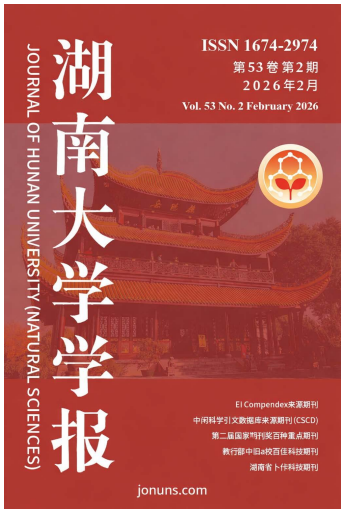

Journal of Hunan University

(Natural Sciences)

Vol. 53 No. 2

February 2026

Available online at

https://jonuns.com

Open Access Article

https://doi.org/10.55463/issn.1674-2974.53.2.7

Blockchain-Based Transparency in Global Supply Chains-A Systematic Literature Review

Kenneth Baayeh[1], Prashanth Beleya[1], Diana Airawaty[2], Sadegh Salehi[3]

[1]Faculty of Business and Communications, INTI International University, Malaysia,
[2]Faculty of Economy, Universitas Mercu Buana Yogyakarta, Indonesia,
[3]Faculty of Humanities & Social Sciences, University of Mazandaran, Iran,

* Corresponding author: prashanth.beleya@newinti.edu.my

Article History:

Received: December 3, 2025
Revised: January 24, 2026
Accepted: January 31, 2026
Published: March 27, 2026

Abstract: Global supply chains are increasingly exposed to transparency challenges, information asymmetry, and vulnerabilities to fraud and counterfeiting. Blockchain technology can play a pivotal role by providing a decentralized, tamper-resistant, and verifiable infrastructure that enhances trust and transparency across supply chain networks. This paper presents a systematic literature review (SLR) of 33 peer-reviewed articles published between 2020 and 2025, following the PRISMA guidelines, to examine how blockchain improves transparency in supply chains, identify key adoption barriers, and highlight emerging research trends and opportunities. The results indicate that blockchain enhances transparency through data immutability, smart contracts, and real-time data sharing enabled by IoT technologies. However, its adoption remains constrained by challenges related to scalability, interoperability, regulatory uncertainty, implementation costs, and organizational culture, particularly among small and medium-sized enterprises (SMEs). Emerging trends include the integration of blockchain with IoT and artificial intelligence (AI), the development of consortium and hybrid blockchain models, sustainability-oriented applications, and privacy-preserving mechanisms. Overall, the review highlights the transformative potential of blockchain to reshape secure and ethical supply chains while emphasizing the importance of industry collaboration, regulatory clarity, and organizational readiness for large-scale adoption.

Keywords: Blockchain; transparency; global supply chains; traceability; logistics.

基于区块链的全球供应链透明度—系统性文献综述

摘要：全球供应链正日益面临透明度不足、信息不对称以及欺诈和伪造等风险。区块链技术能够通过提供去中心化、防篡改且可验证的基础设施，在提升供应链网络中的信任与透明度方面发挥关键作用。本文依据 PRISMA 指南，对 2020-2025 年发表的 33 篇同行评议文献进行了系统性文献综述（SLR），旨在探讨区块链如何提升供应链透明度，识别其应用推广中的主要障碍，并分析新兴研究趋势与未来研究机遇。研究结果表明，区块链通过数据不可篡改性、智能合约以及物联网（IoT）支持的实时数据共享显著提升了供应链透明度。然而，其应用仍受到可扩展性、互操作性、监管不确定性、实施成本以及组织文化等因素的限制，尤其是在中小企业（SMEs）中更为明显。当前的新兴趋势包括区块链与物联网及人工智能（AI）的融合、联盟链与混合区块链模式的发展、面向可持续发展的应用场景，以及隐私保护机制的研究。总体而言，本研究强调了区块链在重塑安全且合乎伦理的供应链体系方面的变革潜力，同时指出实现大规模应用仍需加强产业协作、提升监管清晰度以及增强组织层面的准备度。

关键词：区块链；透明度；全球供应链；可追溯性；物流

1. Introduction

1.1 Background and Motivation

Global supply chains, which involve numerous stakeholders and geographical areas, are beset by inefficiencies that compromise operational performance, compliance, and trust. As a new technology, blockchain provides a groundbreaking solution in the form of secure and decentralized data management, which allows transparency and traceability. This is a systematic literature review (SLR) of 33 peer-reviewed articles (2020-2025) in accordance with PRISMA to investigate the application of blockchain to improve supply chain transparency. It answers three research questions that include how blockchain promotes transparency (RQ1), barriers to adoption (RQ2), and new trends and future research directions (RQ3). This paper combines practice and theory to present practical recommendations to practitioners and policymakers on how to eliminate technical, regulatory, and socio-economic barriers to ensure the adoption of resilient and transparent supply chain ecosystems.

1.2 Systematic Literature Review (SLR)

A Systematic Literature Review (SLR) is a rigorous and structured protocol-driven approach to synthesize scholarly knowledge so that researchers can combine evidence from various studies in a transparent and reproducible manner, with minimal intervention from reviewers [21]. Unlike narrative reviews, which may be selective or interpretive, SLRs are supposed to follow pre-determined checklists and guidelines such as PRISMA to ensure an exhaustive set of literature and methodological rigor. A SLR is therefore warranted in this particular case, given the massive and accelerated growth of studies on blockchain-based supply chain transparency since it was brought to the limelight in 2015 [16]. Transparency research regarding blockchain is one introspective domain between supply chain management, information systems, and operations research and hence is benefited by the ability of the SLR to amalgamate all disciplinary perspectives into given consolidated knowledge synthesis [23].

Peer-reviewed studies published between 2020 and 2025 are the main focus of this review, which documents the development of blockchain from theoretical investigations to real-world, empirical applications in sectors like manufacturing, food, logistics, and pharmaceuticals where provenance, traceability, and transparency are crucial [1, 16]. In order to identify patterns, obstacles, mechanisms, and new trends in blockchain-based transparency research, the review used a structured search protocol, strict inclusion and exclusion criteria, and thematic synthesis in accordance with the PRISMA methodology [21, 10].

2. Method

The method used in this systematic literature review (SLR) mimics the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method, which is used to provide a systematic, reproducible, and rigorous evidence synthesis of

blockchain-based transparency in the global supply chain [21]. PRISMA represents a standardization that allows researchers to clearly and consistently define how to identify, screen, include, and exclude studies to limit biases and include as comprehensive an inquiry as possible across the research field. This method described the research design, search strategy, inclusion and exclusion criteria, and method of data extraction and synthesis. The PRISMA flow diagram for the identification, screening, eligibility, and inclusion process is shown in Figure 1.

