Revue Internationale des Sciences de Gestion
ISSN: 2665-7473
Volume 8 : Numéro 4

The Transformative Role of Blockchain Technology in Supply Chain Management: Enhancing Risk Management, Security, and Transparency

Le Rôle Transformateur de la Technologie Blockchain dans la Gestion de la Chaîne Logistique : Amélioration de la Gestion des Risques, de la Sécurité et de la Transparence

ABA-TALIB Khawla,
Laboratory of Studies and Research in Economic Sciences and Management (LERSEM)
Chouaib Doukkali University, ENCG
El Jadida, MOROCCO

ZOUINE Abdessamad,
Laboratory of Studies and Research in Economic Sciences and Management (LERSEM)
Chouaib Doukkali University, ENCG
El Jadida, MOROCCO

Date submitted : 30/09/2025

Date of acceptance : 19/11/2025

To cite this article :

ABA-TALIB K. & ZOUINE A. (2025) «The Transformative Role of Blockchain Technology in Supply Chain Management: Enhancing Risk Management, Security, and Transparency», Revue Internationale des Sciences de Gestion « Volume 8 : Numéro 4 » pp : 2001 - 2025

Abstract
Blockchain technology has emerged as a disruptive innovation for enhancing risk management, security and transparency within supply chains across numerous industries, which drew considerable attention for its potential in revolutionizing supply chain management practices. This systematic review analyzed 282 peer-reviewed articles published between 2016 and 2024 to explore the integration of blockchain technology in supply chain management. The analysis and bibliometric techniques applied in this review highlight leading researchers, influential journals, and emerging trends in blockchain adoption within supply chains, specifically focusing on risk management, security and transparency.
The findings of this research underscore blockchain's potential to strengthen supply chain resilience through the improvement of risk assessment capabilities and fostering of trust among stakeholders with an enhanced data integrity and transparency.
This systematic review synthesizes empirical evidence suggesting that blockchain technology offers a robust framework to address challenges in supply chain risk management and security. It promises significant advancements in operational efficiency, reduced vulnerabilities to fraud and cyber threats, and improved overall transparency, hence, providing critical insights for researchers, practitioners, and policymakers seeking to harness blockchain's potential in enhancing supply chain resilience and security.
Keywords: Blockchain technology, risk management, security, supply chain management, systematic review, transparency.

Résumé
La technologie blockchain s'est imposée comme une innovation disruptive pour renforcer la gestion des risques, la sécurité et la transparence au sein des chaînes logistiques dans de nombreux secteurs, suscitant un intérêt croissant pour son potentiel à transformer les pratiques de gestion de la chaîne logistique. Cette revue systématique, fondée sur l'analyse de 282 articles publiés entre 2016 et 2024, explore l'intégration de la blockchain dans la gestion des chaînes logistiques. Les analyses et techniques bibliométriques appliquées mettent en évidence les chercheurs majeurs, les revues influentes et les tendances émergentes dans l'adoption de la blockchain, avec un focus particulier sur la gestion des risques, la sécurité et la transparence.
Les résultats soulignent le potentiel de la blockchain à renforcer la résilience des chaînes logistiques en améliorant les capacités d'évaluation des risques et en favorisant la confiance entre les parties prenantes grâce à une intégrité et une transparence accrues des données.
Cette revue systématique synthétise des preuves empiriques indiquant que la blockchain offre un cadre robuste pour relever les défis liés à la gestion des risques et à la sécurité dans les chaînes logistiques. Elle met en lumière des avancées significatives en matière d'efficacité opérationnelle, de réduction des vulnérabilités face à la fraude et aux cybermenaces, ainsi que d'amélioration de la transparence globale, fournissant ainsi des éclairages essentiels pour les chercheurs, praticiens et décideurs souhaitant exploiter son potentiel pour renforcer la résilience et la sécurité des chaînes logistiques.
Mots-clés : Blockchain, gestion des risques, sécurité, chaîne logistique, revue systématique, transparence.

Introduction

The evolution of industries has been marked by many significant transformations driven by advancements in Industry 4.0 technologies. From traditional marketplaces to sophisticated e-commerce platforms, sectors have undergone profound shifts. However, these advancements have also introduced challenges that threaten trade integrity, in both physical and digital spaces. Nowadays, issues such as counterfeit and stolen goods undermine product authenticity and seller credibility, which poses financial risks and damages the reputations of legitimate brands.

In response to these challenges, there is an urgent need for a resilient system that is capable of ensuring product authenticity throughout the supply chain. Traditional methods, although somewhat effective, often struggle against today's sophisticated counterfeiting techniques.

Initially developed to support cryptocurrencies like Bitcoin, blockchain has emerged as a versatile tool transcending financial transactions. With its decentralized nature, coupled with its ability to provide transparent and immutable transaction records, it positions itself as an ideal candidate to address the challenges plaguing various industries (Xiao et al., 2020).

Blockchain technology, with its decentralized and immutable nature, offers an innovative approach to overcoming traditional limitations in ensuring transparency and trust across supply chains. Several studies have highlighted its contribution to improving traceability and mitigating logistics risks (Dhiba & Alaoui, 2020).

This study raises the following central question: How can blockchain technology effectively enhance risk management, security, and transparency within supply chain management systems?

To address this question, the study adopts the PRISMA systematic literature review approach combined with bibliometric analysis. Data were collected from major academic databases (Scopus, Web of Science, IEEE, and Emerald) and analyzed using tools such as VOSviewer, Zotero, and Excel to ensure methodological rigor and reproducibility.

This systematic review aims to comprehensively explore the recent emergence of blockchain technology. The study begins with an analysis of the current state and a meticulous collection of necessary data. Subsequently, these data will undergo rigorous analysis to identify various methodologies widely employed in examining the transformation of supply chain management (SCM) through blockchain.

Furthermore, this phase of the study intends to conduct a systematic review specifically focusing on the implications for risk management, security and transparency within SCM.

The study employs an analytical framework centered around terms such as "blockchain," "SCM," "risk management," "security implications" and "transparency" to trace the evolution of academic interest in this transformative field.

The study includes a detailed systematic review of relevant literature, an exploration of primary data sources, and a comprehensive descriptive analysis of scholarly records, further emphasizing the identification and analysis of risk management, transparency and security implications associated with blockchain adoption in supply chain contexts to delineate the emergence of academic interest in this field.

The study delineates a methodological framework intended to integrate novel methodological approaches and tools to enhance understanding, anticipate trends, and deepen insights into the transformative implications of blockchain technology within supply chain management, particularly in terms of risk management, transparency and security implications.

The remainder of this paper is structured as follows. Section 2 presents the methodological framework and PRISMA approach adopted in this study. Section 3 discusses the main bibliometric results and research trends. Section 4 provides a synthesis of the findings and their implications for risk management, security, and transparency in supply chain management. Finally, Section 5 concludes with key insights and recommendations for future research.

