worth of the articles published by the UK and USA is more than China. Interestingly, it is also observed that some developing countries, e.g., India and Pakistan, also make a significant contribution in this domain.

A bibliometrix, an R-based tool, is used to sketch the triple field plot mentioned in Fig. 5. This shows the interconnection among authors (left), affiliation (middle), and authors' keywords (right). This plot is based on count values, e.g., the number of publications per author, institute, and number of times keywords appear in the database. However, the sequence arrangement will differ. The graph reveals that three authors published most of the papers on blockchain technology with the affiliation of Khalifa University. Most articles are on blockchain technology and its core application (smart contracts, traceability). Moreover, sustainability is also a keyword for most of the articles.

Co-authorship analysis

To understand the multiple author contributions, a co-authorship analysis was performed. In a research field, co-authorship analysis measures the degree of combined publications between the scholars to expand the knowledge. Figure 6 presents the top four authors cluster with a minimum of five citations threshold and a resolution of 1.0. The clear look of Table 6 indicates that cluster 1 (red) Li Z. and Huang G.Q. having four links and 4 and 3 TLS, respectively, are the dominant authors. Wang J. and Li H. are more productive authors in cluster 2 (green) and Liu Y. in cluster 3 (blue), and Wang X. and Wang Y. in cluster 4 (yellow) appear as strong collaborative authors.

Most prominent authors of a few clusters are also considered the top 10 authors mentioned in bibliographic coupling analysis. Moreover, this also predicts that many authors are from the same region (China) and prefer collaboration with authors in the exact geographic location.

Co-authorship analysis for the organizations is depicted in Table 7. Only two clusters were considered for the

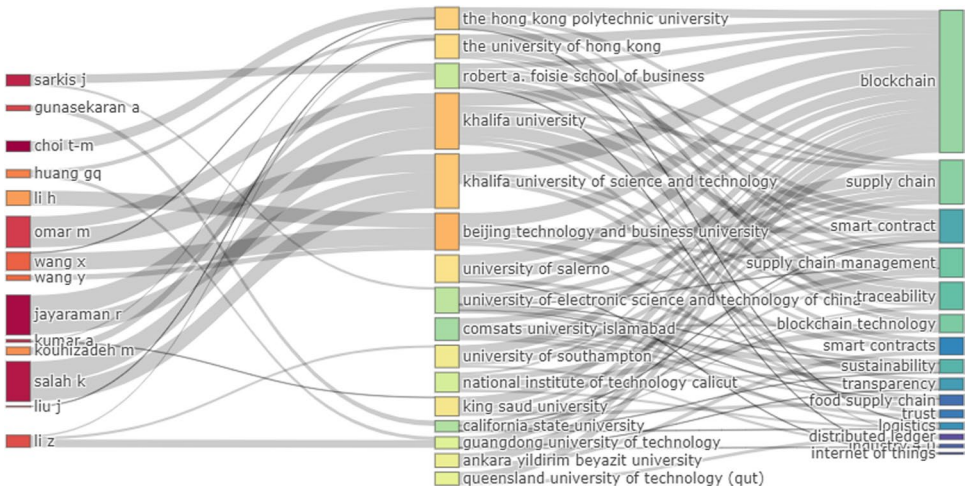

Fig. 5 Triple field plot of authors, affiliation, and keywords

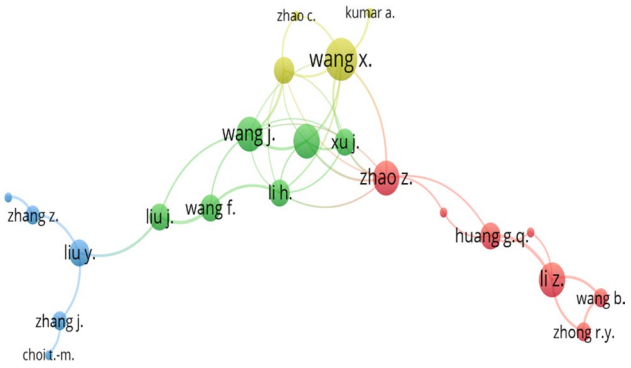

Fig. 6 Top 4 author clusters obtained from co-authorship analysis

Table 6 Links and TLS for co-authorship analysis for an author

Cluster 1(red)	Links	TLS	Cluster 2 (green)	Links	TLS
Huang G.Q	4	3	Wang F	3	3
Li Z	4	4	Wang J	8	4
Liu X	2	1	Li H	7	3
Wang B	2	2	Liu J	3	3
Zhang M	2	1	Xu J	6	3
Zhao Z	8	4	Zhang X	6	4
Zhong R.Y	2	2			
Cluster 3 (blue)	Links	TLS	Cluster 4 (yellow)	Links	TLS
Zhang J	2	2	Wang X	8	5
Zhang Z	2	2	Zhao C	2	1
Liu Y	3	3	Wang Y	7	3
Choi T-M	1	1	Kumar A	1	1
Chen Y	1	1			

organizations. Cluster 1 (red) contains six universities having six and eight links values. In cluster 2 (green), the average link value is four, except for the Emlyon Business School, Ecully, France, which has a link value of ten.

Compared to other analysis, co-authorship for an organization has not been harmonized as it contains threshold values for a minimum number of documents and citations of an organization which is challenging to meet simultaneously. Secondly, organizations include long names, including the school, university, city, and country. That is why the organization's name may not have a consistent format. Co-authorship analysis for an organization is shown in Fig. 7

The co-authorship analysis for 22 countries can be subdivided into the five clusters mentioned in Table 8 and shown in Fig. 8. Cluster 1 (red) is the most dominating one containing China and USA. Moreover, India and France in cluster 2 (green), Australia and Malaysian in cluster 3 (blue), Canada in cluster 4 (yellow), and Pakistan in cluster 5 (purple) are the most influencing countries according to their TLS values.

Citation analysis

Citation analysis provides help in understanding the research status in the domain of authors, countries, and organizations. Table 9 reveals that Sarkis and Kouhizadeh got the highest value of citation, followed by Choi and Wang. The USA, China, and the UK are on top of the list for the most cited articles. The result proposed that the researchers in these countries may focus on hot research topics in that domain. In case of affiliation, the Hong Kong Polytechnic University, Hong Kong, is nominated as a leading organization in citation analysis, same as bibliographic coupling results (refer to Table 5).

In comparison, bibliographic coupling provides the most efficient clustering and sharing of the intellectual framework of coupled articles, whereas citation analysis provides the details of the number of accepted published articles. Thus, the combined result of bibliographic coupling and citation analysis reveals that the Hong Kong Polytechnic University has published famous and highly accepted articles in this era

Table 7 Links and TLS for co-authorship analysis for an organization

Cluster 1 (red)	Links	TLS
Bahria Business School, Bahria University, Islamabad, Pakistan	6	1
Beijing Key Laboratory of Urban Spatial Information Engineering, Beijing, China	8	1
Lincoln International Business School, Lincoln, UK	8	1
School of Economics and Management, Chang'an University, Xi'an, China	6	1
School of Management and Economics, Dalian University, Dalian, China	6	1
School of Management and Engineering, Xuzhou University, Xuzhou, China	6	1
Cluster 2 (green)	Links	TLS
College of Business Administration, Sao Paulo, Brazil	4	1
Emlyon Business School, Ecully, France	10	2
Indian Institute of Management Kashipur, India	4	1
Jaipuria Institute of Operation and Supply Chain Management, Noida, India	4	1
National Institute of Industrial Engineering, Mumbai, India	4	1

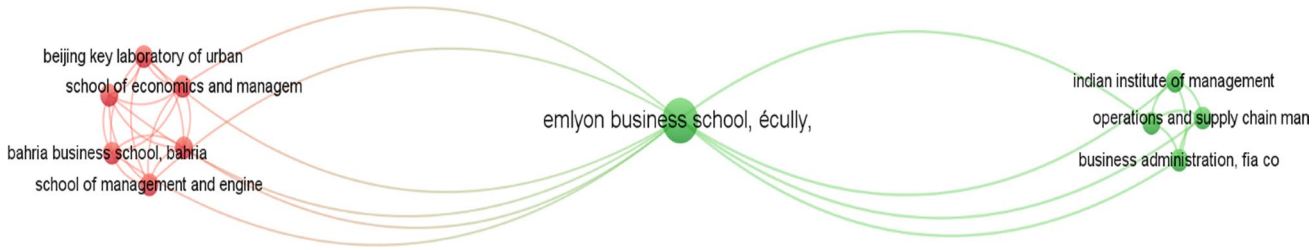

Fig. 7 Co-authorship analysis of organizations

Table 8 Links and TLS for co-authorship analysis for each country

Cluster 1(red)	Links	TLS	Cluster 2 (green)	Links	TLS	Cluster 3 (blue)	Links	TLS
China	15	49	France	12	16	Australia	12	14
Finland	3	5	India	15	30	Malaysia	9	9
Hong Kong	8	18	Russian federation	7	3	New Zealand	6	6
Taiwan	8	10	Turkey	3	3	UAE	8	9
USA	14	33	UK	5	10			
Cluster 4 (yellow)	Links	TLS	Cluster 5 (purple)	Links	TLS			
Canada	11	14	Pakistan	12	14			
Iran	8	8	Saudi Arabia	9	14			
Italy	9	7	South Korea	5	5			

