

## The Role of Blockchain Technology in Supply Chain Management

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### Abstract

In the rapidly evolving digital era, efficiency and transparency are key to gaining a competitive edge in business. Blockchain technology has emerged as a revolutionary solution with the potential to enhance transparency, security, and efficiency in the supply chain. While many large companies have adopted it for various benefits, challenges such as scalability, interoperability, and legal uncertainties still hinder the widespread adoption of blockchain. This research utilizes a literature review to explore the challenges and benefits of implementing blockchain in the supply chain, as well as strategies to enhance data security, transparency, and efficiency. The findings indicate that blockchain can improve transparency, security, and efficiency in the supply chain, but there are still challenges to be addressed. Nonetheless, with proper investment and development, the potential benefits of blockchain in supply chain management (SCM) are significant.

**Keywords:** Blockchain Technology, Supply Chain Management, Transparency and Efficiency

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### INTRODUCTION

In the rapidly evolving digital era, efficiency and transparency have become essential for gaining a competitive edge in business. The supply chain, as the lifeblood of industry, is not exempt from these demands. Various technological innovations continue to emerge to optimize processes and increase trust in the supply chain. One of the breakthroughs increasingly being implemented is blockchain technology.

Blockchain, known as the technology behind cryptocurrencies like Bitcoin, offers revolutionary solutions for various sectors, including the supply chain. This technology can provide unmatched transparency, security, and efficiency, opening new opportunities for industrial transformation. The application of blockchain in the supply chain is becoming more widespread. Large companies use blockchain to trace the origin of food, ensure product quality and authenticity, and increase consumer trust (Vazquez Melendez et al., 2024). Specialized blockchain platforms for the supply chain, such as IBM Food Trust and BiTA, are also emerging, offering ready-made solutions for companies looking to adopt this technology (Pejic, 2019; Vivien, 2018).

Industry collaboration is also intensifying. Consortia such as the Blockchain in Transport Alliance (BiTA) and Food Trust have been established to formulate standards and best practices for the use of blockchain in the supply chain (Chang et al., 2020; Tiwari et al., 2023). This demonstrates the industry's commitment to maximizing the potential of this technology.

Despite its great potential, the implementation of blockchain in the supply chain still faces several challenges. Scalability is one of the main issues, as the current capacity of

blockchain is not yet able to handle the high transaction volumes required by large-scale industries (Nasir et al., 2022). Interoperability between blockchain platforms also remains a challenge. The incompatibility between these platforms makes collaboration between companies in the supply chain difficult (Rejeb et al., 2021).

A critical gap in research exists regarding the long-term impacts of blockchain technology on supply chain efficiency and transparency. While numerous studies have highlighted its potential benefits, there is a lack of empirical data demonstrating its effectiveness in real-world applications across different industries. This gap presents an opportunity for future research to explore not only the technical aspects of blockchain implementation but also the sociocultural and economic implications for businesses and consumers alike. The lack of clear regulations related to blockchain also raises doubts for companies looking to adopt this technology. Legal and regulatory uncertainties can be a barrier to investment and the development of blockchain technology in the supply chain (Sabeti et al., 2019).

The novelty of this research lies in its comprehensive approach to evaluating blockchain's impact on the supply chain. By analyzing case studies from various sectors and integrating stakeholder perspectives, this research aims to provide a holistic view of how blockchain can transform supply chain operations. Moreover, it seeks to identify best practices and strategies for successful implementation, thereby contributing to a more informed adoption of this technology.

The global benefits of adopting blockchain in supply chains are significant. Enhanced transparency can lead to increased consumer trust, ultimately fostering brand loyalty. Improved efficiency through streamlined processes can reduce operational costs, which is crucial in a highly competitive market. Furthermore, by utilizing blockchain to trace product origins and ensure authenticity, companies can promote ethical sourcing and sustainability, aligning with growing consumer demand for responsible business practices. Overall, the integration of blockchain technology has the potential to revolutionize supply chains, making them more resilient, trustworthy, and efficient.

## RESEARCH METHOD

The author employs literature review as the method for this research. Literature review is a systematic investigation that involves searching, collecting, synthesizing, and concluding information from various sources. Various library resources such as articles, previous research, reference books, notes, and journals aid in this process.

Relevant previous research is utilized to facilitate discussions and discourse on the research topic. The table below summarizes these references.

**Table 1. Relevant Previous Research**

NO	Author	Title	Result
1.	M. Asep Rizkiawan Harry Ramza (2024)	Enhancement And Operational Efficiency Of Supply Chain Management (Scm) Utilizing Technology	Integrating emerging technologies such as AI and blockchain into supply chain management can be highly beneficial for organizations. These technologies can enhance traceability, supply chain security, operational efficiency, and reduce costs.