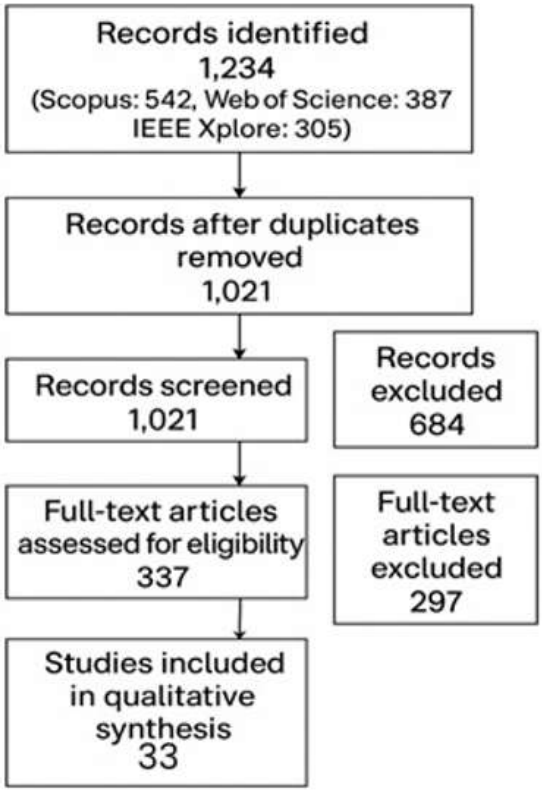

Figure 1: PRISMA Flow Diagram

2.1 Research Design

This study used a systematic literature review (SLR) approach, involving a wide range of peer-reviewed articles between 2020 and 2025. The review process followed the four well-defined steps described in the PRISMA model, which include, identification, screening, eligibility, and inclusion. This framework was adopted in an organized manner to examine how blockchain technology enhances provenance, transparency, and traceability in global supply chains, and also identify the dominant challenges, emerging trends, and potential future directions. The review was guided by three research questions (RQs), which collectively constituted the conceptual and analytical foundation of the study. The research questions are:

RQ1: How does blockchain technology develop transparency in global supply chains?

RQ2: What are the main challenges and barriers to accepting blockchain within supply chain transparency?

RQ3: What trends are emerging, and what are the future research directions for blockchain-based transparency?

2.2 Systematic Analysis

The SLR considered three major academic databases, Scopus, Web of Science, and Institute of Electrical and Electronics Engineers (IEEE) Xplore were used to conduct an overall search of literature in supply chain management, information systems and technology. A Boolean search string was employed to search the literature through Web of Science and IEEE Xplore, which was rigorous and systematic. The Boolean search string is as follows:

("blockchain" OR "distributed ledger technology" OR "DLT") AND
("supply chain" OR "global supply chain" OR "logistics") AND
("transparency" OR "traceability" OR "provenance" OR "visibility")
(“emerging markets” OR “developing economies” OR “Southeast Asia” OR “Africa” OR “Latin America”).

After performing the initial search, 1,234 records (Scopus: 542, Web of Science: 387, IEEE Xplore: 305) were identified. After the removal of duplicates, 1,021 unique records were screened. To add to the completeness of the search, backward and forward citation searching of foundational papers on Google Scholar was performed to yield another 47 relevant records related to the search topic.

2.2.1 Inclusion, and Exclusion Criteria

The inclusion and exclusion criteria were applied to ensure relevance and scholarly rigor, focusing on studies that address blockchain applications for transparency, traceability, or provenance in global supply chains. *Table 1* below summaries the inclusion and exclusion criteria.

Table 1: Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Study Focus	Applications or use cases of blockchain/DLT in a global supply chain context	Studies focused on blockchain in other domains (finance, healthcare)
Thematic Scope	Studies addressing transparency,	Studies not addressing transparency,

	traceability, or provenance	traceability, or provenance
Methodology	Empirical (case studies, experiments), theoretical (frameworks), or mixed methods	Descriptive works lacking analytical or methodological depth
Publication Type	Peer-reviewed journal articles and conference papers	Non-peer-reviewed sources (e.g., white papers, blogs, industry reports)
Language	English	Non-English publications
Publication Period	Published between January 2015 and June 2025	Published outside the 2015–2025 range

2.2.2 Data Extraction and Synthesis

Information from 40 included studies was methodically gathered using a consistent data extraction methodology. The template was recorded according to the Characteristics of the Study, Industry Focus, Challenges and Barriers and Emerging trends. *Table 2 below* shows a Summary of Eligible Studies.

Table 2: Summary of Eligible Studies from

Author(s) & Year	Journal / Conference	Industry Focus	Mechanisms for Transparency	Challenges / Barriers	Emerging Trends / Technologies
Cui et al. (2023)	Management Science	Supply Chain	YES	YES	YES
Dasaklis et al. (2022)	Sustainability	Supply Chain Traceability	YES	YES	YES
Faisal et al. (2023)	Benchmarking: An International Journal	Supply Chain	YES	YES	YES
Fosso Wamba et al. (2020)	International Journal of Production Economics	Supply Chain	YES	YES	YES
Yavaprabhas et al. (2024)	International Journal of Production Research	Supply Chain	YES	YES	YES
Medhi (2020)	Information for Efficient Decision Making	Global Supply Chains	YES	YES	YES
Sunmola & Burgess (2023)	Procedia Computer Science	Supply Chain	YES	YES	YES
Caldarelli et al. (2021)	Journal of Organizational Change Management	Fashion	YES	YES	YES
Cao et al. (2021)	ArXiv.org	Supply Chain	YES	YES	YES
Chang & Chen (2020)	IEEE Access	Logistics & SCM	YES	YES	YES
Choi et al. (2023)	Production and Operations Management	Operations Management	YES	YES	YES
Doshi et al. (2024)	Journal of Experimental Agriculture International	Supply Chains	YES	YES	YES
Ejairu et al. (2024)	International Journal of Science and Research Archive	Global SCM	YES	YES	YES
Herbke et al. (2024)	IEEE SOSE	Supply Chain Data Management	YES	YES	YES
Jabbar et al. (2020)	Multimedia Systems	Logistics	YES	YES	YES
Kamble et al. (2021)	Annals of Operations Research	Supply Chains	YES	YES	YES
Kee et al. (2024)	Green Intelligent Systems and Applications	Supply Chain Traceability	YES	YES	YES
Kouhizadeh et al. (2021)	International Journal of Production Economics	Sustainable SCM	YES	YES	YES
Kshetri (2021)	International Journal of Information Management	Developing Economies	YES	YES	YES
Liu et al. (2022)	Sustainability	Supply Chain	YES	YES	YES
Mwewa et al. (2024)	Jurnal Galaksi	Agricultural Supply Chains	YES	YES	YES
Page et al. (2021)	British Medical Journal	Systematic Review	NO	NO	YES