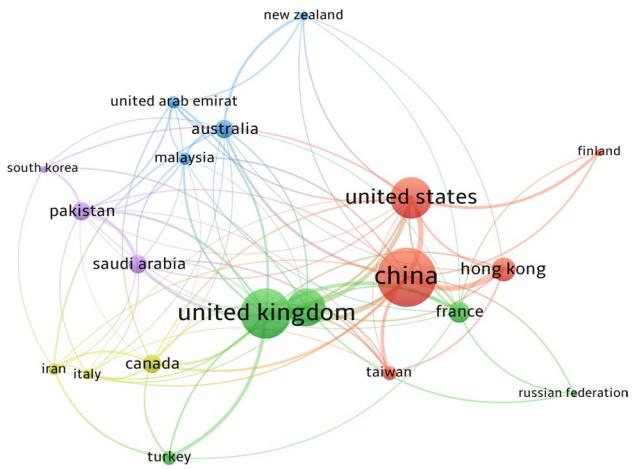

Fig. 8 The co-authorship analysis for countries

and has a significant role in making an intellectual framework and defining the research limitations.

Citation analysis has also been performed in this study to rank the articles based on global and local citations. Table 10 shows the ranking of articles based on a global citation. A local citation (LC) measures the number of citations a paper receives within the network. In contrast, a global citation (GC) is the number of citations received within the database. This value determines the popularity of an article in that domain. Saberi et al. (2019) got the highest-ranking value in global citation (799), followed by Queiroz and Wamba (2019) and Wang et al. (2018), having global citation values of 320 and 307, respectively. The key reason could be that Saberi et al. (2019) discussed blockchain technology and IoT in detail and their application to sustainable supply chains and logistics. Moreover, they also mentioned the implementation issues of blockchain technology in the supply chain. It is observed that global citation is not only the indicator for ranking. Interestingly, Wang et al. (2019) got a higher value of the local citation (73) as compared to Min (2019) having local citation (63). This shows the cross-disciplinary interest of authors in the domain of the blockchain. In addition, it is also observed that 2018–2019 articles got the highest citation values compared to previous years.

Co-citation analysis

Co-citation belongs to the state where two documents appear together in the reference list of the third document (Zupic and Čater 2015). In citation analysis, nodes represent the journal paper, and edges represent the paper's co-citation (Petroni et al. 2018). Therefore, the more the edges, the higher will be the co-citation value. The higher value of co-citation indicates that these papers are correlated and belong to the same field. We also observed that articles with a minimum of one citation also appear in that analysis. As it is difficult to perform an analysis for all the articles, so we choose threshold criteria of a minimum

Table 9 TLS and citation analysis for the top 10 authors, countries, and organizations

Authors	(TLS) Citation	Countries	(TLS) Citation	Organizations	(TLS) Citation
Sarkis J	(91)1446	USA	(1462)3785	The Hong Kong Polytechnic University, Hong Kong	(38)595
Kouhizadeh M	(76)1198	UK	(1278)2315	Cardiff University, UK	(33)327
Choi T.M	(61)787	China	(1213)2786	Shenzhen University, China	(15)162
Wang Y	(52)565	India	(978)1564	Chongqing University, China	(14)44
Wang J	(42)236	France	(557)1104	University of Salerno, Italy	(14)30
Gunasekaran A	(38)642	Italy	(524)749	Lund University, Sweden	(11)22
Li H	(36)115	Hong Kong	(487)1084	Khalifa University of Science and Technology, UAE	(10)227
Queiroz MM	(34)635	Turkey	(362)185	Auckland University of Technology, New Zealand	(10)153
Wang X	(32)76	Taiwan	(334)431	Lumen Research Institute, Australia	(10)141
Zhang X	31(40)	Australia	(299)628	University of Hong Kong, Hong Kong	(10)116

Table 10 Top 10 most cited articles based on the global citation

Author	Title	Journal Name	LC	GC	GCPY
(Saberi et al. 2019)	"Blockchain technology and its relationships to sustainable supply chain management"	*International Journal of Production Research*	158	799	199.7
(Queiroz and Wamba 2019)	"Blockchain adoption challenges in supply chain an empirical investigation of the main drivers in India and the USA"	*International Journal of Information Management*	80	320	80
(Wang et al. 2018)	"Understanding blockchain technology for future supply chains a systematic literature review and research agenda"	*Supply Chain Management*	78	307	76.7
(Min 2019)	"Blockchain technology for enhancing supply chain resilience"	*Business Horizons*	63	246	61.5
(Kamble et al. 2019)	"Understanding the Blockchain technology adoption in supply chains-Indian context"	*International Journal of Production Research*	61	244	61
(Treiblmaier 2018)	"The impact of the blockchain on the supply chain a theory-based research framework and a call for action"	*Supply Chain Management*	59	236	47.2
(Wang et al. 2019)	"Making sense of blockchain technology how will it transform supply chains"	*International Journal of Production Economics*	73	228	57
(Kamble et al. 2020)	"Modeling the blockchain enabled traceability in agriculture supply chain"	*International Journal of Information Management*	37	201	67
(Perboli et al. 2018)	"Blockchain in Logistics and Supply Chain: A Lean Approach for Designing Real-World Use Cases"	*IEEE Access*	41	200	40
(Cole et al. 2019)	"Blockchain technology implications for operations and supply chain"	*Supply Chain Management*	71	195	48.7

of five citations and the top 50 articles. Figure 9 presents the co-citation analysis for references. Four clusters were formed, consisting of 801 links and 418 TLS. This shows that articles in each cluster belong to a similar category and share the same reference list. Moreover, it is noted that Saberi et al. (2019) is the most impactful article having 43 links, 58 TLS, and 61 citations, followed by Kamble et al. (2019), having 42 links, 31 TLS, and 31 citations. This shows that most articles contain these two articles in their reference list.

Co-citation analysis for journals is also demonstrated in Fig. 10. Co-citation analysis for journals denotes the citation of two articles in different journals. Co-citation of the journal states which journal articles are correlated or which journals publish the articles having the same research domain. Three journal clusters were formed, with 80 links and 3291 TLS values. Cluster (red) contains the core journals related to the blockchain-based supply chain. *International Journal of Production Research* got the highest co-citation value among others, having 38 links, 365 TLS, and 854 citations, followed by *IEEE Access* journal, having 49 links, 429 TLS, and 645 citations.