1. Methodology: PRISMA Systematic Literature Review

1.1 Research Design

Establishing a solid foundation is paramount to steer future studies in the right direction in the realm of theoretical research. This study employs the PRISMA systematic literature review approach to ensure transparency and reproducibility. The methodology is organized into distinct phases, including data collection, screening, eligibility assessment, and bibliometric analysis.

1.2 Data Sources and Search Strategy

A comprehensive search was conducted across major academic databases, including Scopus, Web of Science, IEEE, and Emerald Insight, to identify peer-reviewed articles related to blockchain and supply chain management. Only journal articles and reviews published between 2016 and 2024 were considered.

The research plan outlines the methodology employed for document retrieval and the criteria for their inclusion. The approach undertaken includes:

1. The research was conducted through an exploration of peer-reviewed academic databases, specifically Scopus, Web of Science, IEEE Xplore, and Emerald Insight. Exploratory searches were also carried out on HAL and Cairn.info to identify additional scholarly publications.
2. The databases were selected for their extensive coverage and access to comprehensive articles in operations management and economics, which are pertinent to this study.
3. Literature research was employed to gather robust insights into digital technology in economics, focusing on reviews and scholarly articles to ensure a thorough understanding of the field.
4. The research emphasizes the traceability of recent studies to provide insight into technological evolution, as well as to develop a critical perspective on the limitations of prevailing methodologies.
5. Journals and articles were selected based on their titles and relevance, with a thorough review of abstracts to ensure suitability. All references are presented in a standardized editorial format.

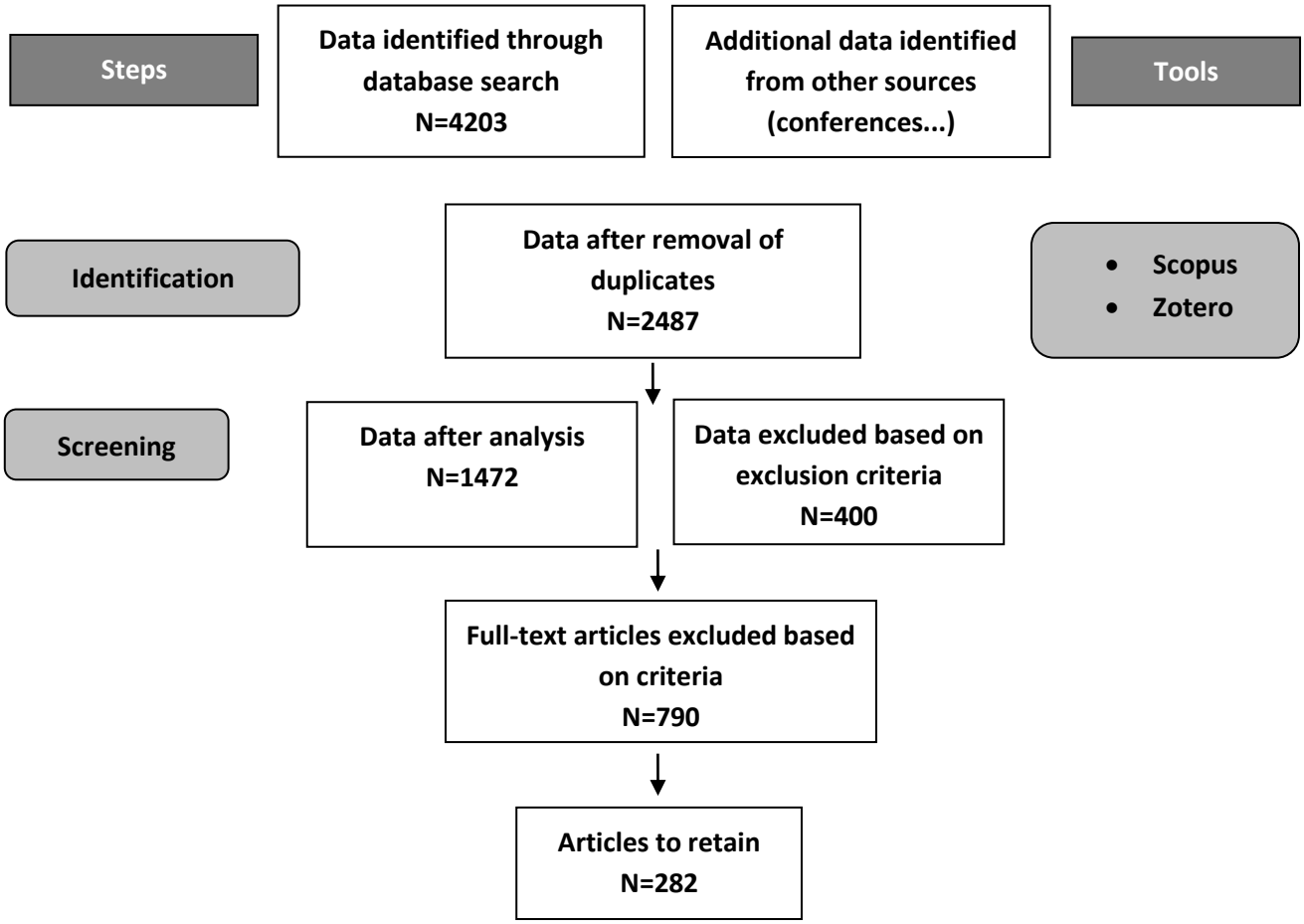
Inclusion criteria required that studies (1) directly addressed blockchain applications in supply chain management, (2) were published in English, and (3) provided empirical, conceptual, or bibliometric analysis. Excluded materials comprised conference abstracts, editorials, and non-peer-reviewed sources. HAL and Cairn were searched for exploratory purposes but excluded following eligibility criteria.

Although the primary inclusion criteria restricted the review to peer-reviewed journal articles and review papers, a limited number of conference papers were exceptionally retained due to their significant methodological or conceptual contribution to blockchain applications in supply chain management.

The relatively large number of duplicates (1716 records) is explained by the strong overlap between Scopus, Web of Science, IEEE Xplore, and Emerald Insight. Many blockchain-related articles appear in multiple databases simultaneously, particularly in computer science and engineering fields. Because the searches used broad TITLE-ABS-KEY strings, the overlap across databases produced a high duplicate rate, which is normal for multidisciplinary topics.

This systematic review, as detailed in Figure 1, illustrates the four-stage process employed in this study to ensure systematic and unbiased selection of sources.

Figure 1: Systematic literature review process (PRISMA flow diagram)



Source: *Author's own elaboration.*

Following duplicate removal and screening, 282 relevant articles were retained for full-text analysis, forming the final dataset employed for bibliometric mapping and synthesis. Duplicate entries were identified and removed using Zotero, based on DOI, article title, and publication year. Titles and abstracts were screened manually to exclude irrelevant studies, and the final inclusion of 282 articles followed the PRISMA selection flow (Figure 1).