		Methodology			
Prajapati (2024)	Research Gate	Supply Chain Management	YES	YES	YES
Queiroz et al. (2020)	International Journal of Production Research	SCM Integration	YES	YES	YES
Rejeb et al. (2021)	Logistics	Logistics & SCM	YES	YES	YES
Sadawi et al. (2021)	IEEE Access	Supply Chain & IoT	YES	YES	YES
Sahoo et al. (2022)	Electronic Commerce Research	Sustainable SCM	YES	YES	YES
Sarker et al. (2021)	Journal of Management Information Systems	Maritime Trade	YES	YES	YES
Sharma et al. (2023)	Operations Management Research	Food Supply Chain	YES	YES	YES
Singh et al. (2022)	Multimedia Tools and Applications	Food Traceability	YES	YES	YES
Smith & McElwee (2021)	Supply Chain Management: An International Journal	Food Supply Chain	YES	YES	YES
Sunny et al. (2020)	Computers & Industrial Engineering	Pharma & Traceability	YES	YES	YES
Yahaya Saidu et al. (2025)	IEEE Access	Traceability Systems	YES	YES	YES

Based on the methodological approach outlined above, the data gathered from the extraction were then synthesized through a visual mapping approach. A heatmap was, specifically, prepared to show the distribution of three thematic dimensions that were identified as significant in the selected studies: mechanisms for transparency, challenges or barriers, and emerging trends or technologies. This graphical support complements the systematic review by presenting a straight comparative snapshot, making it easier to identify trends, thematic threads, and unexplored issues within the literature. Displaying these dimensions as a summarized visual entity, the heatmap in *Figure 2* below presents a concise but comprehensive picture of where blockchain applications are in the research on global supply chains.

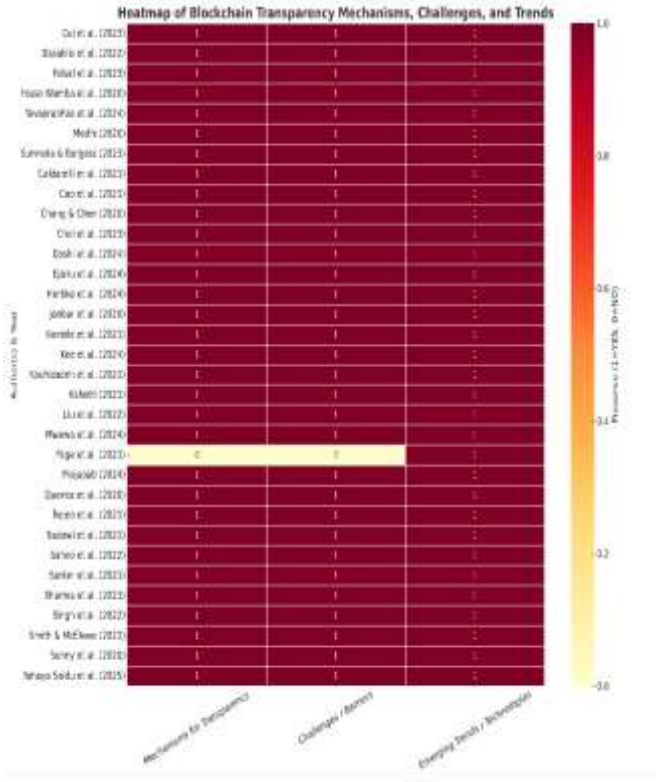

Figure 2: Heatmap of Transparency Mechanisms, Challenges, and Emerging Technologies in Blockchain–IoT-Enabled Supply Chains (2020-2025)

3. Results and Discussion

The 33 peer-reviewed studies show that blockchain guarantees transparency in global supply chains primarily through its data immutability, smart contracts, and real-time transparency, decreasing fraud, counterfeiting, and information asymmetry [1, 13]. Adoption is constrained by enormous barriers, including scalability and performance limitations, interoperability with legacy systems, regulatory complexity, and enormous implementation costs burdening predominantly SMEs [23, 5]. In addition to growing applications in sustainability and circular economy projects like carbon tracking and ethical sourcing, emerging trends show a shift toward integration with IoT, AI, and consortium blockchain models [16, 33]. The synthesis as a whole show that blockchain is moving from isolated pilot projects to ecosystem-level solutions, but scaling up will require overcoming organizational, technical, financial, and regulatory barriers to create robust, transparent, and sustainable global supply chains [24]. The visual integration in *Figure 2* above, indicates there is good representation of mechanisms for transparency but where it overlaps with emergent AI-based technologies it remains relatively unexplored.

Based on this synthesis, the next sections present more substantively on the evidence organized over the three guiding research questions. RQ1 looks at how blockchain features like smart contract automation,

immutable ledgers, and IoT-enabled real-time data exchange help increase supply chains' transparency and trust [32]. RQ2 explores the organizational, technical, and legal obstacles to adoption, such as interoperability gaps, scalability constraints, and privacy laws, which all prevent blockchain from being widely utilized in supply chain networks [17, 23]. Finally, RQ3 maps the emerging trends and future research, of special interest being hybrid blockchain architectures, cross-platform standardization, sustainability-oriented applications, and the convergence of blockchain with IoT and artificial intelligence [24, 33].

3.1 RQ1: How Does Blockchain Technology Develop Transparency in Global Supply Chains?

Blockchain technology has become a transformative enabler of transparency and trust in international supply chains, allowing for decentralized, tamper-proof, and verifiable records of activities [5]. A systematic review of the literature conducted identified three primary mechanisms that contribute to blockchain transparency: data immutability, smart contracts, and real-time data sharing [5, 24]. As demonstrated in food supply chains where customers confirm organic claims, immutability guarantees tamper-proof records, allowing traceable product provenance and lowering fraud [1, 29]. Smart contracts can be used to automate compliance and reduce pharmaceutical serialization errors [32]. Real time data sharing as demonstrated by TradeLens, enhances coordination between logistics partners, promotes visibility and decision-making [27]. All these mechanisms turn supply chains into auditable ecosystems, which reduce inefficiencies and create trust. Research also shows that blockchain can be used to overcome inefficiencies such as counterfeiting, unethical sourcing and improve trust within supply chain networks [3, 9, 30]. Recent studies also highlight how blockchain might improve logistics traceability and sustainable supply chains by using decentralized ledgers to provide verified data [4, 6]. Recent research also highlights the application of blockchain in improving traceability of logistics and sustainable supply chains by using decentralized registries for verifiable data [4, 6].

A comparison of IBM Food Trust, MediLedger, and TradeLens demonstrates the usefulness of blockchain's transparency measures (Figure 3).