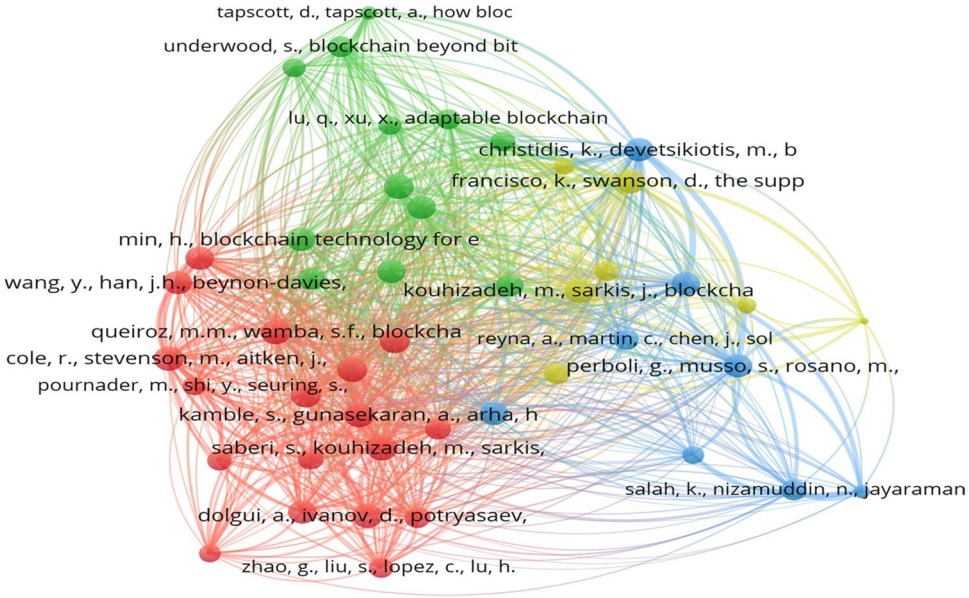

Fig. 9 Co-citation analysis for references

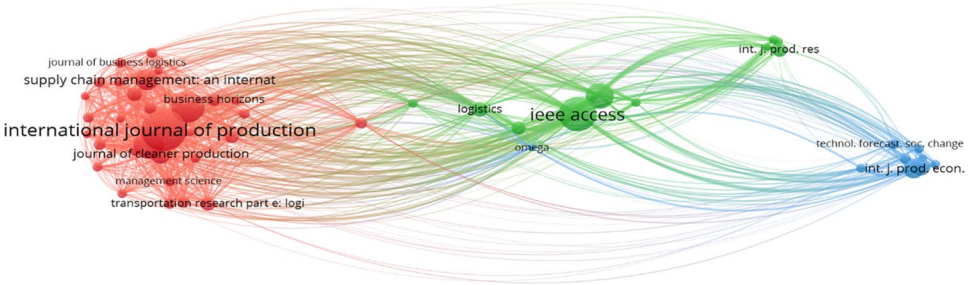

Fig. 10 Co-citation analysis for journals

Blockchain-based supply chain themes

With the increase in blockchain applications, it is challenging to analyze its knowledge-based areas. Thematic analysis is one of the methods by which previous literature can be categorized based on semantic similarities (Caviggioli and Ughetto 2019; Ali et al. 2022). The thematic analysis provides help in examining each cluster based on the content analysis.

Six thematic areas were identified using the bibliometric tool having 4627 links and 2457 TLS. Clusters are separated by different colors, as shown in Fig. 11. The top 5 articles from each cluster are ranked based on their TLS, as mentioned in Table 11.

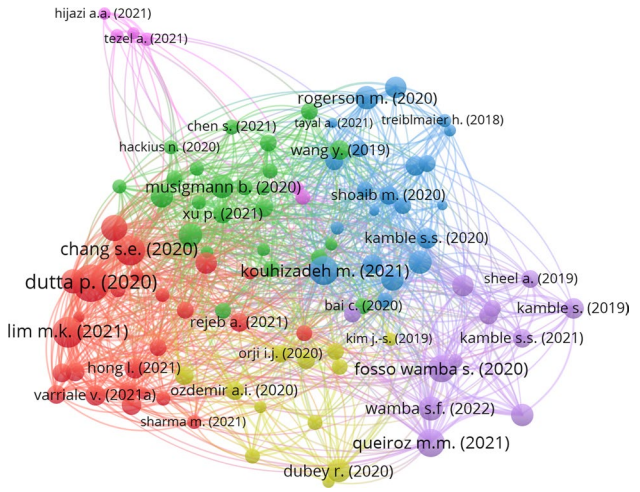

Fig. 11 Identified thematic areas using the bibliographic tool

Knowledge integration

This is one of the dominant clusters, containing 25% of articles. The articles within this cluster mainly focus on blockchain technology in general and supply chain in particular. Lim et al. (2021) mentioned the critical concepts related to blockchain technology and its characteristics. Furthermore, Dutta et al. (2020) noted its technological

Table 11 Six thematic clusters and their links, TLS, and citation values

Cluster	Articles	Links	TLS	Citations
Cluster 1(red) Knowledge integration	(Dutta et al. 2020)	96	132	129
	(Lim et al. 2021)	98	101	35
	(Chang and Chen 2020)	97	98	59
	(Kayikci et al. 2022)	98	81	30
	(Hong and Hales 2021)	95	6	8
Cluster 2 (green) Strategy and potential	(Wang et al. 2018)	95	56	307
	(Pournader et al. 2020)	96	49	191
	(Kopyto et al. 2020)	96	46	25
	(Li et al. 2020)	97	43	16
	(Centobelli et al. 2021)	96	41	17
Cluster 3 (purple) Technology implementation	(Wamba et al. 2020)	97	87	90
	(Queiroz and Wamba 2019)	90	66	20
	(Kamble et al. 2019)	75	59	244
	(Kamble et al. 2021)	94	56	29
	(Wong et al. 2020)	96	53	142
Cluster 4 (blue) Sustainability development	(Saberi et al. 2019)	82	69	799
	(Mukherjee et al. 2021)	97	67	21
	(Paul et al. 2021)	97	62	5
	(Nayak and Dhaigude 2019)	76	39	30
	(Kouhizadeh et al. 2021)	97	32	24
Cluster 5 (yellow) Performance and resilience	(Dubey et al. 2020)	90	69	139
	(Nandi et al. 2020)	98	46	38
	(Wang et al. 2020)	87	42	10
	(Lohmer et al. 2020)	94	40	68
	(Kim and Shin 2019)	97	33	52
Cluster 6 (pink) Industrial application	(Wang et al. 2021)	96	38	20
	(Tezel et al. 2021)	96	34	14
	(Kifokeris and Koch 2020)	84	33	10
	(Hamledari and Fischer 2021)	34	30	14
	(Hijazi et al. 2021)	79	29	6

key challenges in operational management as blockchain have the potential to make supply chain operations smooth. Blockchain's core characteristics, e.g., smart contracts, mutual trust, scalability, and transparency, help supply chain partners make agreements, payments, and many others.

Moreover, Kayikci et al. (2022) discussed blockchain technology in the light of operation, people (customers, stakeholders), and their performance. They argued that blockchain could potentially overcome supply chain issues in the future. It is also observed that some studies state the challenges of blockchain technology. For example, companies do not feel secure sharing their information in an unauthorized blockchain network, including scalability and latency issues (Dutta et al. 2020).

Strategy and potential

Articles within this cluster contain 24% of the total articles. They discuss the potential of blockchain technology in the supply chain and logistics. Most of the studies in this cluster mention transparency, trust, data security, information sharing, and decentralization network supply chain characteristics. Wang et al. (2018) provided the framework model for making a future strategy using blockchain technology. Li et al. (2020) argued that RFID and IoT could not improve transparency alone but with the integration of blockchain technology, especially in manufacturing organizations where integrated technology can enhance production.

Technology implementation

Cluster 3 shares 12% of total articles labeled as a technology implementation, with articles related to the adoption of blockchain technology in the supply chain. Due to the COVID-19 pandemic, the world economy has deteriorated. This raises a question mark on trust issues in the supply chain. According to a survey, over 75% of US firms have been disturbed by the lack of adoption of blockchain

technology (Fahim and Mahadi 2022). Shoaib et al. (2020) stated that 35% of organizations do not want to adopt this technology. In comparison, the challenges of blockchain technology got more attention for researchers than enablers. Queiroz and Wamba (2019) stated that cost is one of the main challenges for adopting blockchain technology, as this requires a heavy investment.

Many authors also studied the adoption of blockchain technology for different geological locations. The main reason is to validate the prime barriers that affect the adoption of blockchain technology. Kamble et al. (2019) studied the adoption of blockchain technology in India. Similarly, Queiroz and Wamba (2019) considered adopting blockchain technology in the USA and India, whereas Wong et al. (2020) mainly focused on Malaysia. Integrating all these studies concludes that technology adoption is one of the main barriers, including data mutability, scalability, data privacy, and security risk (Kamble et al. 2021). Furthermore, top management support is also one of the barriers. This includes organizational trust, culture for adoption, and hesitation to adopt the new technology.

Sustainability development

Sustainability in a blockchain-based supply chain is also one of the hot research domains. Saberi et al. (2019) stated that blockchain technology provides the best solution for making the supply chain more sustainable. They also argued that organizations could improve transparency by minimizing network and manufacturing costs. Organization can achieve their economic goals by using blockchain technology. Mukherjee et al. (2021) stated that blockchain provides transparency for food products. Due to the blockchain network, customers can easily trace the origin of the food (Paul et al. 2021). Hence, blockchain can improve customer satisfaction and trust between the stakeholders. Previous research also proposed a sustainable framework for adopting blockchain technology for small and medium enterprises (Nayak and Dhaigude 2019). This determines blockchain technology's potential for improving scalability and flexibility for operational management (Paul et al. 2021). Blockchain technology helps minimize the carbon footprint and reduce reverse logistics (Saberi et al. 2019).