This structured methodological framework ensures that the findings are grounded in a comprehensive and replicable review of current literature on blockchain technology in supply chain management.

1.3 Deduplication procedure and accounting

All records exported from the searched databases (Scopus, Web of Science, IEEE Xplore, Emerald Insight and complementary sources) were merged into a single master file (CSV) and

imported into Zotero for deduplication and bibliographic management. Deduplication followed a three-stage, reproducible workflow:

1. **Automated DOI exact-match removal.** First, Zotero's DOI and identifier fields were used to identify exact duplicates. Where two or more records shared an identical DOI, only one representative record was retained and all other DOI-identical records were removed automatically.
2. **Automated title + year fuzzy matching.** Second, remaining records were compared using title and publication year for near-exact matches (to catch records lacking DOI or having DOI formatting differences). A conservative fuzzy-matching rule was applied to avoid erroneous merges of distinct items with similar titles.
3. **Manual verification and consolidation.** Third, remaining potential duplicates flagged by Zotero were inspected manually. When multiple versions of the same work were present (e.g., conference preprint and later journal article), the version retained followed the study inclusion policy described in Methods (preference for peer-reviewed journal version). In cases of genuinely duplicated entries (same title, authors and year), duplicates were removed and the canonical record retained.

The deduplication process reduced the initial pool of 4203 records to 2487 records. For transparency and reproducibility, duplicate removals were logged and categorized by matching rule: DOI exact matches, Title+Year/fuzzy matches, and Manual consolidations.

Table 1. Reasons for exclusion during full-text screening

Reason for exclusion	n
Not focused on blockchain or SCM (scope mismatch)	**232**
Wrong document type	**137**
Lack of methodological relevance	**118**
Unavailable full text	**46**
Duplicate publication	**34**
Not in English	**21**
Out of time window (pre-2016 or post-2024)	**17**
No substantive discussion of risk, transparency, or security	**185**

Source: *Compiled by the authors based on the systematic screening process.*

Systematic research into the impact of blockchain technology on SCM employs a range of tools to ensure rigorous data collection, analysis, and synthesis.

The following are some of the key tools that were employed in the production of this article:

Table 2. Analytical tools and software used in the systematic literature review

• **EXCEL**	Content analysis
• **Data base**	Scopus
• **Logiciel ZOTERO**	Management of bibliographical references
• **VOSviewer**	Linking and mapping of bibliography
• **WorldART**	
• **R logiciel - R studio**	

Source: *Author's own elaboration.*

The integration of multiple analytical tools enhanced both the precision and depth of this systematic review. By combining VOSviewer for network visualization, Zotero for bibliographic organization, and Excel for content analysis, the study ensured methodological rigor and replicability. These tools collectively facilitated the identification of research trends, keyword clusters, and citation dynamics that underpin the subsequent bibliometric analysis.

The use of Zotero and VOSviewer will be discussed and visually represented later in this research, particularly in the bibliometric mapping figures that illustrate the relationships among keywords, authors, and affiliations.

Table 3: Synthesized overview of blockchain's role in supply chain management: a comparative analysis of risk management and security approaches

Authors (Year)	Work Title	Methodology	Key Contributions
Lashkari, Bahareh, Musilek, Petr (2021)	*A Comprehensive Review of Blockchain Consensus Mechanisms*	Literature review	• Provides a comprehensive review of 130 consensus algorithms with an architectural classification, analyzing their application domains and performance metrics.
Agrawal, Kanika, Mayank aggarwal, sudeeptanwar, gulshansharma, pitshou n. bokoro, ravisharma (2022)	*An Extensive Blockchain Based Applications Survey: Tools, Frameworks, Opportunities, Challenges and Solutions*	Experimentation in two comparative studies (augmented reality vs website)	• Surveys diverse blockchain applications across multiple domains, identifies key tools, frameworks, and explores recent research trends in blockchain technology.
Denisolt Shakhbulatov, Jorge Medina, Ziqian Dong, Roberto Rojas-Cessa (2020)	*How Blockchain Enhances Supply Chain Management: A Survey*	Review of the literature on blockchain and its transformational impact	• Surveys various blockchain frameworks in supply chain management, evaluating their respective advantages and disadvantages across diverse industrial sectors.
Arun Kumar S., Dharani Nagineni, Buvanambigai J., Mallikharjuna Rao S., Raghava A. Satya (2019)	*Developing a context for security and privacy in decentralized trading based blockchain technology*	First quantitative study (by online questionnaire) followed by a second qualitative study (by unstructured interviews)	• Implements a proof of concept for a decentralized trading system using blockchain technology, emphasizing security and privacy in supply chain transactions.
Casino, F., Dasaklis, T. K., & Patsakis, C. (2019)	*A systematic review of blockchain-based applications: Current status, classification and open issues*	Systematic literature review of blockchain applications; classification of studies; analysis of technical and security-related issues.	• Identifies technical security risks and vulnerabilities in blockchain systems, including consensus weaknesses and data integrity issues.
Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019)	*Blockchain technology and its relationships to sustainable supply chain management*	Integrative literature review combining sustainability and supply chain risk frameworks to assess blockchain implications.	• Shows how blockchain reduces operational and informational risks, enhances coordination, and supports sustainable and resilient supply chain practices.
Francisco, K., & Swanson, D. (2018)	*The supply chain has no clothes: Technology adoption of blockchain for supply chain transparency*	Conceptual analysis supported by case-based evidence on blockchain adoption for	• Demonstrates how blockchain improves traceability, visibility, and information sharing across multi-tier supply chains, reducing information asymmetry and

		transparency in supply chains.	enhancing trust.
Kshetri, Nir (2017)	*Blockchain's roles in strengthening cybersecurity and protecting privacy*	Two experiments followed by a questionnaire each	• Evaluates blockchain's role in enhancing cybersecurity and privacy compared to cloud computing, focusing on IoT security and supply chain management.

Source: *Author's own elaboration.*

Based on the comparative analysis presented in Table 3, blockchain technology demonstrates a profound impact on risk management and security within supply chain management. The reviewed literature highlights the core attributes of blockchain. By leveraging its decentralized ledger and cryptographic principles, blockchain enables transparent and tamper-proof tracking of transactions and goods throughout the supply chain, significantly reducing vulnerabilities to fraud and counterfeit products. Moreover, blockchain's capability to automate and secure transactions through smart contracts further strengthens its operational efficiencies. Therefore, the synthesized findings from prior studies underscore blockchain's pivotal contribution to transforming supply chain practices by fortifying risk management frameworks and enhancing security measures, as delineated in Table 3.