IBM Food Trust uses Hyperledger to achieve real-time traceability and cut the recall periods by 80 percent in agri-food supply chains [1]. MediLedger uses smart contracts to ensure pharmaceutical serialization, which improves regulatory compliance [32]. TradeLens enhance coordination of logistics by providing real-time information but has a regulatory issue across jurisdictions [27]. Although their scalability differs depending on the business and type of blockchain, these examples show how blockchain can reduce fraud and increase trust.

Case Study	Industry	Blockchain Type	Transparency Mechanism	Outcomes	Challenges
IBM Food Trust	Agri-Food	Consortium (Hyperledger)	Real-time traceability, smart contracts	Reduced recall times by 80% [1]	High setup costs for SMEs
MediLedger	Pharma-ceuticals	Consortium	Smart contracts for serialization	Improved regulatory compliance [32]	Interoperability with legacy systems
TradeLens	Logistics	Consortium (Hyperledger)	Real-time data sharing	Enhanced coordination among shipping partners [27]	Regulatory complexity across jurisdictions

Figure 3: An overview of blockchain implementations in IBM Food Trust, MediLedger, and TradeLens that emphasizes their worldwide supply chain transparency processes, Outcomes, and Challenges.

Real-world examples such as MediLedger for pharmaceutical serialization, and IBM Food Trust for traceability exemplify the impact that blockchain technology has had in establishing transparent, trustworthy, and resilient supply chain networks [1, 32]. Blockchain contributes to transparency in global supply chains by mitigating the risk of counterfeits, supplier misrepresentation, and regulatory non-compliance, which has narrowed the data gap between operational intricacies, and verifiable trust [5, 23].

3.2 RQ2: What Are the Main Challenges and Barriers to Adopting Blockchain for Supply Chain Transparency?

Despite the potential of blockchain to improve transparency and trust in global supply chains, there are several related hurdles involving technical, organizational, economic, and regulatory factors to widespread use [5]. Scalability and performance issues are a big problem because global supply chains handle enormous volumes of transactions, which puts a lot of strain on blockchain networks [16]. The high energy consumption of consensus mechanisms like Proof of Work (PoW) and throughput and latency problems in public blockchains, in particular, limit their real-time usability for large-scale logistics operations and raise sustainability concerns [5, 19].

Interoperability and system integration are closely related issues because the lack of common standards makes it difficult to exchange data between legacy

Enterprise Resource Planning (ERP) systems and diverse blockchain platforms [10,12]. In other words, a manufacturer using Hyperledger Fabric will have a difficult task in synchronizing information with their logistics partner using an Ethereum-based solution, and this would put the concept of end-to-end transparency solution out of reach [10].

Apart from the technical barriers, regulatory and legal uncertainty continues to hinder adoption [17]. Blockchain's openness and immutability, which appeal to users, frequently clash with privacy laws like the General Data Protection Regulation (GDPR) of the European Union, where the "right to be forgotten" calls into question the technology's permanent record structure [5]. Additionally, inconsistent jurisdictional regulations could result in compliance confusion, especially in cross-border supply chains and a lack of clarity for organizations looking to understand their legal obligations and liabilities [23].

There are also barriers beyond regulatory challenges, as blockchain implementation involves high costs and complexity, requiring capital investment into infrastructure, systems integration, and training of staff [16]. Small and medium-sized businesses (SMEs), which make up a sizable share of participants in global supply chains, usually lack the financial and technical resources necessary to maintain blockchain adoption, which causes a lag between initial interest and long-term operationalization [22, 23].

Blockchain implementation is severely hampered by organizational and cultural constraints, especially in sectors with entrenched practices [16]. Based on the Technology Acceptance Model (TAM), the resistance may be predetermined with the low perceived ease of use and the lack of beliefs in the advantages of blockchain, in particular, among the SMEs with limited technical expertise [13]. The willingness to use new technologies and the trust of stakeholders in them is also one of the most important, but least studied, variables. For example, resistance in low-digital economies and cultural reluctance toward decentralized systems makes it challenging in developing economies [17]. Recent studies point out pilot projects and training as the solutions to the challenge of overcoming cultural resistance in logistics and supply chain management [12, 31]. The solution to these barriers should be specific awareness campaigns, pilot projects with visible benefits and training program to increase the organizational preparedness [32].

3.3 RQ3: What Emerging Trends and Future Research Directions Exist for Blockchain-Based Transparency in Global Supply Chains?

The systematic review suggests blockchain-based supply chain transparency is still an emerging and evolving area shaped by various technological, organizational, regulatory, and socio-economic trends [5, 24]. As research increasingly examines the convergence of blockchain with the Internet of Things (IoT) and artificial intelligence (AI) to improve transparency and operational efficiency, technological integration and scalability solutions are a prominent trend [33]. Figure 4 demonstrates an IoT-blockchain integrated framework and how IoT devices, cloudlet, and dew computing layers improve the process of data processing and transparency in supply chain management [25]. Recent reviews also focus on the IoT-blockchain integration with traceability of the food and logistics supply chain by noting the issues of scalability and energy consumption [14, 15, 18].

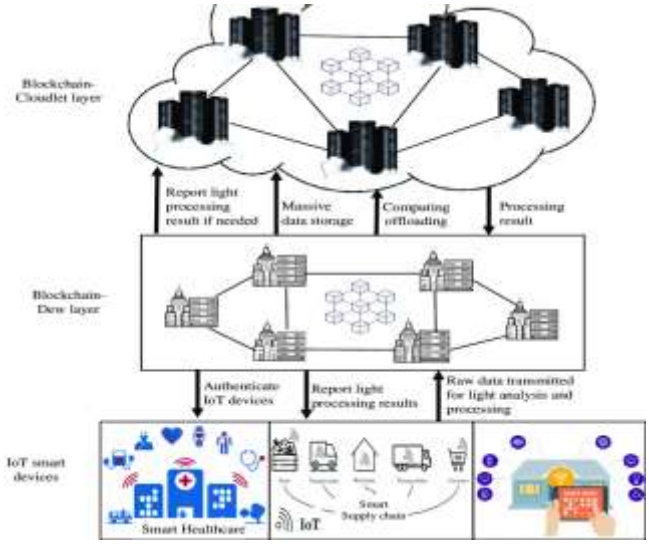

Figure 4: IoT–blockchain integrated framework for smart healthcare and supply chain management, adopted from Sadawi et al. (2021*).*

While hybrid blockchain designs that combine public backings with private reasoning will increase throughput and reduce latency, there are still research gaps around simulating real-world applications, especially concerning high-volume global supply chains where energy efficiency and performance are paramount. This is closely tied to the issue of standardization and interoperability, where adoption is hindered by the lack of universal protocols for cross-platform data exchange and integration with legacy enterprise systems [23].