Researchers recommended that blockchain technology increase the green supply chain transparency, support eco-design practices, and facilitate future strategies for making the supply chain green (Kouhizadeh and Sarkis 2018). This statement concluded that blockchain technology favors implementing green incentives in the supply chain.

Performance and resilience

Cluster 5 revolves around the resilience and overall performance of the blockchain-based supply chain. This cluster also contains 12% of the articles. Resilience in the supply chain is the "ability to resist risk," in other words, capacity for resistance or facility to quickly recover from disruption. These disruptions may be in the form of a sudden disaster, market trend, change in customer requirements, or competition between the companies and stakeholders. Globalization makes the supply chain more complex. Basole and Bellamy (2014) argued that the only way to mitigate the supply chain risk is to increase the visibility of supply chain operations and enhance the relationship with supply chain partners. Dubey et al. (2020) stated that the organization's capability to retort the risk could be enhanced by increasing the trust between the partners, cooperative learning, and introducing a transparent system within a supply chain. Blockchain provides the best solution to improve supply chain resilience by making all operations streamlined and building transparency in data sharing and products. Integrating the IoT and RFID system blockchain enhances the partners' transparency and accountability and develops a trust culture in supply chain operations.

Industrial application

The last theme, cluster 6, contains 6% of articles that focus on applying blockchain technology in the industry. Hamledari and Fischer (2021) argued that blockchain technology provides a better response for resolving the financial and physical issues in the engineering industry, as blockchain not only saves time and cost while sending the transactions within a network but it also provides a better solution for sharing information along with the material. Many authors, such as Tezel et al. (2021) and Kifokeris and Koch (2020), designed digital framework models to efficiently flow digital cash, product, and information. Moreover, it is observed that there are fewer articles in this domain and scholars must focus on this area for the better implementation of blockchain technology in industries.

Adopted methodologies

This section discusses the research methods used to study the blockchain-based supply chain. Articles are categorized into six main research methods. The percentage of the adopted methods is as follows: content analysis (38%), case study (21%), questionnaire survey (15%), decision modeling (14%), mixed method (9%), and grounded theory (3%). The adopted methodology illustrates the critical methodology

adopted by scholars in this domain. For this purpose, we include the articles till 2021.

Content analysis got the highest percentage in this domain. This category contains research-based articles. Articles in this category discuss the relationship of blockchain technology with the supply chain (Saberi et al. 2019; Schmidt and Wagner 2019), the implications of blockchain technology for operations (Cole et al. 2019; Tseng et al. 2018), implementation enablers and challenges (Dutta et al. 2020; Wamba and Queiroz 2020), and literature review (Chang and Chen 2020; Pournader et al. 2020).

The case study is considered to be the second most adopted methodology. Perboli et al. (2018) performed a case study on tracing and tracking, in which they integrated blockchain technology with RFID and IoT. Kshetri (2018), in his article, explained the significance of blockchain resilience, sustainability, increased quality, speed, and decreased cost. Furthermore, Tönnissen and Teuteberg (2020) also presented multiple case studies to check the impact of blockchain on the logistics industry and the business model.

The questionnaire survey and expert opinion (interview) got the third rank. Kamble et al. (2018) surveyed 181 participants from the supply chain industry and built a structural equation modeling for adopting the blockchain-based supply chain. In addition, Patil et al. (2020) surveyed different industries to identify 14 challenges for implementing blockchain in the supply chain. Their results state that data privacy, cost, and technological issues are the main barriers to implementing blockchain technology.

The next category is decision modeling, which includes articles containing mathematical modeling. Decisions are made based on the acquired results. This includes methods such as frequency analysis method, mean and variance approach, non-linear programming, and fuzzy set theory. Manupati et al. (2020) used mixed integer non-linear programming in their research and stated that blockchain practices could minimize cost and carbon emissions. Furthermore, Bai and Sarkis (2020) adopted the fuzzy set theory to tackle data uncertainty during evaluation.

Mix method is the fifth category that contains articles that cover a combination of two different methods. Mubarik and Mubarak (2020), in their study, initially used the hypothesis method and then took experts' opinions for the Malaysian manufacturing sector in their analysis. Azizi et al. (2021) integrate IoT and blockchain to build an intelligent supply chain. In the methodology section, they first used the qualitative method and then examined it using the quantitative approach (DEMATEL).

Grounded theory is the last research method. De Boissieu et al. (2021) emphasized that a blockchain provides efficiency and transparency in the supply chain, brings trust, and increases brand revenue. In addition, Della Valle and Oliver (2020), in their article, took interviews with 18 experts and provided the five critical enablers for the adoption of blockchain in the industry.

Dynamic industries

This section provides a detailed review of the literature based on adopted industries. As per the definition of the Australian Bureau of Statistics (Akbar et al. 2019), we divided industries into three main categories: small industry (i.e., 0–19 employees), medium industry (i.e., 20–200 employees), and large industry (i.e., greater than 200 employees). This provides help for researchers and scholars to examine which one is the prime industry in the blockchain-based supply chain field.

Small industries reported 36.8% and referred to the agricultural and food industries (Niknejad et al. 2021), which comprise above 50% of the total small industry. The main reason for having great attention is its security, as consumers must know the origin of the food and want transparency within a supply chain. Fresh food and meat also require a cold chain to maintain their temperature and humidity. Other industries include plastic (Pekarcikova et al. 2021) for making PVC pipes and other daily usage products, forest or wood (Molinaro and Orzes 2022) for making paper, and the fish industry (Tsolakis et al. 2021).

The medium industries accounted for approximately 34.5%; these industries contain multiple steps to make a finished product. It includes the industries for making electrical and electronic components (Bressanelli et al. 2021), small tools, instruments, and surgical equipment (Ahmad et al. 2021), pharmaceutical (Tseng et al. 2018), construction (Hamledari and Fischer 2021), and small manufacturing units (Karamchandani et al. 2021).

Large industries share 28.7%, it includes aviation (X. Li et al. 2021), automobile (Ada et al. 2021), textile (Agrawal et al. 2021), and the shipping industry (Li and Zhou 2021). It also consists of logistics and supply chain activities within three modes (water, air, and land). Blockchain integrated with RFID and IoT provides the finest monitoring system for transporting fresh food and drugs. It notices temperature and humidity every 2 s and uploads the data on a cloud-based system. This not only saves time but also minimizes the recalling of spoiled products. Blockchain improves the information and operations within the manufacturing unit (Karamchandani et al. 2021). It helps maintain warehousing, as retailers must know the arrival of the next shipping.

Discussion

This section discusses this research's main findings, which aid in examining the already addressed domains and identifying the research gaps. Moreover, this section also tries to answer the research questions mentioned in the introduction. Descriptive statistics show that the number of articles on the blockchain-based supply chain has increased exponentially compared to the previous years (Zhu et al. 2022a, b). The main reason is its efficient output in operations management.

The proposed research reveals that most articles are related to operations management and decision sciences. As far as the subject domain is concerned, blockchain and supply chain are the research hotspots (refer to Table 3), followed by a core application of blockchain technology (traceability, smart contract, transparency, trust). Furthermore, the authors' keywords contain the fundamental terms of the blockchain-based supply chain, whereas the index keywords have general terms. As far as the journals are concerned, the operation and production-related journals contain the maximum number of articles compared to others. For most of the journals, their TLS value goes beyond 400.

In terms of country, China published the highest number of articles compared to the others. On the other hand, the USA and UK got the lead from China in terms of authorship and co-citation analysis by comparing TLS and citation values. Most authors and organizations are from the Chinese institute with blockchain and supply chain as its leading research area. The results of this study are in favor of the study proposed by Jin and Chang (2022). Recently, articles on implementing blockchain technology in the supply chain have been hot topics.

Furthermore, the articles were categorized into six main clusters based on their similarities and differences. It is interesting to note that sustainability gained less attention than other clusters due to a lack of research in its two subdomains, environmental and economics (refer to section Sustainability development). As compared to social aspects, scholars must focus on ecological aspects, i.e., renewable energy, waste management, and greenhouse gases, under the umbrella of the blockchain. A pack of studies investigating the environmental aspects of inner and outer organizational development is required. As far as technology adoption in the supply chain is concerned, enough research has been carried out to discuss the technological factors (mathematical modeling, protocol), success factors, and challenges (Almutairi et al. 2022).