1.4 Data sources

In conducting a meticulous review of peer-reviewed literature, this study's primary focus centered on utilizing Scopus as the principal data source for a comprehensive review of articles published from 2016 to 2024 within our specific research domain. Our selection criteria were confined to scholarly articles, conference papers, and reviews that were published exclusively in English. Data were meticulously extracted in CSV format, encompassing comprehensive details such as authors' identities, affiliations, article titles, abstracts, and keywords.

The script adopted to carry out our research on the international database Scopus is presented above. It includes the following thread:

TITLE-ABS-KEY (blockchain AND supply AND chain) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (EXACTKEYWORD , "Supply Chain") OR LIMIT-TO (EXACTKEYWORD , "Blockchain") OR LIMIT-TO (EXACTKEYWORD , "Block-chain") OR LIMIT-TO (EXACTKEYWORD , "Supply Chains") OR LIMIT-TO (EXACTKEYWORD , "Supply Chain Management") OR LIMIT-TO (EXACTKEYWORD , "Internet Of Things") OR LIMIT-TO (EXACTKEYWORD , "Blockchain Technology") OR LIMIT-TO (EXACTKEYWORD , "Smart Contract") OR LIMIT-TO (EXACTKEYWORD , "Distributed Ledger") OR LIMIT-TO (EXACTKEYWORD , "Traceability") OR LIMIT-TO (EXACTKEYWORD , "Transparency") OR LIMIT-TO (EXACTKEYWORD , "Smart Contracts") OR LIMIT-TO (EXACTKEYWORD , "Food Supply") OR LIMIT-TO (EXACTKEYWORD , "Digital Storage") OR LIMIT-TO (EXACTKEYWORD , "Decentralised") OR LIMIT-TO (EXACTKEYWORD , "Ethereum") OR LIMIT-TO (EXACTKEYWORD , "Security") OR LIMIT-TO (EXACTKEYWORD , "IoT") OR LIMIT-TO (EXACTKEYWORD , "Industry 4.0") OR LIMIT-TO (EXACTKEYWORD , "Artificial Intelligence") OR LIMIT-TO (EXACTKEYWORD , "Cryptography") OR LIMIT-TO (EXACTKEYWORD , "Network Security") OR LIMIT-TO (EXACTKEYWORD , "Data Privacy") OR LIMIT-TO (EXACTKEYWORD , "Logistics") OR LIMIT-TO (EXACTKEYWORD , "Traceability Systems") OR LIMIT-TO (EXACTKEYWORD , "Efficiency") OR LIMIT-TO (EXACTKEYWORD , "Big Data") OR LIMIT-TO (EXACTKEYWORD , "Supply Chain Systems") OR LIMIT-TO (EXACTKEYWORD , "Technology")) AND (LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "BUSI"))

The final Scopus query was executed on September 15, 2024, and then adapted for Web of Science, IEEE Xplore, and Emerald Insight using equivalent field codes (TITLE-ABS-KEY or ALL FIELDS). The long list of keywords was initially used to capture a wide range of related concepts (e.g., “blockchain,” “supply chain,” “traceability,” “risk management,” “security”). After several test runs, less frequent or redundant terms were removed to reduce noise, while keeping the core SCM-related studies. This iterative process of keyword expansion and reduction ensured a balance between inclusiveness and relevance, limiting the risk of missing pertinent studies not tagged with specific keywords in Scopus.

1.5 Search Strategy

When conducting the search, we had a list of 4,203 results dating from 2016 to 2024. To refine, only publications of type "Journal" and "Review" were included, and linguistic criteria were limited to English only, to ensure methodological consistency and comparability across studies. The results were saved in CSV format and contained all information such as the authors' name and affiliation, article title, abstract and keywords. This data was used as the primary source for systematic literature analysis.

The methodology adopted is based on the selection of articles from the international Scopus databases. In total, 4203 articles dealing with blockchain technology in SCM were examined, two closely related topics. The dataset covers a wide range of journals (over 300 distinct sources), reflecting the multidisciplinary nature of blockchain and SCM research. This diversity of outlets has made it possible to identify the most frequently discussed topics as well as current topics that could be the subject of future research.

In parallel, the development of this systematic and bibliometric review was based on a thorough reading of various specialized journals in economics all referenced in Scopus and classified in the first quartile. This ensured the relevance and high quality of the information collected, which is essential for the development of this study.

2. Bibliometric Analysis

We have collected a total of 4,203 articles on our topic, as identified through the Scopus database. Our analysis of publication trends reveals that the volume of articles published between 2016 and 2024 was initially modest, potentially due to a nascent interest among researchers in this area. However, since 2020, there has been a marked increase in scholarly interest regarding the impact of blockchain technology on SCM, which has notably attracted the attention of numerous authors eager to investigate this phenomenon.

Table 4 presents the main funding organizations that have supported blockchain-related research in Supply Chain Management during the period 2016–2024.

Table 4. Top Funding Organizations in Blockchain and SCM Research (2016–2024)

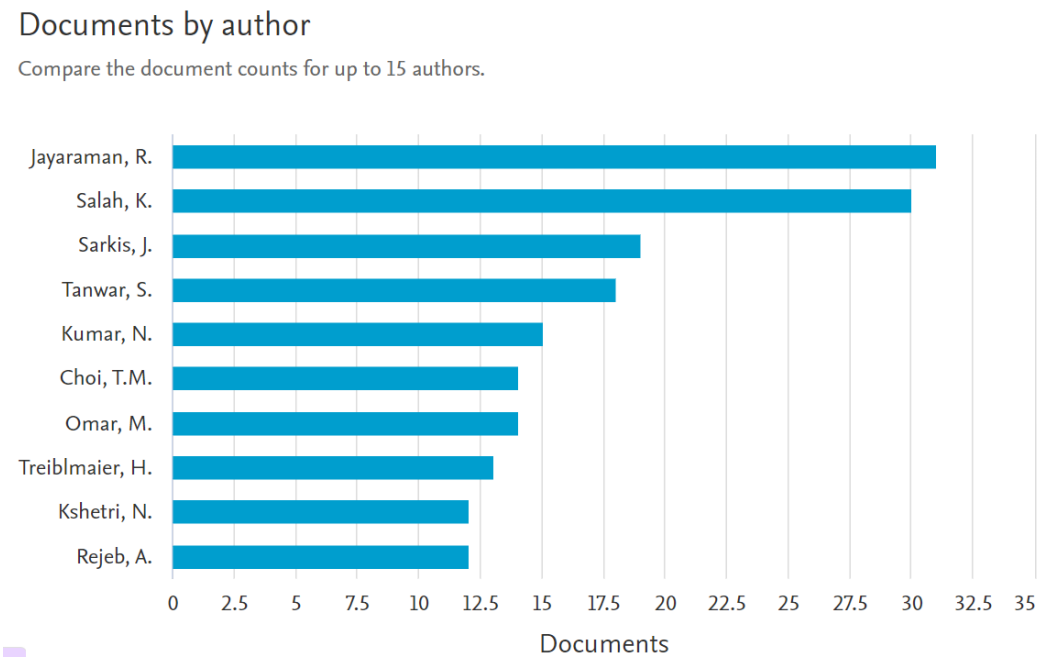
N°	Name of the Funding Organization	NB of article	N°	Name of the journal	NB of article
1	National Natural Science Foundation of China	284	**11**	National Office for Philosophy and Social Sciences	25
2	National Key Research and Development Program of China	67	**12**	Ministry of Science and Technology, Taiwan	20
3	European Commission	59	**13**	Ministry of Science, ICT and Future Planning	19
4	Ministry of Education of the People's Republic of China	56	**14**	Ministry of Education	17
5	Horizon 2020 Framework Programme	53	**15**	BundesministeriumfürBildung und Forschung	17
6	Fundamental Research Funds for the Central Universities	41	**16**	Khalifa University of Science, Technology and Research	16
7	Ministry of Education of the People's Republic of China[i]	39	**17**	Natural Science Foundation of Shandong Province	14
8	European Regional Development Fund	33	**18**	Qatar National ResearchFund	11
9	National Science Foundation	33	**19**	Beijing Municipal Science and Technology Commission, Administrative Commission of Zhongguancun Science Park	7
10	National Research Foundation of Korea	29	**20**	Harbin University of Science and Technology	4