The reviewed studies reveal the need for further study on cross-chain communication frameworks, as well as comparative analysis of interoperability solutions such as Polkadot and Cosmos, to determine best practices of establishing supply chain integration [23].

The socioeconomic aspects of blockchain adoption, which are still underrepresented in the literature are another developing field, especially in developing nations [17]. Financial and technical obstacles frequently prevent SMEs and local producers in areas

with limited infrastructure from implementing blockchain, but they stand to gain a great deal from its capacity to promote equitable and inclusive supply chains [10]. Future research should examine region-centered case studies in Southeast Asia and Africa, which would allow researchers to examine the ways in which blockchain may facilitate equitable access to market participation and reduce asymmetries in supply chain processes [8]. In a similar vein, regulatory and ethical issues are becoming more pressing, as blockchain's immutable and transparent characteristics can contradict data protection regulations [5].

Scholars also suggest that future research could focus on privacy-preserving mechanisms that are separate from blockchain applications, such as zero-knowledge proofs or selective data encoding, whilst considering cross-border regulatory governance and ethical frameworks [23]. The novelty of sustainability and circular economy represents a large potential area for future study, and blockchain can provide various features for tracking carbon footprints, verifying ethical sourcing, and enabling reverse logistics [16, 26]. Research in this area could be expanded to evaluate how tokenized incentives and transparency mechanisms promote circular behaviors like recycling and waste reduction, as well as to align blockchain initiatives with environmental, social, and governance (ESG) reporting [5].

Blockchain in Developing Economies: According to the review, there is increasing interest in blockchain applications in developing countries, where local producers and SMEs are challenged with inadequate infrastructure and budgetary limitations [17, 20]. For example, African agricultural supply chains using blockchain have shown how to help increase market access and decrease information asymmetries in smallholder farming [20]. Future studies in Southeast Asia, Africa, and Latin America must focus on using blockchain to create inclusive and equitable supply chains to overcome socio-economic challenges [8].

Behavioural and Socio-Economic Dimensions: Blockchain is converging with IoT and AI to transform the supply chain transparency, yet human-related aspects are under-investigated. Purchase decisions are influenced by consumer trust in blockchain-verified items, such as organic food certifications, especially in food supply chains [28]. On the same note, the culture of an organization also influences adoption and resistance to change is usually based on fear of interfering with established processes [1]. Future studies must exploit behavioural models such as the Diffusion of Innovations to examine how trust and cultural fit among the stakeholders lead to adoption and socio-economic examinations of how blockchain can empower the marginalised producers in the developing countries [17].

Empirical Research Directions: To confirm the benefits of transparency seen in secondary data, future research should include primary empirical investigations such stakeholder surveys or longitudinal case studies [10]. Strong evidence of blockchain's influence can be obtained using mixed-methods approaches that combine quantitative indicators like cost savings or fraud reduction with qualitative observations from supply chain management. The comparative studies of consortium and public blockchains as presented in Table 3 should be expanded to pilot projects in developing economies with the objective of evaluating scalability and inclusivity.

Finally, because organizational culture, stakeholder trust, and resistance to technological change all have a big impact on uptake, more research is needed to fully understand the human-centric and behavioral aspects of blockchain adoption [32]. While organizational studies could look at how internal readiness and cultural alignment shape successful implementation, behavioral research could look at how transparency affects consumer purchasing decisions [24]. Collectively, these trends indicate that future research on blockchain-based supply chain transparency will need an interdisciplinary approach that incorporates information systems, supply chain management, sustainability, and behavioral sciences [5, 23]. Addressing technological, socio-economic, regulatory, and human factors simultaneously will be essential for transitioning blockchain from isolated pilot projects to scalable, resilient, and equitable global supply chain solutions. By closing these gaps, future scholarship can accelerate the evolution of blockchain from a promising innovation to a mainstream enabler of transparent and trustworthy supply chain ecosystems [33].

4. Practical and Theoretical Contribution

4.1 Theoretical Contributions

This SLR contributes to supply chain management literature by mapping blockchain's transparency mechanisms to established theoretical paradigms. In the case of agency theory, blockchain helps to alleviate some principal-agent problems, because it provides transparent, verifiable proof of the data as well as reducing the need for intermediaries in the supply chain and consequently increasing trust between stakeholders [17]. The consideration of immutable records to document supplier certifications means supplier-buyer interests are better aligned and opportunistic behavior is minimized. Likewise, from a transaction cost economics perspective, blockchain also helps in minimizing the transaction costs associated with monitoring and enforcement [16]. For example, smart contracts are used to support the automation of several of its processes through pre-programmed contractual stipulations, which reduces monitoring and implementation costs.

Building on the IoT–blockchain hybrid model conceived by Sadawi, A. A., Hassan, M. S., & Ndiaye, M. (2021), in Figure 1, this study extends its theoretical relevance from a purely technical performance-based framework to a comprehensive transparency-focused model for global supply chains. Whereas the framework demonstrates the architectural convergence of blockchain, IoT, and layered computing for secure data collection, processing, and verification, our study advances the theoretical agenda by positioning this architecture within supply chain governance dynamics, mechanisms of trust creation, and regulatory compliance [2]. By synthesizing evidence from 33 peer-reviewed papers (2020–2025), we theorize how the data immutability, decentralized validation, and interoperability layers of Amin et al.'s framework can be realized to address transparency deficits, traceability gaps, and fraud vulnerability in multi-stakeholder network [7]. This reconceptualization not only aligns the model to sectoral issues in manufacturing, food, logistics, and pharmaceuticals but also includes new developments in AI-driven analytics, consortium governance arrangements, and sustainability imperatives [11], thereby expanding its theoretical relevance to information systems as well as global supply chain management.

4.2 Practical Implications

From the review, practitioners can learn useful lessons and take significant action to deploy blockchain-based transparency solutions. Some of the practical implications include;

Strategic Adoption: As demonstrated by the TradeLens for shipping and maritime use cases and MediLedger for pharmaceutical use cases, practitioners should give preference to consortium blockchains [27]. It would be beneficial to place pilot projects in a high-risk industry, like pharmaceuticals, to establish traction and win support from stakeholders []. This would allow them to show value up front before moving forward with production and full-scale deployment.

Technology Integration: Blockchain paired with the Internet of Things (IoT) and Artificial Intelligence (AI) will increase the point of traceability to the end consumer as these tools work together to seamlessly expose the digital twin with real-time data capture. For example, sensors from the IoT could feed real-time data to the blockchain, while optimizing for supply chain disruptions could be done using AI [33].

Cost Reduction: Small and medium-sized businesses can use cloud-based platforms to decrease infrastructure costs. Many vendors offer pre-built applications that can be plug-and-play, and firms may explore collaborative models such as industry consortia to share and allocate costs [23].