Furthermore, blockchain challenges, i.e., data privacy, security, information transmission, and storage, still need to be investigated. Scholars must focus on IP-based network systems for sharing blockchain networks. The study's finding shows that there is geographic specificity in terms of research compared to developing countries. Significant empirical studies have been conducted in developed countries discussing the different firms. We suggest that the same research needs to be conducted for developing countries.

This research also provides a theoretical framework for thematic analysis, which helps researchers to overview the existing literature and highlights the knowledge gaps that have not been given much attention. The percentage of each category is mentioned in Fig. 12. To summarize the six categories, much work is needed in the domain of sustainability development and industrial application.

Based on adopted methodologies articles have been categorized into six groups. Most of the research has been conducted on the conceptual work of blockchain technology and case study (refer to section adopted methodologies). Literature reveals that there is still a need for qualitative research. This provides help to investigate the issues related to the adoption of blockchain technology in management and social aspects. The limited literature on the grounded theory and investigating frameworks has been found, so these two sections also need attention.

In addition, articles were also grouped based on industries (refer to section dynamic industries). The agriculture and food industry, a sub-domain of the small industries, got the highest number of articles. Significant research is needed on other small enterprises, i.e., the plastic, wood, and fish industries. Much work has been done in the manufacturing and construction sectors for medium size industries. However, the pharmaceutical and equipment industry needs more consideration. Interestingly, for the large enterprises, compared to the previous two sectors, few articles discussed the aviation and the shipping logistics industries.

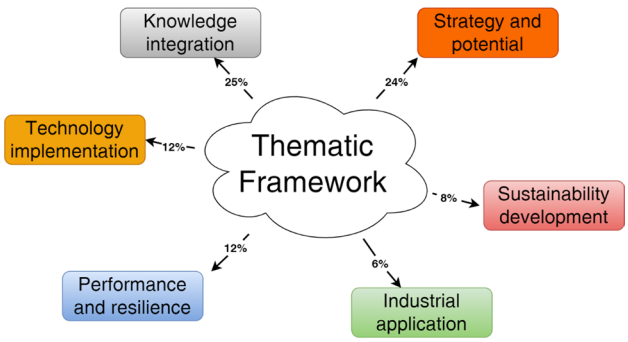

Fig. 12 Thematic framework of blockchain-based supply chain

Implications

This research provides a comprehensive bibliometric analysis that will facilitate the researchers to expand their knowledge about the blockchain-based supply chain. In this regard, the main implications of the proposed research are as follows:

Theoretical and managerial implications

This study facilitates understanding the existing research trends in the blockchain-based supply chain. The main objective is to investigate blockchain technology's scope, boundaries, trends, and development in the supply chain. As blockchain technology is currently in the developing stage, this research states the most impactful subject domains, related publications, authors, countries, organizations, and journals. The co-occurrence, bibliographic coupling, citation, co-authorship, and co-citation analysis enable checking the influencing articles, authors, countries, and research domains. This research allows supply chain researchers to find future research opportunities to resolve issues related to blockchain technology. The thematic analysis addresses the significant content discussed in the literature and further outlines future opportunities for scholars.

This research also provides help for managers and industry practitioners to mitigate the risks of adopting blockchain technology in supply chain operations and management. This can improve understanding of the adoption of blockchain technology and sustainable development in supply chain operations. In addition, the proposed research listed the essential methods adopted in this domain. It provides ease in investigating the previous and current research methods so that the decision-makers can decide which research method is preferable for future decisions. We also subdivided industries into three main categories for industrial practitioners so that managers from similar industries can quickly adopt this technology. Furthermore, some logistics industries (air, sea) have given less attention to adopting blockchain technology, so top management of these industries needs to consider adopting blockchain technology to increase their supply chain efficiency.

Policy-related implications

For policymakers, this research gives insight into many recommendations. Operations are one of the main tasks in the supply chain. Blockchain technology simplifies the process, reduces reverse logistics, and saves operation time and cost. It is recommended that policymakers should build strategies and initiatives to boost supply chain organizations to adopt blockchain technology. Policymakers should also guarantee the ease of blockchain implementation through regulations and legislation. Our proposed study also observed less contribution from developing states compared to developed ones. Therefore, the policymakers should launch plans and initiatives to force the governing bodies to provide more funding for developing regions, give them more incentives, and establish a tax-free zone for industries. The findings also indicate that communication between top management and supply chain partners plays a vital role in making the supply chain more sustainable. Regulatory bodies should reinforce the trust between supply chain partners and management of the organizations to make this more effective.

Conclusion, limitations, and future agenda

This research provides a review of articles published in the domain of the blockchain-based supply chain. It includes the basic information of previous literature, i.e., number of articles, publications per year, and subject areas using an R-based tool, and analyzes the most influencing authors, articles, journals, and countries. VOSviewer has been used to perform bibliometric network and visualization analyses. Furthermore, the thematic framework provides the content of previous literature. It also comprehensively analyzes the research methods used in prior studies and dynamic industries.

This research provides a holistic and integrated view of blockchain-based supply chain for academic scholars and industrial practitioners. As per the author's knowledge, no other research in this domain provided the most comprehensive literature review, which includes the bibliometric analysis, the thematic content analysis, the adopted methodologies, and dynamic industries information. We also examined the different sections and provided a roadmap and future agenda based on the acquired results.

The proposed research tried to cover all aspects of adopting blockchain technology in the supply chain domain. However, the suggested research only adopted the Scopus and WOS databases for data collection. There is a chance that some articles with a title other than the blockchain and supply chain might not be explored. The software (R-based tool, VOSviewer) used for data analysis mainly gives priority to the latest published articles compared to the previous ones, so there is a chance that some vital information might be missed during data analysis. While doing the bibliographic coupling analysis, the result of the VOSviewer analysis depends on selecting several nodes (threshold value) as sample data, which might result in the exclusion of some publications which do not gain much attention. So, future research can try to use different bibliometric software to overcome the limitations of this study.

This study aims to identify the current research status and highlights the research gaps for future research related to blockchain-based supply chain. Based on the acquired results, the following is the research agenda for future publications:

1. Most blockchain-based supply chain studies are on tracing and tracking; however, some other blockchain applications have been ignored by prior research. Future work can focus on discussing other blockchain applications.
2. Blockchain core enablers, e.g., data privacy, interoperability, and scalability, need to be investigated in detail.
3. Supply chain operations mainly operate on IoT and cloud-based blockchain systems. Only a few articles discussed IoT technology's use in supply chain operations, so scholars should focus on this topic.
4. Many organizations want to adopt blockchain technology in their supply chain operations, but it is challenging because of the high investment. Researchers should also concentrate on developing cheaper and new consensus mechanisms.
5. Subject areas, e.g., environmental sustainability, economics, and finance, also need to be discussed in the case of adopting a blockchain-based supply chain.
6. The proposed study states that one of the leading research domains is to discuss blockchain-based supply chain performance analysis. Researchers must focus on this direction as there are few articles in this field.
7. Regarding the adopted methodologies, mixed method and grounded theory received less attention, i.e., 9% and 3%, respectively. Scholars should apply these methodologies in their subsequent research.
8. Much research has been carried out on the small and medium size industries; however, the large industries, such as aviation and shipping, received less attention. Researchers must identify the operation barriers related to these two industries.

We believe that our analyses and proposed research agenda will motivate scholars to expand their knowledge by checking the current status and gaps for future research related to the blockchain-based supply chain. Also, industrial practitioners can implement blockchain technology to avoid supply chain disruptions.

Author contribution Conceptualization by Muhammad Shoaib and Shengzhong Zhang. Methodology by Muhammad Shoaib and Hassan Ali. Writing-original draft by Muhammad Shoaib and Hassan Ali. Finally, reviewing and editing by Shengzhong Zhang and Hassan Ali.

Funding The authors are financially sponsored by Central Universities Fundamental Research Foundation for Chang'an University (No. 300102231603).

Data availability Not applicable.

Declarations

Ethical approval Not applicable.

Consent to participate Not applicable.

Consent for publication All the authors' consent to publish this research paper in the journal of Environmental Science and Pollution Research.

Competing interests The authors declare no competing interests.