Source: *Derived from Scopus data.*

In the domain of blockchain technology and its effects on supply chain management, numerous researchers and institutions have benefited from the support of the funding organizations listed above. Certain scholars are notable for their high citation rates. These researchers, distinguished by their substantial contributions, have profoundly influenced the field, shaping both the understanding and analysis of the subject. Their extensively cited work serves as a foundational reference for numerous subsequent studies, underscoring the significance of their research in the discourse on the relationship between blockchain technology and SCM.

Figure 2 identifies Jayaraman, R., and Salah, K. as the most impactful authors, with 19 and 13 publications, respectively, predominantly addressing the influence of blockchain technology in SCM.

Figure 2. Most cited authors in blockchain and SCM research



Source: *Derived from Scopus data.*

The prominence of these authors reflects not only their foundational contributions but also the accelerating scholarly engagement with blockchain and SCM research. The following figure analyzes the concentration and temporal growth of citations among the most influential publications in this domain to further illustrate the evolution of this interest.

Figure 3: Concentration and growth of citations for leading blockchain and supply chain management publications (2021–2024)

	Documents	Year	<2021	2021	2022	2023	2024	Subtotal	>2024	Total
	Total		**0**	**5**	**117**	**1,873**	**4,320**	**6,315**	**19**	**6,334**
1	An ISM-DEMATEL analysis of blockchain adoption decision in the circular supply chain finance context	2024	0	0	0	0	4	4	0	4
2	S³EF-HBCAs: Secure and Sustainable Software Engineering Framework for Healthcare Blockchain Applications	2023	0	0	0	0	3	3	0	3
3	Intelligent healthcare supply chain	2023	0	0	0	0	1	1	0	1
4	The future of artificial intelligence in blockchain applications	2023	0	0	0	0	10	10	0	10
5	Smart-Contract-Based Agricultural Service Platform for Drone Plant Protection Operation Optimization	2023	0	0	0	1	4	5	0	5
6	TruFLaaS: Trustworthy Federated Learning as a Service	2023	0	0	0	1	5	6	0	6
7	Blockchain-Based IoT Model and Experimental Platform Design in the Defence Supply Chain	2023	0	0	0	2	2	4	0	4
8	The acceptance and continued use of blockchain technology in supply chain management: a unified model from supply chain ...	2023	0	0	1	4	5	10	0	10
9	Transforming finance: Exploring the role of blockchain and smart contracts	2023	0	0	0	0	1	1	0	1
10	Exploring the current status and future opportunities of blockchain technology adoption and application in supply chain mana...	2023	0	0	0	0	3	3	0	3

Source: Derived *from Scopus data.*

The increase in citations has not only been continuous but also accelerating, which may signify that the article is gaining greater relevance as blockchain research within supply chain management becomes more prevalent day by day, or as new developments in the field garner increased attention.

Table 5 illustrates the distribution of publications on our topic across the top five contributing countries. Notably, both industrialized nations (such as the United States, the United Kingdom, France, and Spain) and emerging economies (such as China, India, Indonesia, and South Africa) have demonstrated substantial interest in this subject. The United States has produced over 686 publications, while Japan, ranked 14th, has contributed 98 articles. European countries have also made significant strides in research within this domain. In contrast, Oceania countries are at the lower end of the spectrum, with only a few dozen publications.

Table 5. Article production by country over time

Country	Publications	Country	Publications
India	1354	**South Korea**	102
China	1190	**Brazil**	100
United States	686	**Japan**	98
United Kingdom	443	**Switzerland**	96
Australia	298	**Turkey**	85
Italy	284	**Poland**	72
Germany	249	**Malaysia**	70
Canada	171	**Norway**	67
France	169	**Greece**	65
Saudi Arabia	144	**Hong Kong**	65
South Korea	114	**Indonesia**	65

Source: *Derived from Scopus data.*

It is important to note that in order to ensure methodological transparency, country-level publication numbers were computed using full counting: each author affiliation in a multi-author article is attributed separately. This approach, widely used in bibliometrics to capture the geography of scientific collaboration, naturally produces cumulative country totals exceeding the number of unique articles included in the dataset (4 203).

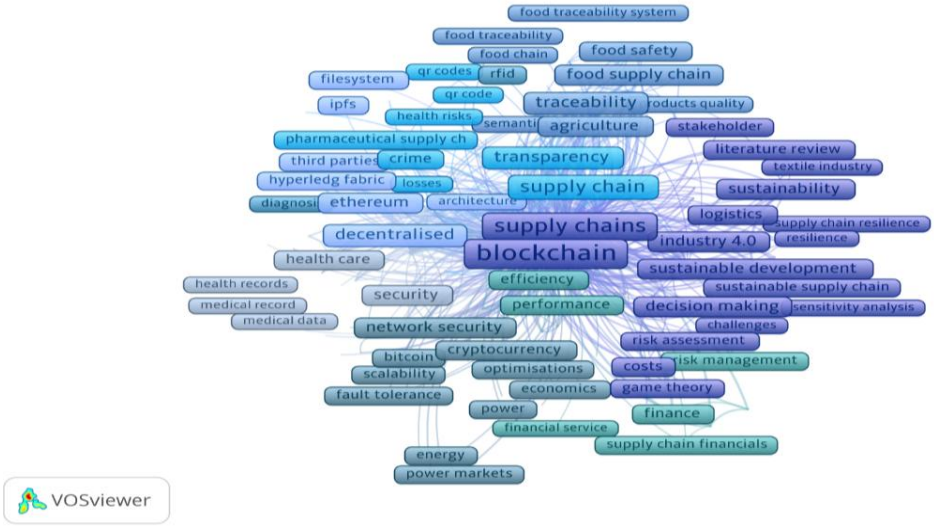
To ensure reproducibility and methodological transparency in the bibliometric analysis, the parameters used in VOSviewer for the construction of keyword, author, and affiliation networks were explicitly defined. Keyword co-occurrence maps were generated using a minimum occurrence threshold of five (5) occurrences per keyword. The association strength normalization method was applied, as it is recommended for co-occurrence and co-authorship networks and provides a more accurate representation of item similarity.