Regulatory Compliance: While firms must coordinate with regulators on how to ensure that their blockchain implementation is compatible with industry standards and data privacy laws, the evidence may allow policymakers to create global standards for blockchain interoperability and data governance that would help improve trust and acceptance across jurisdictions [17].

4.3 Limitations

Despite the stringency of this review, it is not without limitations. Concentrating on peer-reviewed literature excludes potentially pertinent industry reports or grey literature that may provide pragmatic insights [10]. Dominance of research from developed economies in North America and Europe constrains generalizability to developing countries, where adoption of blockchain technology may be confronted with distinct socio-economic issues [17]. Moreover, the fast-changing nature of blockchain technology implies that some emerging applications are perhaps not yet fully captured in the literature [5, 33].

5. Conclusion

This systematic literature review (SLR) of 33 peer-reviewed studies (2020–2025) shows how blockchain technology, including smart contracts, immutable records, and real-time data sharing, can improve supply chain transparency. Its practical uses in food, pharmaceutical and logistics suggest that it can be used to minimize inefficiencies as well as ensure compliance. Nevertheless, regulatory barriers, scalability, interoperability, and cost are discouraging factors to adoption, especially to the SME. The new trends, such as integration of IoT and AI and sustainability applications, imply that it is moving towards a higher solution, at the ecosystem level. To achieve the revolutionary potential of blockchain, future research and collaboration must overcome technical, legislative, and socio-economic challenges.

Declarations

Author Contributions

Conceptualization, methodology, formal analysis, writing original draft; Kenneth Baayeh; Supervision, investigation, validation, project administration; AP Ts Prashanth Beleya: Data curation, writing review and editing; [Author 3]: Supervision, validation, project administration. [Author 4]: All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Data available in a publicly accessible repository: The data presented in this study are openly available in Google Scholar, IEEE Xplore, Scopus with attached doi, reference number 1-33.

Funding
Funding information is not available.

Acknowledgements
The authors express their heartfelt appreciation to AP Ts Prashanth Beleya for the insightful guidance and Supervisor of the entire project to ensure the quality of research on blockchain-based transparency in global supply chains. Special thanks are offered to INTI International University for providing access to scholarly databases which were essential for this systematic review.

Institutional Review Board Statement
Not Applicable

Informed Consent Statement
Not Applicable

Conflicts of Interest
The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

References

[1] Caldarelli, G., Zardini, A., & Rossignoli, C. (2021). Blockchain adoption in the fashion sustainable supply chain: Pragmatically addressing barriers. *Journal of Organizational Change Management*, *34*(2). https://doi.org/10.1108/jocm-09-2020-0299

[2] Cao, S., Miller, T., Foth, M., Powell, W., Boyen, X., & Turner-Morris, C. (2021). *Integrating On-chain and Off-chain Governance for Supply Chain Transparency and Integrity*. ArXiv.org. https://arxiv.org/abs/2111.08455

[3] Cui, Y., Gaur, V., & Liu, J. (2023). Supply Chain Transparency and Blockchain Design. *Management Science*, *70*(5). https://doi.org/10.1287/mnsc.2023.4851

[4] Chang, S. E., & 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

[5] Choi, T. M., Wallace, S. W., & Wang, Y. (2023). *Big Data Analytics in Operations Management. Production and Operations Management, 27, 1868-1883. - References - Scientific Research Publishing*. (2023). Scirp.org. https://www.scirp.org/reference/referencespapers?referenceid=3571495

[6] Dasaklis, T. K., Voutsinas, T. G., Tsoulfas, G. T., & Casino, F. (2022). A Systematic Literature Review of Blockchain-Enabled Supply Chain Traceability Implementations. *Sustainability*, *14*(4), 2439. https://doi.org/10.3390/su14042439

[7] Doshi, S., Jangir, S., & Gohil, P. (2024). Role of Blockchain Technology in Enhancing Supplychain Traceability, Transparency and Efficiency. *Journal of Experimental Agriculture International*, *46*(5), 636–653. https://doi.org/10.9734/jeai/2024/v46i52419

[8] Ejairu, E., Mhlongo, N. Z., Odeyemi, O., Nwankwo, E. E., & Odunaiya, O. G. (2024). Blockchain in global supply chains: A comparative review of USA and African practices. *International Journal of Science and Research Archive*, *11*(1), 2093–2100. https://doi.org/10.30574/ijsra.2024.11.1.0278

[9] Faisal, Mohd. N., Sabir, L. B., & Sharif, K. J. (2023). Operationalizing transparency in supply chains using a systematic literature review and graph theoretic approach. *Benchmarking: An International Journal*. https://doi.org/10.1108/bij-05-2022-0291

[10] Fosso Wamba, S., Queiroz, M. M., & Trinchera, L. (2020). Dynamics between blockchain adoption determinants and supply chain performance: An empirical investigation. *International Journal of Production Economics*, *229*, 107791. https://doi.org/10.1016/j.ijpe.2020.107791

[11] Herbke, P., Lamichhane, S., Barman, K., Pandey, S. R., Kupper, A., Abraham, A., & Sabadello, M. (2024). *DIDChain: Advancing Supply Chain Data Management with Decentralized Identifiers and Blockchain*. 54–63. https://doi.org/10.1109/sose62363.2024.00013

12] Jabbar, S., Lloyd, H., Hammoudeh, M., Adebisi, B., & Raza, U. (2020). Blockchain-enabled supply chain: analysis, challenges, and future directions. *Multimedia Systems*, *27*(1). https://link.springer.com/article/10.1007/s00530-020-00687-0

[13] Kamble, S. S., Gunasekaran, A., Subramanian, N., Ghadge, A., Belhadi, A., & Venkatesh, M. (2021). Blockchain technology's impact on supply

chain integration and sustainable supply chain performance: evidence from the automotive industry. *Annals of Operations Research*, *327*(1). https://link.springer.com/article/10.1007/s10479-021-04129-6

[14] Kee, E., Ting, H. Y., & Atanda, A. F. (2024). Enhancing Supply Chain Traceability through Blockchain and IoT Integration: A Comprehensive Review. *Green Intelligent Systems and Applications*, *4*(1), 11–28. https://doi.org/10.53623/gisa.v4i1.355

[15] Kongmanas Yavaprabhas, Mehrdokht Pournader, & Seuring, S. (2024). Blockchain and trust in supply chains: a bibliometric analysis and trust transfer perspective. *International Journal of Production Research*, 1–28. https://doi.org/10.1080/00207543.2024.2389544

[16] Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics*, *231*(107831), 107831. https://doi.org/10.1016/j.ijpe.2020.107831

[17] Kshetri, N. (2021). Blockchain and sustainable supply chain management in developing countries. *International Journal of Information Management*, *60*(2), 102376. https://www.sciencedirect.com/science/article/pii/S0268401221000694