2.	Desy Apriani, Nadia Nur Azizah, Nova Ramadhona, Dhiyah Ayu Rini Kusumawardhani (2023)	Optimizing Data Transparency In The Supply Chain Through Blockchain Technology Integrity	This study emphasizes the importance of data transparency in modern supply chains and how blockchain technology, along with smart contracts and IoT, can enhance this transparency. The study also identifies the challenges in achieving a balance between transparency and privacy in the supply chain, and highlights the need for increased investment in these technologies. Some market players are reluctant to adopt blockchain in supply chains due to privacy-related obstacles that need to be addressed.
3.	Gunawan Witjaksono, Virginia, Almahyra Zea Amanda, Pandri, Loso Judijanto (2023)	Blockchain Technology In Supply Chain Management: Enhancing Transparency And Security	Transparency and security in supply chains are significantly influenced by the adoption of blockchain technology in supply chain management (SCM). The findings of this research highlight several crucial elements that need attention. The implementation of blockchain technology clearly enhances the transparency of the supply chain as an initial step.
4.	Wiji Safitri, Miftakul Huda (2023)	Adoption Of Blockchain Technology In Indonesian Msme Supply Chain Management (Scm)	Many MSMEs find it challenging to learn about blockchain supply chain and lack sufficient legal support from regulators. As a result, they are reluctant to adopt blockchain in their supply chain. However, MSMEs believe that adopting blockchain will enhance their benefits and competitiveness.
5.	Syamsuddin, Saharuddin, Yusrizal, Tuti Dharmawati, Yusti Pujisari, Endang Fatmawati (2023)	Utilizing Blockchain Technology In Global Supply Chain Management: An Exploration Of Scalable Information Systems	Utilizing blockchain technology in global supply chain management holds promising potential, including transparency, efficiency, and security. By leveraging Smart Contracts, companies can automate business operations and reduce expenditure. Collaborating with third parties

			is also a crucial strategy to enhance supply chain efficiency.
6.	Iwan Adhicandra (2024)	Implementation Of Blockchain Technology In Logistics Management Systems To Improve Reliability And Transparency	Implementing blockchain technology in logistics management systems has the potential to enhance reliability, transparency, and efficiency in the supply chain. Through securely distributed records, blockchain can mitigate the risks of data loss or manipulation, create clear audit trails, and enhance trust among supply chain partners. Moreover, blockchain improves transparency by enabling easy and secure access to information regarding the origin, status, and condition of goods.
7.	Dra. Manovri Yeni, M.Si, dan Devi Kumala, S.Si, M.T. (2020)	Blockchain Technology For Transparency And Security In The Digital Era	Blockchain technology is a new innovation that utilizes cryptographic techniques and decentralized data distribution to store data with high security levels. This article discusses the basic concepts of blockchain, technologies used such as asymmetric key encryption, hash functions & hashchains, and peer-to-peer networks. It also examines the application of blockchain technology in cryptocurrencies and smart contracts, and its impact on transparency and security of digital data.
8.	Tia Octaviany, Ahmad Gunawan (2023)	Optimizing Inventory Management Through Supply Chain Technology	Various common inventory management methods include Economic Order Quantity (EOQ), Material Requirement Planning (MRP), Just In Time (JIT), and Periodic Review. EOQ optimizes inventory orders by purchasing in economical quantities. MRP ensures that inventory levels

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			<p>remain sufficient but minimal to optimize costs. JIT enables scheduled inventory ordering to avoid unnecessary storage, and Periodic Review involves ordering based on scheduled routines. Meanwhile, technology in supply chain management enhances operational efficiency by optimizing processes, increasing transparency, improving customer satisfaction through fast product delivery, and enhancing decision-making through real-time data and analysis.</p>
9.	Kadek Bagus Putra Permana (2023)	Analysis Of The Role Of Supply Chain Management (Scm) In Improving Company Performance	<p>Research results indicate that the relationship between suppliers and customers can run smoothly when information is shared openly, resulting in a positive and significant impact on company performance. Supply Chain Management plays a role in enhancing company performance by reducing delivery delays and raw material quality issues.</p>
10.	Fachri Rizky Sitompul, Nukhe Andri Silviana, Yudi Daeng Polewangi, Haniza (2024)	Blockchain Technology In Supply Chain Digitalization:	<p>This research reviews literature from various academic and practitioner sources, including scientific and practical knowledge sources, research findings, and case studies. It explains the operations, benefits, and challenges of blockchain in supply chains. The study finds that supply chain applications greatly benefit from blockchain. Blockchain can enhance data accuracy, reduce errors, eliminate intermediaries, directly connect stakeholders, increase supply chain productivity and performance, enhance control and trust through transparency, track the flow of information</p>