References

Ada N, Ethirajan M, Kumar A, Kek V, Nadeem SP, Kazancoglu Y, Kandasamy J (2021) Blockchain technology for enhancing traceability and efficiency in automobile supply chain—a case study. Sustainability 13(24):13667. https://doi.org/10.3390/su132413667

Agrawal TK, Kumar V, Pal R, Wang L, Chen Y (2021) Blockchain-based framework for supply chain traceability: a case example of textile and clothing industry. Comput Ind Eng 154:107130. https://doi.org/10.1016/j.cie.2021.107130

Ahmad RW, Salah K, Jayaraman R, Yaqoob I, Omar M, Ellahham S (2021) Blockchain-based forward supply chain and waste management for COVID-19 medical equipment and supplies. IEEE Access 9:44905–44927. https://doi.org/10.1109/ACCESS.2021.3066503

Akbar MA, Sang J, Khan AA, Hussain S (2019) Investigation of the requirements change management challenges in the domain of global software development. J Software: Evol Process 31(10):2207. https://doi.org/10.1002/smr.2207

Akinlolu M, Haupt TC, Edwards DJ, Simpeh F (2020) A bibliometric review of the status and emerging research trends in construction safety management technologies. International J Constr Manag 1-13. https://doi.org/10.1080/15623599.2020.1819584

Ali H, Shoaib M (2023) A comprehensive literature review on green supply chain management: recent advances and potential research directions. Int J Supply Oper Manag 10(1):57–75. https://doi.org/10.22034/IJSOM.2022.109587.2503

Ali H, Zhang J, Liu S, Shoaib M (2022) An integrated decision-making approach for global supplier selection and order allocation to create an environment-friendly supply chain. Kybernetes. https://doi.org/10.1108/K-10-2021-1046

Almutairi K, Hosseini Dehshiri SJ, Hosseini Dehshiri SS, Hoa AX, Dhanraj JA, Mostafaeipour A, Issakhov A, Techato K (2022) Blockchain technology application challenges in renewable energy supply chain management. Environ Sci Pollut Res 1-18. https://doi.org/10.1007/s11356-021-18311-7

Aria M, Cuccurullo C (2017) Bibliometrix: An R-tool for comprehensive science mapping analysis. J Informet 11(4):959–975. https://doi.org/10.1016/j.joi.2017.08.007

Azizi N, Malekzadeh H, Akhavan P, Haass O, Saremi S, Mirjalili S (2021) IoT–blockchain: harnessing the power of internet of thing and blockchain for smart supply chain. Sensors 21(18):6048. https://doi.org/10.3390/s21186048

Bai C, Sarkis J (2020) A supply chain transparency and sustainability technology appraisal model for blockchain technology. Int J Prod Res 58(7):2142–2162. https://doi.org/10.1080/00207543.2019.1708989

Basole RC, Bellamy MA (2014) Supply network structure, visibility, and risk diffusion: a computational approach. Decis Sci 45(4):753–789. https://doi.org/10.1111/deci.12099

Bhatt Y, Ghuman K, Dhir A (2020) Sustainable manufacturing. Bibliometrics and content analysis. J Clean Prod 260:120988. https://doi.org/10.1016/j.jclepro.2020.120988

Bonilla CA, Merigó JM, Torres-Abad C (2015) Economics in Latin America: a bibliometric analysis. Scientometrics 105(2):1239–1252. https://doi.org/10.1007/s11192-015-1747-7

Bressanelli G, Pigosso DC, Saccani N, Perona M (2021) Enablers, levers and benefits of circular economy in the electrical and electronic equipment supply chain: a literature review. J Clean Prod 298:126819. https://doi.org/10.1016/j.jclepro.2021.126819

Caviggioli F, Ughetto E (2019) A bibliometric analysis of the research dealing with the impact of additive manufacturing on industry, business and society. Int J Prod Econ 208:254–268. https://doi.org/10.1016/j.ijpe.2018.11.022

Centobelli P, Cerchione R, Del Vecchio P, Oropallo E, Secundo G (2021) Blockchain technology for bridging trust, traceability and transparency in circular supply chain. Information & Management 59(7):103508. https://doi.org/10.1016/j.im.2021.103508

Chang SE, Chen Y-C, Lu M-F (2019) Supply chain re-engineering using blockchain technology: a case of smart contract based tracking process. Technol Forecast Soc Chang 144:1–11. https://doi.org/10.1016/j.techfore.2019.03.015

Chang SE, Chen Y (2020) When blockchain meets supply chain: a systematic literature review on current development and potential applications. IEEE Access 8:62478–62494. https://doi.org/10.1109/ACCESS.2020.2983601

Cherven K (2015) Mastering Gephi network visualization: Packt Publishing Ltd. https://www.packtpub.com/product/mastering-gephi-network-visualization/9781783987344. Accessed 15 Jun 2022

Cole R, Stevenson M, Aitken J (2019) Blockchain technology: implications for operations and supply chain Management. Supply Chain Manag: Int J 24(4):469–483. https://doi.org/10.1108/SCM-09-2018-0309

Dasaklis TK, Voutsinas TG, Tsoulfas GT, Casino F (2022) A systematic literature review of blockchain-enabled supply chain traceability implementations. Sustainability 14(4):2439. https://doi.org/10.3390/su14042439

De Boissieu E, Kondrateva G, Baudier P, Ammi C (2021) The use of blockchain in the luxury industry: supply chains and the traceability of goods. J Enterp Inf Manag 34(5):1318–1338. https://doi.org/10.1108/JEIM-11-2020-0471

Della Valle F, Oliver M (2020) Blockchain enablers for supply chains: how to boost implementation in industry. IEEE Access 8:209699–209716. https://doi.org/10.1109/ACCESS.2020.3038463

Dubey R, Gunasekaran A, Bryde DJ, Dwivedi YK, Papadopoulos T (2020) Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. Int J Prod Res 58(11):3381–3398. https://doi.org/10.1080/00207543.2020.1722860

Dutta P, Choi T-M, Somani S, Butala R (2020) Blockchain technology in supply chain operations: applications, challenges and research opportunities. Trans Res E: Logistics Trans Rev 142:102067. https://doi.org/10.1016/j.tre.2020.102067

Fahim F, Mahadi B (2022) Green supply chain management/green finance: a bibliometric analysis of the last twenty years by using the Scopus database. Environ Sci Pollut Res 1-27. https://doi.org/10.1007/s11356-022-21764-z

Foncubierta-Rodríguez A, Müller H, Depeursinge A (2014) Retrieval of high-dimensional visual data: current state, trends and challenges ahead. Multimedia Tools Appl 69(2):539–567. https://doi.org/10.1007/s11042-012-1327-2

Guleria D, Kaur G (2021) Bibliometric analysis of ecopreneurship using VOSviewer and RStudio Bibliometrix, 1989–2019. Library Hi Tech 39(4):1001–1024. https://doi.org/10.1108/LHT-09-2020-0218

Hamledari H, Fischer M (2021) The application of blockchain-based crypto assets for integrating the physical and financial supply chains in the construction and engineering industry. Autom Constr 127:103711. https://doi.org/10.1016/j.autcon.2021.103711

Hijazi AA, Perera S, Calheiros RN, Alashwal A (2021) Rationale for the integration of BIM and blockchain for the construction supply chain data delivery: a systematic literature review and validation through focus group. J Constr Eng Manag 147(10):03121005. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002142

Hong L, Hales DN (2021) Blockchain performance in supply chain Management: application in blockchain integration companies. Ind Manag Data Syst 121(9):1969–1996. https://doi.org/10.1108/IMDS-10-2020-0598

Jin S, Chang H (2022) The trends of blockchain in environmental management research: a bibliometric analysis. Environ Sci Pollut Res 1-18. https://doi.org/10.1007/s11356-022-19856-x

Kamble S, Gunasekaran A, Arha H (2019) Understanding the Blockchain technology adoption in supply chains-Indian context. Int J Prod Res 57(7):2009–2033. https://doi.org/10.1080/00207543.2018.1518610

Kamble SS, Gunasekaran A, Gawankar SA (2018) Sustainable Industry 4.0 framework: a systematic literature review identifying the current trends and future perspectives. Process Saf Environ Prot 117:408–425. https://doi.org/10.1016/j.psep.2018.05.009

Kamble SS, Gunasekaran A, Kumar V, Belhadi A, Foropon C (2021) A machine learning based approach for predicting blockchain adoption in supply Chain. Technol Forecast Soc Chang 163:120465. https://doi.org/10.1016/j.techfore.2020.120465