[18] Liu, B., Si, X., & Kang, H. (2022). A Literature Review of Blockchain-Based Applications in Supply Chain. *Sustainability*, *14*(22), 15210. https://doi.org/10.3390/su142215210

[19] Medhi, P. K. (2020). Blockchain-Enabled Supply Chain Transparency, Supply Chain Structural Dynamics, and Sustainability of Complex Global Supply Chains — A Text Mining Analysis. *Information for Efficient Decision Making*, 273–312. https://doi.org/10.1142/9789811220470_0011

[20] Mwewa, T., Lungu, G., Turyasingura, B., Umer, Y., & Chavula, P. (2024). Blockchain Technology: A Review Study on Improving Efficiency and Transparency in Agricultural Supply Chains. *Jurnal Galaksi*, *1*(3), 178–190. https://doi.org/10.70103/galaksi.v1i3.46

[21] Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., & McGuinness, L. A. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *British Medical Journal*, *372*(71). https://doi.org/10.1136/bmj.n71

[22] Prajapati, D. (2024, August 18). *Blockchain in Supply Chain Management: Enhancing transparency, traceability and trust*. https://www.researchgate.net/publication/383211732_Blockchain_in_Supply_Chain_Management_Enhancing_transparency_traceability_and_trust

[23] Queiroz, M. M., Fosso Wamba, S., De Bourmont, M., & Telles, R. (2020). Blockchain adoption in operations and supply chain management: empirical evidence from an emerging economy. *International Journal of Production Research*, *59*(20), 1–17. https://doi.org/10.1080/00207543.2020.1803511

[24] Rejeb, A., Rejeb, K., Simske, S., & Treiblmaier, H. (2021). Blockchain Technologies in Logistics and Supply Chain Management: A Bibliometric Review. *Logistics*, *5*(4), 72. mdpi. https://doi.org/10.3390/logistics5040072

[25] Sadawi, A. A., Hassan, M. S., & Ndiaye, M. (2021). A Survey on the Integration of Blockchain With IoT to Enhance Performance and Eliminate Challenges. *IEEE Access*, *9*, 54478–54497. https://doi.org/10.1109/access.2021.3070555

[26] Sahoo, S., Kumar, S., Sivarajah, U., Lim, W. M., Westland, J. C., & Kumar, A. (2022). Blockchain for sustainable supply chain management: trends and ways forward. *Electronic Commerce Research*, *24*. https://doi.org/10.1007/s10660-022-09569-1

[27] Sarker, S., Henningsson, S., Jensen, T., & Hedman, J. (2021). The Use Of Blockchain As A Resource For Combating Corruption In Global Shipping: An Interpretive Case Study. *Journal of Management Information Systems*, *38*(2), 338–373. https://doi.org/10.1080/07421222.2021.1912919

[28] Sharma, A., Sharma, A., Bhatia, T., & Singh, R. K. (2023). Blockchain enabled food supply chain management: A systematic literature review and bibliometric analysis. *Operations Management Research*. https://doi.org/10.1007/s12063-023-00363-2

[29] Singh, A., Gutub, A., Nayyar, A., & Khan, M. K. (2022). Redefining food safety traceability system through blockchain: findings, challenges and open issues. *Multimedia Tools and Applications*. https://doi.org/10.1007/s11042-022-14006-4

[30] Smith, R., & McElwee, G. (2021). The "horse-meat" scandal: illegal activity in the food supply chain. *Supply Chain Management: An International Journal*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/scm-08-2019-0292
[31] Sunmola, F., & Burgess, P. (2023). Transparency by Design for Blockchain-Based Supply Chains. *Procedia Computer Science*, *217*, 1256–1265. sciencedirect. https://doi.org/10.1016/j.procs.2022.12.324
[32] Sunny, J., Undralla, N., & Pillai, V. M. (2020). Supply chain transparency through blockchain-based traceability: An overview with demonstration. *Computers & Industrial Engineering*, *150*(150), 106–895. https://doi.org/10.1016/j.cie.2020.106895
[33] Yahaya Saidu, Shuhaida Mohamed Shuhidan, Dahiru Adamu Aliyu, Aziz, I. A., & Adamu, S. (2025). Convergence of Blockchain, IoT, and AI for Enhanced Traceability Systems: A Comprehensive Review. *IEEE Access*, 1–1. https://doi.org/10.1109/access.2025.3528035

参考文:

[1] Caldarelli, G., Zardini, A., & Rossignoli, C. (2021). 时尚可持续供应链中的区块链应用：务实地解决应用障碍。《组织变革管理杂志》(Journal of Organizational Change Management), 34(2). https://doi.org/10.1108/jocm-09-2020-0299
[2] Cao, S., Miller, T., Foth, M., Powell, W., Boyen, X., & Turner-Morris, C. (2021). 结合链上与链下治理以实现供应链透明度与完整性。ArXiv.org. https://arxiv.org/abs/2111.08455
[3] Cui, Y., Gaur, V., & Liu, J. (2023). 供应链透明度与区块链设计。《管理科学》(Management Science), 70(5). https://doi.org/10.1287/mnsc.2023.4851
[4] Chang, S. E., & Chen, Y. (2020). 当区块链遇到供应链：当前发展与潜在应用的系统文献综述。《IEEE Access》, 8, 62478–62494. https://doi.org/10.1109/ACCESS.2020.2983601
[5] Choi, T. M., Wallace, S. W., & Wang, Y. (2023). 运营管理中的大数据分析。《生产与运营管理》(Production and Operations Management), 27, 1868–1883. https://www.scirp.org/reference/referencespapers?referenceid=3571495
[6] Dasaklis, T. K., Voutsinas, T. G., Tsoulfas, G. T., & Casino, F. (2022). 基于区块链的供应链可追溯性实施的系统文献综述。《可持续性》(Sustainability), 14(4), 2439. https://doi.org/10.3390/su14042439
[7] Doshi, S., Jangir, S., & Gohil, P. (2024). 区块链技术在提升供应链可追溯性、透明度和效率中的作用。《国际实验农业期刊》(Journal of Experimental Agriculture International), 46(5), 636–653. https://doi.org/10.9734/jeai/2024/v46i52419
[8] Ejairu, E., Mhlongo, N. Z., Odeyemi, O., Nwankwo, E. E., & Odunaiya, O. G. (2024). 全球供应链中的区块链：美国与非洲实践的比较研究。《国际科学与研究档案》(International Journal of Science and Research Archive), 11(1), 2093–2100. https://doi.org/10.30574/ijsra.2024.11.1.0278
[9] Faisal, M. N., Sabir, L. B., & Sharif, K. J. (2023). 通过系统文献综述与图论方法实现供应链透明度。《Benchmarking: An International Journal》. https://doi.org/10.1108/bij-05-2022-0291
[10] Fosso Wamba, S., Queiroz, M. M., & Trinchera, L. (2020). 区块链采用决定因素与供应链绩效之间的动态关系：一项实证研究。《国际生产经济学期刊》(International Journal of Production Economics), 229, 107791. https://doi.org/10.1016/j.ijpe.2020.107791
[11] Herbke, P., Lamichhane, S., Barman, K., Pandey, S. R., Kupper, A., Abraham, A., & Sabadello, M. (2024). DIDChain：利用去中心化身份标识与区块链推进供应链数据管理。54–63. https://doi.org/10.1109/sose62363.2024.00013
[12] Jabbar, S., Lloyd, H., Hammoudeh, M., Adebisi, B., & Raza, U. (2020). 基于区块链的供应链：分析、挑战与未来方向。《Multimedia Systems》, 27(1). https://link.springer.com/article/10.1007/s00530-020-00687-0
[13] Kamble, S. S., Gunasekaran, A., Subramanian, N., Ghadge, A., Belhadi, A., & Venkatesh, M. (2021). 区块链技术对供应链整合与可持续供应链绩效的影响：来自汽车行业的证据。《Annals of Operations Research》, 327(1). https://link.springer.com/article/10.1007/s10479-021-04129-6
[14] Kee, E., Ting, H. Y., & Atanda, A. F. (2024). 通过区块链与物联网整合提升供应链可追溯性：综合综述。《Green Intelligent Systems and Applications》, 4(1), 11–28. https://doi.org/10.53623/gisa.v4i1.355
[15] Kongmanas Yavaprabhas, Mehrdokht Pournader,