For author and institutional analyses, the study employed full counting, meaning that each occurrence of an author or affiliation was fully counted in network construction. A minimum threshold of two (2) documents per author and three (3) documents per institution was applied to reduce noise and highlight the most influential contributors in the field. These parameter settings ensured the clarity and robustness of the bibliometric visualizations and made the analytical process fully replicable.

3. Bibliographic Mapping

Bibliographic mapping was employed for content analysis through the transfer of the selected article library from Zotero to VOSviewer, facilitating the creation of a keyword map. The articles in our sample were closely interconnected within the literature, and this linkage was employed to identify various sub-streams of research. VOSviewer was chosen for intellectual mapping due to its user-friendly visualizations, which enable straightforward interpretation of the data (van Eck & Waltman, 2012).

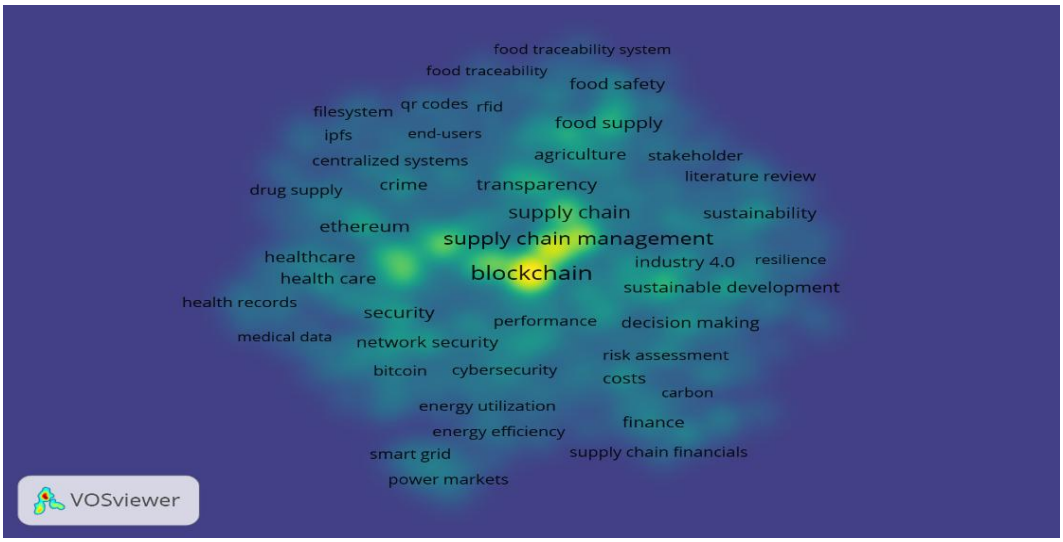
Figure 4: Bibliographic mapping by keywords using VOSviewer



Source: *Derived from VOSviewer data.*

This bibliographic map was generated using VOSviewer from a sample of 4,203 articles, with data extraction conducted via Zotero. The map groups keywords based on co-occurrence, highlighting thematic clusters within the dataset. These clusters reflect the core research areas and emerging trends, providing a visual representation of the most influential topics and their relationships within the bibliographical sample.

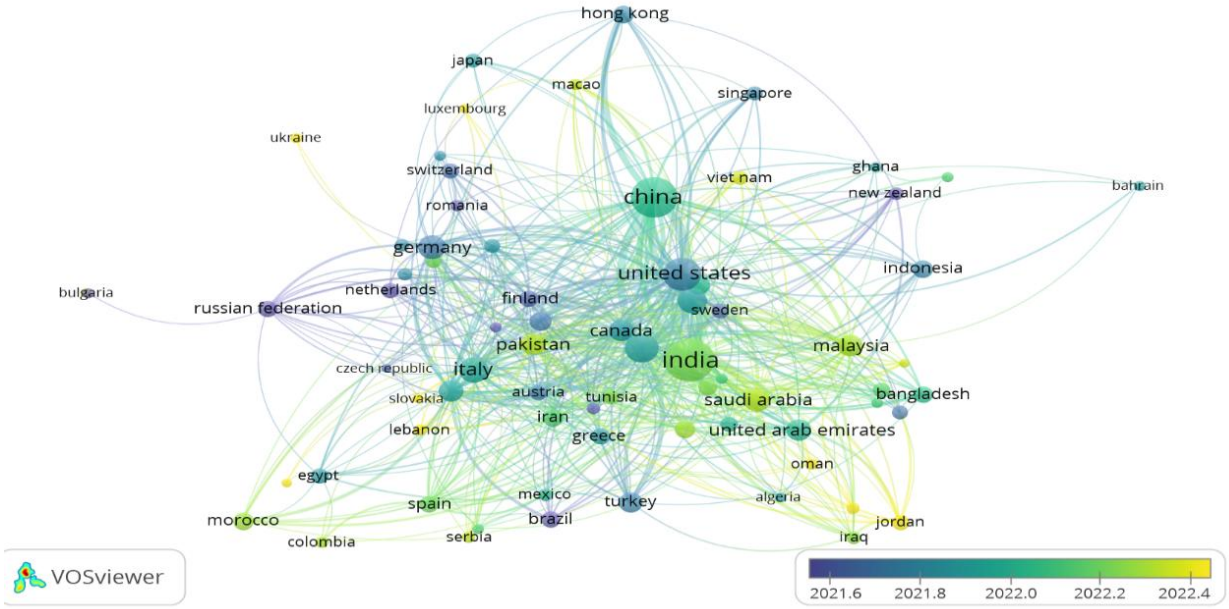
Figure 5: Geographic distribution of publications and affiliations



Source: *Derived from VOSviewer data*

The geographical analysis highlights the global nature of blockchain research, with significant clusters across Asia, Europe, and North America. However, understanding geographic spread alone does not capture the full collaborative network. Therefore, the next figure provides a detailed examination of publication locations, offering insights into how research collaborations are structured across countries.