Kamble SS, Gunasekaran A, Sharma R (2020) Modeling the blockchain enabled traceability in agriculture supply chain. Int J Inf Manage 52:101967. https://doi.org/10.1016/j.ijinfomgt.2019.05.023

Karamchandani A, Srivastava SK, Kumar S, Srivastava A (2021) Analysing perceived role of blockchain technology in SCM context for the manufacturing industry. Int J Prod Res 59(11):3398–3429. https://doi.org/10.1080/00207543.2021.1883761

Kayikci Y, Subramanian N, Dora M, Bhatia MS (2022) Food supply chain in the era of Industry 4.0: Blockchain technology implementation opportunities and impediments from the perspective of people, process, performance, and technology. Prod Plan Control 33(2–3):301–321. https://doi.org/10.1080/09537287.2020.1810757

Khanra S, Dhir A, Kaur P, Mäntymäki M (2021) Bibliometric analysis and literature review of ecotourism: toward sustainable development. Tour Manag Perspect 37:100777. https://doi.org/10.1016/j.tmp.2020.100777

Khanra S, Dhir A, Mäntymäki M (2020) Big data analytics and enterprises: a bibliometric synthesis of the literature. Enterp Inf Syst 14(6):737–768. https://doi.org/10.1080/17517575.2020.1734241

Kifokeris D, Koch C (2020) A conceptual digital business model for construction logistics consultants, featuring a sociomaterial blockchain solution for integrated economic, material and information flows. J Info Technol Constr 25(29):500–521. https://doi.org/10.36680/j.itcon.2020.029

Kim J-S, Shin N (2019) The impact of blockchain technology application on supply chain partnership and performance. Sustainability 11(21):6181. https://doi.org/10.3390/su11216181

Kopyto M, Lechler S, Heiko A, Hartmann E (2020) Potentials of blockchain technology in supply chain management: long-term judgments of an international expert panel. Technol Forecast Soc Chang 161:120330. https://doi.org/10.1016/j.techfore.2020.120330

Kouhizadeh M, Sarkis J (2018) Blockchain practices, potentials, and perspectives in greening supply chains. Sustainability 10(10):3652. https://doi.org/10.3390/su10103652

Kouhizadeh M, Saberi S, Sarkis J (2021) Blockchain technology and the sustainable supply chain: theoretically exploring adoption barriers. Int J Prod Econ 231:107831. https://doi.org/10.1016/j.ijpe.2020.107831

Kshetri N (2018) 1 Blockchain's roles in meeting key supply chain management objectives. Int J Inf Manage 39:80–89. https://doi.org/10.1016/j.ijinfomgt.2017.12.005

Kuzior A, Sira M (2022) A Bibliometric Analysis of Blockchain Technology Research Using VOSviewer. Sustainability 14(13):8206. https://doi.org/10.3390/su14138206

Li J, Maiti A, Springer M, Gray T (2020) Blockchain for supply chain quality management: challenges and opportunities in context of open manufacturing and industrial internet of things. Int J Comput Integr Manuf 33(12):1321–1355. https://doi.org/10.1080/0951192X.2020.1815853

Li L, Zhou H (2021) A survey of blockchain with applications in maritime and shipping industry. IseB 19(3):789–807. https://doi.org/10.1007/s10257-020-00480-6

Li X, Lai P-L, Yang C-C, Yuen KF (2021) Determinants of blockchain adoption in the aviation industry: empirical evidence from Korea. J Air Transp Manag 97:102139. https://doi.org/10.1016/j.jairtraman.2021.102139

Lim MK, Li Y, Wang C, Tseng ML (2021) A literature review of blockchain technology applications in supply chains: a comprehensive analysis of themes, methodologies and industries. Comput Ind Eng 154:107133. https://doi.org/10.1016/j.cie.2021.107133

Lohmer J, Bugert N, Lasch R (2020) Analysis of resilience strategies and ripple effect in blockchain-coordinated supply chains: an agent-based simulation study. Int J Prod Econ 228:107882. https://doi.org/10.1016/j.ijpe.2020.107882

Maflahi N, Thelwall M (2016) When are readership counts as useful as citation counts? Scopus versus Mendeley for LIS journals. J Am Soc Inf Sci 67(1):191–199. https://doi.org/10.1002/asi.23369

Manupati VK, Schoenherr T, Ramkumar M, Wagner SM, Pabba SK, Singh RIR (2020) A blockchain-based approach for a multi-echelon sustainable supply chain. Int J Prod Res 58(7):2222–2241. https://doi.org/10.1080/00207543.2019.1683248

Min H (2019) Blockchain technology for enhancing supply chain resilience. Bus Horiz 62(1):35–45. https://doi.org/10.1016/j.bushor.2018.08.012

MOBI (2020) About MOBI, mobility open blockchain initiative. https://dlt.mobi/about/. Accessed 22 Jun 2022

Molinaro M, Orzes G (2022) From forest to finished products: the contribution of Industry 4.0 technologies to the wood sector. Computers Ind 138:103637. https://doi.org/10.1016/j.compind.2022.103637

Moosavi J, Naeni LM, Fathollahi-Fard AM, Fiore U (2021) Blockchain in supply chain management: a review, bibliometric, and network analysis. Environ Sci Pollut Res 1-15. https://doi.org/10.1007/s11356-021-13094-3

Moral-Muñoz JA, Herrera-Viedma E, Santisteban-Espejo A, Cobo MJ (2020) Software tools for conducting bibliometric analysis in Science: an up-to-date review. El Profesional De La Información 29(1):e290103. https://doi.org/10.3145/epi.2020.ene.03

Mrvar A, Batagelj V (2014) Analysis and visualization of large networks with program package Pajek. Complex Adaptive Systems Modeling 4:6. https://doi.org/10.1186/s40294-016-0017-8

Mubarik M, Mubarak MF (2020) Fostering supply chain integration through blockchain technology: a study of Malaysian manufacturing sector. Int J Manag Sustain 9(3):135–147. https://doi.org/10.18488/journal.11.2020.93.135.147

Mukherjee AA, Singh RK, Mishra R, Bag S (2021) Application of blockchain technology for sustainability development in agricultural supply chain: justification framework. Oper Manag Res 1-16. https://doi.org/10.1007/s12063-021-00180-5

Nakamoto S (2008) Re: Bitcoin P2P e-cash paper. The Crypt Mailing List 1–2. https://www.bitcoin.org/bitcoin.pdf. Accessed 22 May 2022

Nandi ML, Nandi S, Moya H, Kaynak H (2020) Blockchain technology-enabled supply chain systems and supply chain performance: a resource-based view. Supply Chain Manag 25(6):841–862. https://doi.org/10.1108/SCM-12-2019-0444

Nayak G, Dhaigude AS (2019) A conceptual model of sustainable supply chain Management in small and medium enterprises using blockchain technology. Cogent Econ Finance 7(1):1667184. https://doi.org/10.1080/23322039.2019.1667184

Niknejad N, Ismail W, Bahari M, Hendradi R, Salleh AZ (2021) Mapping the research trends on blockchain technology in food and agriculture industry: a bibliometric analysis. Environ Technol Innov 21:101272. https://doi.org/10.1016/j.eti.2020.101272

Oyewola DO, Dada EG (2022) Exploring machine learning: a scientometrics approach using bibliometrix and VOSviewer. SN Appl Sci 4(5):1–18. https://doi.org/10.1007/s42452-022-05027-7

Pandey V, Pant M, Snasel V (2022) Blockchain technology in food supply chains: Review and bibliometric analysis. Technol Soc 101954. https://doi.org/10.1016/j.techsoc.2022.101954

Patil A, Shardeo V, Dwivedi A, Madaan J (2020) An integrated approach to model the blockchain implementation barriers in humanitarian supply chain. J Global Oper Strateg Sour 14(1):81–103. https://doi.org/10.1108/JGOSS-07-2020-0042

Paul T, Mondal S, Islam N, Rakshit S (2021) The impact of blockchain technology on the tea supply chain and its sustainable performance. Technol Forecast Soc Chang 173:121163. https://doi.org/10.1016/j.techfore.2021.121163

Pekarcikova M, Trebuna P, Kliment M, Kral S (2021) Case Study: 3D Modelling and Printing of a Plastic Respirator in Laboratory Conditions. Appl Sci 12(1):96. https://doi.org/10.3390/app12010096