& Seuring, S. (2024). 供应链中的区块链与信任：文献计量分析与信任转移视角。《International Journal of Production Research》, 1–28. https://doi.org/10.1080/00207543.2024.2389544

[16] Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). 区块链技术与可持续供应链：对采用障碍的理论探索。《国际生产经济学期刊》(International Journal of Production Economics), 231(107831), 107831. https://doi.org/10.1016/j.ijpe.2020.107831

[17] Kshetri, N. (2021). 发展中国家的区块链与可持续供应链管理。《国际信息管理期刊》(International Journal of Information Management), 60(2), 102376. https://www.sciencedirect.com/science/article/pii/S0268401221000694

[18] Liu, B., Si, X., & Kang, H. (2022). 基于区块链的供应链应用文献综述。《可持续性》(Sustainability), 14(22), 15210. https://doi.org/10.3390/su142215210

[19] Medhi, P. K. (2020). 基于区块链的供应链透明度、供应链结构动态与复杂全球供应链可持续性：文本挖掘分析。Information for Efficient Decision Making, 273–312. https://doi.org/10.1142/9789811220470_0011

[20] Mwewa, T., Lungu, G., Turyasingura, B., Umer, Y., & Chavula, P. (2024). 区块链技术：提升农业供应链效率与透明度的综述研究。《Jurnal Galaksi》, 1(3), 178–190. https://doi.org/10.70103/galaksi.v1i3.46

[21] Page, M. J., McKenzie, J. E., Bossuyt, P. M., 等. (2021). PRISMA 2020 声明：系统综述报告的更新指南。《英国医学杂志》(British Medical Journal), 372(71). https://doi.org/10.1136/bmj.n71

[22] Prajapati, D. (2024). 供应链管理中的区块链：提升透明度、可追溯性与信任。https://www.researchgate.net/publication/383211732_Blockchain_in_Supply_Chain_Management_Enhancing_transparency_traceability_and_trust

[23] Queiroz, M. M., Fosso Wamba, S., De Bourmont, M., & Telles, R. (2020). 运营与供应链管理中的区块链采用：来自新兴经济体的实证证据。《International Journal of Production Research》, 59(20), 1–17. https://doi.org/10.1080/00207543.2020.1803511

[24] Rejeb, A., Rejeb, K., Simske, S., & Treiblmaier, H. (2021). 物流与供应链管理中的区块链技术：文献计量综述。《Logistics》, 5(4), 72. https://doi.org/10.3390/logistics5040072

[25] Sadawi, A. A., Hassan, M. S., & Ndiaye, M. (2021). 区块链与物联网融合以提升性能并消除挑战的综述。《IEEE Access》, 9, 54478–54497. https://doi.org/10.1109/access.2021.3070555

[26] Sahoo, S., Kumar, S., Sivarajah, U., Lim, W. M., Westland, J. C., & Kumar, A. (2022). 面向可持续供应链管理的区块链：趋势与未来发展路径。《Electronic Commerce Research》, 24. https://doi.org/10.1007/s10660-022-09569-1

[27] Sarker, S., Henningsson, S., Jensen, T., & Hedman, J. (2021). 区块链作为打击全球航运腐败的资源：解释性案例研究。《Journal of Management Information Systems》, 38(2), 338–373. https://doi.org/10.1080/07421222.2021.1912919

[28] Sharma, A., Sharma, A., Bhatia, T., & Singh, R. K. (2023). 基于区块链的食品供应链管理：系统文献综述与文献计量分析。《Operations Management Research》. https://doi.org/10.1007/s12063-023-00363-2

[29] Singh, A., Gutub, A., Nayyar, A., & Khan, M. K. (2022). 通过区块链重新定义食品安全可追溯系统：研究发现、挑战与开放问题。《Multimedia Tools and Applications》. https://doi.org/10.1007/s11042-022-14006-4

[30] Smith, R., & McElwee, G. (2021). “马肉丑闻”：食品供应链中的非法活动。《Supply Chain Management: An International Journal》. https://doi.org/10.1108/scm-08-2019-0292

[31] Sunmola, F., & Burgess, P. (2023). 面向区块链供应链的设计型透明度。《Procedia Computer Science》, 217, 1256–1265. https://doi.org/10.1016/j.procs.2022.12.324

[32] Sunny, J., Undralla, N., & Pillai, V. M. (2020). 通过基于区块链的可追溯性实现供应链透明度：概述与示例。《Computers & Industrial Engineering》, 150, 106895. https://doi.org/10.1016/j.cie.2020.106895

[33] Yahaya Saidu, Shuhaida Mohamed Shuhidan, Dahiru Adamu Aliyu, Aziz, I. A., & Adamu, S. (2025). 区块链、物联网与人工智能融合以提升可追溯系统：综合综述。《IEEE Access》. https://doi.org/10.1109/access.2025.3528035

Manuscript Information
Word count: 9,617 words (excluding references).

Peer-Review Record
Fast-track status: Not fast-tracked.
First-round reviews received: 3 reports.
Revision cycles completed: 3 rounds.
Final version submitted: January 31, 2026