Figure 6: Location and affiliation statistics of blockchain and supply chain management publications (2016–2024)



Source: *Derived from VOSviewer data.*

4. Synthesis and Insights

Through a comprehensive analysis of the existing research, a unified definition of blockchain technology in the context of supply chain management (SCM) emerges. Blockchain technology is crucial in SCM and known for its ability to enhance risk management strategies, reinforce organizational resilience, and strengthen security frameworks. It fosters transparency and accountability across SCM operations, which effectively mitigates vulnerabilities to fraudulent activities and ensures the integrity of transactional data throughout the supply chain lifecycle. Moreover, blockchain supports secure data handling and bolsters cybersecurity measures, thereby building trust among stakeholders and optimizing operational efficiencies in global supply chain networks (Kshetri, 2017; Shakhbulatov et al., 2020).

4.1 Analytical Framework for Risk Management (ISO 31000)

To provide a structured interpretation of how blockchain contributes to supply chain risk management, this study adopts the ISO 31000 framework, which defines risk management as a systematic process for identifying, analyzing, evaluating, and mitigating risks across organizational systems. ISO 31000 emphasizes three core components: risk identification**,** risk analysis**,** and risk treatment**.**

Applying ISO 31000 to blockchain-enabled supply chains allows the classification of risks encountered in global logistics systems as operational risks**,** informational risks**, and** relational risks**.** Blockchain supports ISO 31000 requirements by enabling earlier detection of anomalies, improving the accuracy of shared information, and reducing uncertainty through immutable and transparent data flows. Smart contracts additionally reinforce risk treatment activities by automating verification steps and reducing human-induced variability.

This analytical framework provides a consistent basis for interpreting how blockchain mechanisms address the most prominent categories of supply chain risks identified in the reviewed literature.

The review of the 282 selected articles reveals that blockchain contributes significantly to strengthening supply chain operations in terms of risk management. Across the literature, three main categories of risks emerge as central: operational risks, informational risks, and relational risks. Operational risks; including product counterfeiting, quality degradation, and lack of end-to-end traceability are all mitigated through blockchain's immutable ledger and real-time auditability, which enable a more accurate detection of anomalies and reduce

process uncertainty (Tseng et al., 2018). Along the same lines, blockchain further reduces informational risks by limiting data manipulation and ensuring that the records shared across stakeholders are fully reliable. Several empirical studies highlight how error propagation is reduced and how inventory-tracking accuracy is improved when blockchain is coupled with IoT sensors (Saberi et al., 2019).

Moreover, relational risks, primarily linked to inter-organizational distrust and asymmetric information, are mitigated through decentralized governance structures. Supply chain resilience is hence enhanced through smart contracts by automating verification processes and reducing opportunistic behaviour. Previous work has also confirmed that blockchain significantly improves logistical risk management through enhanced traceability and data integrity (Dhiba & Alaoui, 2020). Overall, the literature converges on the finding that blockchain provides a mechanism for proactive risk identification, which enables firms to better anticipate disruptions and strengthen their continuity planning.

Table 6. Risk Management Themes in Blockchain-Enabled Supply Chains

Risk Type	Description	Blockchain Mechanism	Representative Studies
Operational risks	Counterfeiting, fraud, lack of end-to-end traceability, product quality degradation	Immutable ledger, timestamping, real-time tracking through IoT-blockchain integration	Tseng et al. (2018); Bhalerao et al. (2019)
Informational risks	Data manipulation, unreliable information flows, inconsistent records	Distributed consensus, tamper-proof data, shared visibility across stakeholders	Lashkari & Musilek (2021)
Relational risks	Distrust among partners, asymmetric information, opportunistic behavior	Smart contracts, automated verification, decentralized trust mechanisms	Kshetri (2017); Shakhbulatov et al. (2020)

Source: *Author's own elaboration based on the reviewed literature.*

4.2 Analytical Framework for Security (NIST + ISO 27001)

The security analysis in this review is structured according to the NIST Cybersecurity Framework (Identify, Protect, Detect, Respond, Recover) and the ISO 27001 Information Security Management System (ISMS). Together, these standards provide internationally recognized guidelines for assessing and enhancing the security of information systems.

Blockchain maps naturally onto several NIST and ISO 27001 control domains:

- **Protect:** cryptographic hashing, distributed ledger architecture, identity management
- **Detect:** tamper-evident records, real-time monitoring, auditable transactions
- **Respond:** smart contract automation that enforces predefined actions
- **Recover:** decentralized redundancy eliminating single points of failure

From the ISO 27001 perspective, blockchain reinforces key security principles including integrity**,** confidentiality**,** and availability. The distributed nature of blockchain reduces exposure to centralized attacks, while its cryptographic foundations and consensus mechanisms strengthen data integrity and authenticity. These standards therefore provide a robust analytical lens through which blockchain's security contributions to supply chain management can be evaluated.

Security emerges as a core dimension in blockchain-enabled supply chains. Correspondingly, the reviewed literature emphasizes that blockchain's cryptographic foundations substantially reinforce cybersecurity in multi-organizational networks (Kshetri, 2017). Traditional supply chains face security vulnerabilities, which often stem from centralized databases that are susceptible to single points of failure and external attacks. Blockchain, by contrast, distributes data across a peer-to-peer network, to significantly lower the likelihood of successful cyber intrusions or unauthorized data alteration.

Smart contracts further reduce security-related human errors by the automation of processes such as compliance checks and document verification. Nonetheless, several studies still highlight residual vulnerabilities, and particularly those related to consensus mechanisms, private key management, and interoperability with legacy systems (Casino et al., 2019). Despite these challenges, the evidence overwhelmingly supports blockchain's capacity to elevate security standards across global supply chains.

Table 7. Security Themes in Blockchain-Based Supply Chains

Security Dimension	Description	Blockchain Mechanism	Representative Studies
Data authenticity & integrity	Protecting supply chain data from alteration or forgery	Cryptographic hashing, distributed ledger, tamper-evidence	Cachin (2016); Kshetri (2017)
Cybersecurity & system robustness	Preventing attacks targeting centralized databases and single points of failure	Decentralized network architecture, distributed storage	Mrazek et al. (2022); Xiao et al. (2020)
Secure automation	Reducing human errors in compliance checking and validation processes	Self-executing smart contracts	Kosba et al. (2016)

Source: *Author's own elaboration based on the reviewed literature.*

4.3 Analytical Framework for Transparency (Traceability Depth / Latency / Provenance)

To systematically evaluate blockchain's contribution to supply chain transparency, this study adopts a three-dimension traceability framework commonly used in digital supply chain research: traceability depth**,** traceability latency**,** and provenance accuracy**.**

- **Traceability depth** refers to how many tiers of the supply chain are visible (suppliers, subcontractors, logistics providers, distributors). Blockchain's immutable distributed ledger extends visibility beyond direct partners to multi-tier networks.
- **Traceability latency** refers to the time required for supply chain information to propagate between actors. Blockchain integrated with IoT devices significantly reduces latency by enabling near real-time data recording and access.
- **Provenance accuracy** concerns the reliability of information on product origin, transformation, and movement. Blockchain provides tamper-proof historical records that strengthen auditability and reduce information asymmetry.