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			about goods, and provide reliable data and security.
11.	Ahmad Fadil Alamsyah (2024)	Implementation Of Blockchain Technology In Supply Chain Management:	The implementation of blockchain technology in supply chain management has resulted in positive impacts and addresses several common SCM challenges, such as lack of end-to-end visibility, product tracking uncertainties, and risks of fraud and data errors. Blockchain involvement also brings significant changes in operational efficiency, automates contract processes, enables real-time tracking, and enhances information accuracy.
12	Kaysa Ramadhani (2024)	Application Of Blockchain Technology In Electronic Health Management Systems:	This study investigates the introduction of blockchain technology and its application in the healthcare sector. Originally introduced for cryptocurrency data storage, blockchain now extends to various financial and business applications. Its distributed and immutable data storage system could potentially enhance efficiency and security, particularly in managing electronic medical records.
13.	Muhammad Arwin, Dena Aulia, Lia Uzliawati (2023)	Blockchain Implementation In Accounting And Supply Chain Management:	Blockchain technology has been widely discussed in recent years and attracts interest across various industrial sectors, including its application in supply chain management. It enhances efficiency, transparency, fraud reduction, ensures product quality and authenticity, and accelerates audit and verification processes.
14	Rahman Insani	Role Of Blockchain Technology In Enhancing Data	As information technology adoption increases, the agro-industrial sector utilizes

		Security In Agro-Industrial Supply Chain Traceability Systems:	developments for various purposes. Blockchain technology is implemented in traceability systems, facilitating the recording of agricultural activities from seed planting to consumer delivery. This system benefits the agro-industry by tracking products and improving supply chain transparency.
15	Tiara Devi Maharani, Aris Sarjito, Christine sri Marnani (2023)	Application Of Blockchain Technology In Defense Logistics Management:	Logistics management in defense contexts is crucial for maintaining readiness and operational efficiency of military forces. Efficient logistics processes are essential for ensuring the supply, maintenance, and distribution of military equipment.
16	Isma Elan Maulani, Tedi Herdianto, Dwi Febri Syawaludin, and Medika Oga Laksana (2023)	Implementation Of Blockchain Technology In Information Security Systems:	The implementation of blockchain technology in information security systems discusses the importance of information security, solutions offered by blockchain technology, and its benefits and challenges in implementation. It highlights aspects such as information security, data integrity, anonymity, transparency, and reliability achieved through blockchain technology, aiming to enhance security and ensure data integrity across sectors like banking, commerce, and government.

## RESULT AND DISCUSSION

Blockchain represents a cutting-edge innovation in the digital era, offering high security and transparency capabilities. One promising application of blockchain technology in the digital age includes data security, such as verification, medical data storage, and payment systems. Blockchain ensures secure data storage and effective management, benefiting IoT devices. It also facilitates smooth communication across the supply chain.

The implementation of blockchain technology in supply chain management (SCM) brings significant positive impacts on data security and transparency. With its distributed system, every transaction can be directly and transparently traced within companies adopting blockchain technology. Another advantage lies in the use of smart contracts, which automate and enforce business contracts, ensuring transactions align with agreements.

Despite its potential, blockchain adoption in SCM faces challenges. Scalability, interoperability, and regulatory issues are major concerns. Current blockchain capacities may

not handle the large transaction volumes required by large-scale industries. Interoperability between blockchain platforms can be complex without clear protocols and standards. Legal uncertainties also hinder blockchain investment and development.

Nevertheless, the potential benefits of blockchain in SCM are substantial. Companies can discover new opportunities to enhance efficiency, transparency, and supply chain security by addressing these challenges and investing in technological advancements.

#### **Application of Blockchain Technology in Defense Logistics Management**

The implementation of blockchain technology utilizes a distributed ledger system, or DLT. Essentially, blockchain is a systematically distributed database comprised of multiple immutable blocks. Due to the network displaying the source of data and its owner, participants can economically authenticate and verify transactions, thereby enabling transparency in the supply chain (Hellani et al., 2021). Subsequently, copies or partial copies of the database are provided to each entity. By adhering to collectively agreed rules, each entity then has the capability to modify the database. The operation of blockchain technology aligns with the statements by Perboli et al., (2018), which state that the design of blockchain technology systems adheres to several principles, including:

- a. **Open Distributed Ledger:** A database distributed across all relevant parties, verifiable without centralized authority. A new block is created and linked to previous blocks if a transaction is altered. With decentralization and real-time data updates, blockchain functions effectively in networks encompassing various organizations.
- b. **Rules Governing Data Distribution:** To manage blockchain, participants first agree on the type of transactions to be conducted and bind them into the chain as smart contracts. There is also minimal involvement of third parties acting as intermediaries.
- c. **Minimal Third-Party Intermediaries:** Based on consensus and trust due to decentralized storage, this prevents errors or fraud that could affect the database.
- d. **Stored via Cryptography:** Cryptographic methods ensure that data contained within the blockchain is immutable and unique.
- e. **Sequentially Ordered:** This allows participants to conduct analyses with continuously updated data.