Perboli G, Musso S, Rosano M (2018) Blockchain in logistics and supply chain: a lean approach for designing real-world use cases. IEEE Access 6:62018–62028. https://doi.org/10.1109/ACCESS.2018.2875782

Petroni BCA, de Moraes EM, Gonçalves RF (2018) Big data analytics for logistics and distributions using blockchain. In: Moon I, Lee G, Park J, Kiritsis D, von Cieminski G (eds) Advances in Production Management Systems. Smart Manufacturing for Industry 4.0. APMS 2018. IFIP Advances in Information and Communication Technology 536:363–369. Springer, Cham. https://doi.org/10.1007/978-3-319-99707-0_45

Pilkington A (2018) Bibexcel-quick start guide to bibliometrics and citation analysis. World Scientific Publishing 585-600. https://doi.org/10.1142/9781786344069_0021

Pournader M, Shi Y, Seuring S, Koh SL (2020) Blockchain applications in supply chains, transport and logistics: a systematic review of the literature. Int J Prod Res 58(7):2063–2081. https://doi.org/10.1080/00207543.2019.1650976

Queiroz MM, Wamba SF (2019) Blockchain adoption challenges in supply chain: an empirical investigation of the main drivers in India and the USA. Int J Inf Manage 46:70–82. https://doi.org/10.1016/j.ijinfomgt.2018.11.021

Saberi S, Kouhizadeh M, Sarkis J, Shen L (2019) Blockchain technology and its relationships to sustainable supply chain Management. Int J Prod Res 57(7):2117–2135. https://doi.org/10.1080/00207543.2018.1533261

Schmidt CG, Wagner SM (2019) Blockchain and supply chain relations: a transaction cost theory perspective. J Purch Supply Manag 25(4):100552. https://doi.org/10.1016/j.pursup.2019.100552

Shammar EA, Zahary AT, Al-Shargabi AA (2021) A survey of IoT and blockchain integration: security perspective. IEEE Access 9:156114–156150. https://doi.org/10.1109/ACCESS.2021.3129697

Shoaib M, Lim MK, Wang C (2020) An integrated framework to prioritize blockchain-based supply chain success factors. Ind Manag Data Syst 120(11):2103–2131. https://doi.org/10.1108/IMDS-04-2020-0194

Tagde P, Tagde S, Bhattacharya T, Tagde P, Chopra H, Akter R, Kaushik D, Rahman MH (2021) Blockchain and artificial intelligence technology in e-Health. Environ Sci Pollut Res 28(38):52810–52831. https://doi.org/10.1007/s11356-021-16223-0

Tandon A, Kaur P, Mäntymäki M, Dhir A (2021) Blockchain applications in management: a bibliometric analysis and literature review. Technol Forecast Soc Chang 166:120649. https://doi.org/10.1016/j.techfore.2021.120649

Tapscott D, Tapscott A (2017) How blockchain will change organizations. MIT Sloan Management Review. https://sloanreview.mit.edu/article/how-blockchain-will-change-organizations/. Accessed 10 Jun 2022

Tezel A, Febrero P, Papadonikolaki E, Yitmen I (2021) Insights into blockchain implementation in construction: models for supply chain Management. J Manag Eng 37(4):1–19. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000939

Tönnissen S, Teuteberg F (2020) Analysing the impact of blockchain-technology for operations and supply chain management: an explanatory model drawn from multiple case studies. Int J Inf Manage 52:101953. https://doi.org/10.1016/j.ijinfomgt.2019.05.009

Treiblmaier H (2021) The token economy as a key driver for tourism: entering the next phase of blockchain Research. Ann Tour Res 91:103177. https://doi.org/10.1016/j.annals.2021.103177

Treiblmaier H (2018) The impact of the blockchain on the supply chain: a theory-based Res framework and a call for action. Supply Chain Manag: Int J 23(6):545–559. https://doi.org/10.2139/ssrn.3224145

Tseng J-H, Liao Y-C, Chong B, Liao S-W (2018) Governance on the drug supply chain via gcoin blockchain. Int J Environ Res Public Health 15(6):1055. https://doi.org/10.3390/ijerph15061055

Tseng ML, Tran TPT, Ha HM, Bui TD, Lim MK (2021) Sustainable industrial and operation engineering trends and challenges Toward Industry 4.0: a data driven analysis. J Ind Prod Eng 38(8):581–598. https://doi.org/10.1080/21681015.2021.1950227

Tsolakis N, Niedenzu D, Simonetto M, Dora M, Kumar M (2021) Supply network design to address United Nations Sustainable Development Goals: a case study of blockchain implementation in Thai fish industry. J Bus Res 131:495–519. https://doi.org/10.1016/j.jbusres.2020.08.003

Vailshery LS (2022) Blockchain - Statistics & Facts. https://www.statista.com/topics/5122/blockchain/#dossierContents__outerWrapper. Accessed 12 Jun 2022

Van Eck NJ, Waltman LJS (2017) Citation-based clustering of publications using CitNetExplorer and VOSviewer. Scientometrics 111(2):1053–1070. https://doi.org/10.1007/s11192-017-2300-7

Wamba SF, Queiroz MM, Trinchera L (2020) Dynamics between blockchain adoption determinants and supply chain performance: an empirical investigation. Int J Prod Econ 229:107791. https://doi.org/10.1016/j.ijpe.2020.107791

Wamba SF, Queiroz MM (2020) Blockchain in the operations and supply chain management: benefits, challenges and future research opportunities. Int J Inf Manage 52:102064. https://doi.org/10.1016/j.ijinfomgt.2019.102064

Wamba SF, Queiroz MM (2022) Industry 4.0 and the supply chain digitalisation: a blockchain diffusion perspective. Prod Plan Control 33(2–3):193–210. https://doi.org/10.1080/09537287.2020.1810756

Wang M, Wu Y, Chen B, Evans M (2020) Blockchain and supply chain Management: a new paradigm for supply chain integration and collaboration. Oper Supply Chain Manag: Int J 14(1):111–122. https://doi.org/10.31387/oscm0440290

Wang Y, Chen CH, Zghari-Sales A (2021) Designing a blockchain enabled supply chain. Int J Prod Res 59(5):1450–1475. https://doi.org/10.1016/j.ifacol.2019.11.082

Wang Y, Han JH, Beynon-Davies P (2018) Understanding blockchain technology for future supply chains: a systematic literature review and Research agenda. Supply Chain Manag 24(1):62–84. https://doi.org/10.1108/SCM-03-2018-0148

Wang Y, Singgih M, Wang J, Rit M (2019) Making sense of blockchain technology: how will it transform supply chains? Int J Prod Econ 211:221–236. https://doi.org/10.1016/j.ijpe.2019.02.002

Wong L-W, Leong L-Y, Hew JJ, Tan GW-H, Ooi K-B (2020) Time to seize the digital evolution: adoption of blockchain in operations and supply chain Manag among Malaysian SMEs. Int J Inf Manage 52:101997. https://doi.org/10.1016/j.ijinfomgt.2019.08.005

Xue X, Wang L, Yang R (2018) Exploring the Science of resilience: critical review and bibliometric analysis. Natural Hazards 90(1):477–510. (https://link.springer.com/article/10.1007/s11069-017-3040-y)

Yadav S, Luthra S, Garg D (2021) Modelling Internet of things (IoT)-driven global sustainability in multi-tier agri-food supply chain under natural epidemic outbreaks. Environ Sci Pollut Res 28(13):16633–16654. https://doi.org/10.21203/rs.3.rs-84820/v1

Zhang M, Gao M, Yue S, Zheng T, Gao Z, Ma X, Wang Q (2018) Global trends and future prospects of food waste research: a bibliometric analysis. Environ Sci Pollut Res 25(25):24600–24610. https://doi.org/10.1007/s11356-018-2598-6

Zhu C, Guo X, Zou S (2022) Impact of information and communications technology alignment on supply chain performance in the Industry 4.0 era: Mediation effect of supply chain integration. J Ind Prod Eng 39(7):505–520. https://doi.org/10.1080/21681015.2022.2099472

Zhu Q, Bai C, Sarkis J (2022b) Blockchain technology and supply chains: the paradox of the atheoretical research discourse. Trans Res E: Logistics Trans Rev 164:102824. https://doi.org/10.1016/j.tre.2022.102824

Zupic I, Čater T (2015) Bibliometric methods in management and organization. Organ Res Methodol 18(3):429–472. https://doi.org/10.1177/1094428114562629