Using this framework, the transparency effects observed in the reviewed studies can be analyzed in terms of how blockchain enhances visibility, accelerates information flows, and improves the quality of provenance records across global supply chains.

Transparency is one of the most frequently cited advantages of blockchain in supply chain management. In a similar vein, the synthesis of findings indicates that blockchain enhances visibility at multiple tiers of the supply chain by enabling continuous and trustworthy access

to product and process information. Through the immutability of timestamped records, blockchain facilitates end-to-end traceability of main product operations, meaning origin, transformation, and movement, which is especially significant in industries such as agri-food, pharmaceuticals, and luxury goods.

The literature underscores that this increased transparency reduces information asymmetry and enhances accountability among actors, that way consumer trust and compliance with regulatory requirements are improved (Francisco & Swanson, 2018). Similarly, blockchain enables multi-tier visibility, meaning extending beyond direct suppliers to second- and third-tier partners, thus addressing long-standing blind spots in complex and traditional global supply chains. Moreover, studies highlight that blockchain-enabled transparency fosters sustainability reporting, ethical sourcing validation, and environmental monitoring.

Across the body of research, transparency consistently emerges as the dimension where blockchain delivers the most immediate and measurable improvements.

Table 8. Transparency Themes in Blockchain-Enhanced Supply Chains

Transparency Dimension	Description	Blockchain Mechanism	Representative Studies
Multi-tier visibility	Access to shared, real-time supply chain information across all tiers	Distributed ledger providing unified visibility	Tseng et al. (2018)
Product traceability	Tracking product origin, transformations, and movements	Timestamped immutable records ensuring provenance	Zheng et al. (2017)
Transaction transparency	Reducing information asymmetry and enhancing auditability	Smart contracts, cryptographic proofs, immutable transactions	Zheng et al. (2017); Shakhbulatov et al. (2020)

Source: *Author's own elaboration based on the reviewed literature.*

Conclusion

This article aims to conduct a comprehensive literature review to examine the role of blockchain technology in transforming global supply chains (GCS). Its primary focus is on the integration of blockchain within supply chain management (SCM), offering a significant contribution to the academic literature as well as to practitioners and decision-makers seeking an in-depth understanding of this advanced technology.

The findings presented herein are essential for understanding the growing impact of blockchain on transforming supply chain management, particularly concerning risk management and security implications. Through systematic analytical tools, we have identified key trends and explored the relationships among researchers, institutions, and core concepts.

This chronological analysis reveals a notable increase in publications regarding blockchain's role in supply chain transformation, driven by its capacity to deliver transparent and immutable transaction records. This capability not only reduces fraud risk but also improves traceability and bolsters overall supply chain resilience against disruptions.

By incorporating insights from leading studies and projecting trends into 2024, this analysis underscores the dynamic evolution of blockchain technology within SCM and highlights its critical significance in the modern digital economy.

Yet, despite the promising applications of blockchain and its potential to drive transformative changes across various supply chain models, the literature on blockchain technology in SCM remains nascent.

This article provides valuable insights for both researchers and practitioners aiming to advance blockchain integration into SCM. First, there is an opportunity to explore, through empirical research, the maturity and capabilities of blockchain technology. Second, decision-makers are provided with an opportunity to gain a thorough understanding of blockchain integration within GCS and to initiate relevant projects within their organizations.

Our analysis also indicates that the predominant theoretical results in the reviewed literature are conceptual. This highlights opportunities for researchers to employ alternative research tools, such as econometric and statistical methods, and to develop empirical studies.

Given the preliminary state of this field, it has indeed been proven that there are numerous opportunities for future research on blockchain technology. However, diverse theoretical perspectives and multi-methodological approaches should be employed to further elucidate the phenomenon and its potential disruptions.

Acknowledgments

This work was carried out with the support of the National Center for Scientific and Technical Research (CNRST) as part of the “PhD-Associate Scholarship – PASS” Program.

References

Agi, M. A. N., & Jha, A. K. (2022). *Blockchain technology in the supply chain: An integrated theoretical perspective of organizational adoption*. International Journal of Production Economics, 247, 108458. https://doi.org/10.1016/j.ijpe.2022.108458

Al-Rakhami, M. S., & Al-Mashari, M. (2021). *A blockchain-based trust model for the Internet of Things supply chain management*. Sensors, 21(5), 1759. https://doi.org/10.3390/s21051759

Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). *A systematic review of blockchain-based applications: Current status, classification and open issues*. Telematics and Informatics, 36, 55–81. https://doi.org/10.1016/j.tele.2018.11.006

Chowdhury, S., Rodriguez-Espindola, O., Dey, P., & Budhwar, P. (2023). *Blockchain technology adoption for managing risks in operations and supply chain management: Evidence from the UK*. Annals of Operations Research, 327, 539–574. https://doi.org/10.1007/s10479-021-04487-1

Dhiba, Y., & Alaoui, M. (2020). *Blockchain et gestion des risques logistiques : Quel apport ?* Revue Internationale du Chercheur, 1(3).

Francisco, K., & Swanson, D. (2018). *The supply chain has no clothes: Technology adoption of blockchain for supply chain transparency*. Logistics, 2(1), 2. https://doi.org/10.3390/logistics2010002

Kshetri, N. (2017). *Blockchain's roles in strengthening cybersecurity and protecting privacy*. Telecommunications Policy, 41(10), 1027–1038. https://doi.org/10.1016/j.telpol.2017.09.003

Lashkari, B., & Musilek, P. (2021). *A comprehensive review of blockchain consensus mechanisms*. IEEE Access, 9, 43620–43652. https://doi.org/10.1109/ACCESS.2021.3065880

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). *Blockchain technology and its relationships to sustainable supply chain management*. International Journal of Production Research, 57(7), 2117–2135. https://doi.org/10.1080/00207543.2018.1533261

Shakhbulatov, D., Medina, J., Dong, Z., & Rojas-Cessa, R. (2020). *How blockchain enhances supply chain management: A survey*. IEEE Open Journal of the Computer Society, 1, 230–249. https://doi.org/10.1109/OJCS.2020.3025313

Tseng, J.-H., Liao, Y.-C., Chong, B., & Liao, S.-W. (2018). *Governance on the drug supply chain via gcoin blockchain*. International Journal of Environmental Research and Public Health, 15(6), 1019. https://doi.org/10.3390/ijerph15061055

Xiao, Y., Zhang, N., Lou, W., & Hou, Y. T. (2020). *A survey of distributed consensus protocols for blockchain networks*. IEEE Communications Surveys & Tutorials, 22(2), 1432–1465.

[i] *Ministry of Education of the People's Republic of China appears twice because database indexing (Scopus/VOSviewer) separates full-form and short-form institutional names into two distinct affiliation clusters. To preserve bibliometric accuracy, both counts are reported without manual aggregation.*