#### **Implementation of Blockchain in Accounting and Supply Chain Management: A Literature Review**

The advancement of blockchain technology has rapidly evolved in recent years, with many companies beginning to implement it in areas such as Supply Chain Management (SCM). SCM involves the efficient processing of data related to the flow of goods, information, and services across business sectors including suppliers, manufacturers, distributors, retailers, and customers (Khan et al., 2019). In developing countries, persistent issues of perceived injustice in the supply chain affect stakeholders such as farmers, fishermen, and other suppliers (Kshetri, 2021).

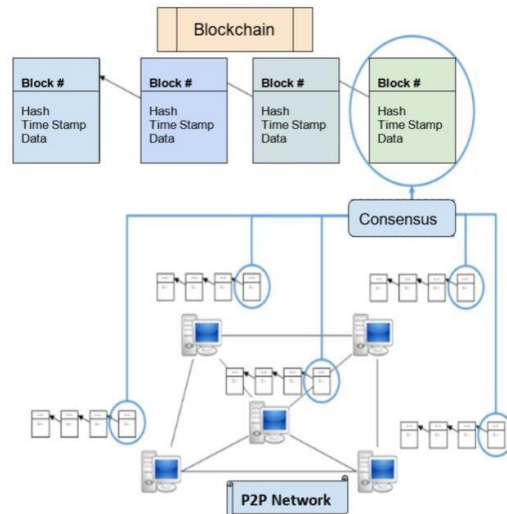
In the food industry, one of the causes of food safety incidents is the lack of integrity among food producers and operators, alongside information asymmetry between links, leading to trust issues in transactions for both parties (Ling & Wahab, 2020). SCM includes efficient coordination, production tracking, accurate inventory management, supplier reliability, and product authenticity management. As noted by Benedito et al., (2020), internal risks (endogenous) encompass moral hazards, information delivery risks, risks in production and procurement organizations, and logistical risks. External risks (exogenous) include market demand risks, legal policy risks, accident disaster risks, and others.

Blockchain offers the potential to transform industrial operations and project management by providing higher levels of transparency, security, and efficiency through its mechanisms. Li & Kassem, (2021) state that blockchain has addressed issues in supply chains caused by information asymmetry. Smart contracts, automated programs within blockchain



systems, execute upon the completion of transaction activities. According to Taherdoost, (2023), implementing smart contracts represents one of the most transformative aspects of blockchain systems. Contracts provide certainty to involved parties that the other party will fulfill promises or contracts made.

### Conceptual Frame Work



**Figure 2. Conceptual Frame Work**

### CONCLUSION

Based on the findings of this research, blockchain technology significantly aids supply chain management by enhancing operational efficiency, reducing costs, and improving security. This underscores the advancing sophistication of blockchain technology today and its high level of security. In supply chains utilizing blockchain technology, achieving transparency and privacy is crucial yet challenging due to the substantial investment required in blockchain infrastructure.

Technological advancements have played a pivotal role in bolstering supply chain management to date. Leveraging blockchain technology is proven to yield profits. However, its adoption is not without challenges, as not everyone can easily navigate the regulatory landscape that currently lacks adequate support for blockchain technology. The current use of blockchain technology primarily focuses on security aspects, such as in logistics, where it enables tracking the whereabouts of goods and verification processes to prevent unauthorized access, thus ensuring data transparency and security.

Blockchain can be employed as a method to enhance transparency and efficiency in supply chain management. This technology facilitates real-time recording and tracking of transactions and supply movements, thereby providing more accurate information access to all relevant parties. By implementing the principle of decentralization, blockchain enhances data security by ensuring that data is distributed across the entire system rather than relying on a single central point. Consequently, data manipulation and unauthorized access are more difficult, ensuring data authenticity and minimizing risks of leakage and fabrication.

Furthermore, blockchain can improve operational efficiency, enhance consumer trust, and ensure production sustainability. It enables real-time and transparent tracking of goods, minimizing delays and errors. This transparency strengthens consumer trust by providing full visibility into the origin and quality of products. Additionally, blockchain ensures that production practices adhere to sustainability standards and ethics, supporting automation through smart contracts, thereby reducing the need for manual oversight.

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