

Role of Block Chain Technology Challenges in Supply Chain Management

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Abstract: *Supply Chain Management is the backbone of any business balancing efficiency, agility, and sustainability through technologies. The technology enhances the operation of the supply chain in various industries such as food and agriculture, pharmaceuticals, retail and e-commerce, automotive, healthcare, fashions, and logistics. The government provides subsidies and benefits to small and medium enterprises for the adoption of blockchain. The policymakers establish a well-defined framework and promote trust in the businesses. The clear framework and cost-sharing models create trust in the adoption of technologies. The energy-intensive process of blockchain helps to adapt and overcome the challenges for sustainability in supply chain management.*

Keywords: supply chain management, blockchain, adoption, challenges

1. Introduction

Supply chain management is an interconnected process of the flow of goods, data, and finance ensuring the efficient delivery of the products to end customers. The recent trends involved in supply chain management such as digital transformation, resilience, risk management, customer-centric, and sustainability ensure the product reaches the customer at the right time and place. The SCM is the backbone of any business balancing efficiency, agility, and sustainability through technologies. The new technologies help the inventory management needs to maintain and avoid overstocking and manage the timely delivery of goods.

Technologies like artificial intelligence, the Internet of Things, and Blockchain help supply chain management enhancing visibility and efficiency of supply chains. It reduces carbon footprint and resource wastage and promotes environmental sustainability by adopting green practices. It focuses on fast delivery, transparent tracking, and ethical consideration of the business to meet consumer expectations.

Blockchain technology has a transformative explanation for supply chain management by offering a secure, decentralized, and translucent method for recording business transactions. The supply chain system process leads to inefficiency, inaccuracy, and distrust of the stakeholders in the traditional method. With the help of blockchain technology, it overcomes the issues of the supply chain process by providing end-to-end visibility and accountability. The technology enhances the operation of the supply chain in various industries such as food and agriculture, pharmaceuticals, retail and e-commerce, automotive, healthcare, fashions, and logistics.

2. Review of Literature

Babei et al. (2025) elaborate on the applications of renewable energy in blockchain technology for supply chains. This enhances the accuracy of the decision-making methods of decision-making theory. The researchers applied the fuzzy tri-objective model based on their efficiency to represent the multifaceted challenges in technical, environmental, and

regulatory frameworks. It concludes investment cost and blockchain deployment are major problems in utilizing blockchain in renewable energy supply chains.

Hua X et al. (2025) focus on 220 manufacturing firms in China for sustainable performance in supply chain management using the structural equation method. The organizational information processing theory helps to learn the adoption of blockchain technology to achieve performance of sustainability. The results found that supply chain learning is leverage between the adoption and sustainability of blockchain. Organizational inertia negatively impacts adoption and supply chain learning.

Polas MRH et al. (2025) demonstrate the innovation, technology, and innovation-sharing capability of the adoption of blockchain technology impact the performance of a firm. The data was collected from 198 electronic companies in Dhaka, Bangladesh. The structural equation modeling helps to investigate the three capabilities of small and medium-sized enterprises to enhance the firm performance using blockchain technology. It concludes that the enterprises enhanced by blockchain technology increase strategic value in sustainability and competitiveness to promote resource efficiency and meet the consumer experience in electronic companies.

Ali M R et al. (2025) reveal a three-phase framework of machine learning, the BORUTA algorithm, and the Grey-DEMATEL method used to recognize the 26 potential barriers to the accuracy of machine learning models. Blockchain adoption identifies the hurdles to the sustainability of the supply chain uncovering the interrelatedness of adopting technology. It reveals the random forest classifier concise with 15 barriers performed with 2.38 % accuracy and 2.19% F score by detecting the barriers for validating the algorithm. The study found that industry practitioners develop new strategies for adopting blockchain technology for sustainability in supply chains.

Alazab M et al. (2021) integrate the conceptual model of a Unified Theory of Acceptance and Use of Technology

(UTAUT), Task Technology Fit (TTF), and Information System Success (ISS) for the adoption of blockchain in supply chains. The result shows ISS, TTF, and UTAUT positively influence employees' willingness to supply chains. It found that the intention to adopt the blockchain factor negatively influences the unified theory of acceptance and use of technology social factors. The trust of organization factors strongly influences UTAUT factors and intention to adopt blockchain.

Ghode D et al. (2020) identify the factors influencing blockchain technology in the supply chain. The researcher analyzed the rank factors using the Grey Relational Analysis to identify the strategy for implementing blockchain in the supply chain. The key factors are inter - organizational trust, challenges, transparency, social influence, and behavioral intention influence the adoption of blockchain in the supply chain.

Wamba SF et al. (2020) conducted a bibliometric analysis to access blockchain technology by highly disruptive technology using the remodeling of the organization of the supply chain models. The role was easily traceable by e - commerce, agriculture, public services and so on. This research helps to integrate and impact the new business models, and improve the performance and stakeholder relationship providing an in - depth discussion of operational supply chain management.

Cole R et al. (2019) encourage the implication of blockchain technology in the application areas of operations and supply chain management. It identified factors such as product safety and security, improving quality management, reducing illegal, sustainability, inventory management, new product design and development, and reducing cost. The researcher found that blockchain technology supports the early stage of the implication of business and shapes the framework operation of its adoption for sustainability.

Saberi S et al. (2019) examine the supply chain management problems to ensure transparency, traceability, and security with blockchain technology and smart contracts. The researcher introduced the four adoption blockchain barriers as inter - organizational, intra - organizational, technical, and external barriers to overcome the early evolution of the technology to overcome the barriers in the adoption of blockchain technology.

Objectives:

- Understanding the blockchain technology to implement in supply chain management
- Increased efficiency and improved customer experience.
- Challenges of cyber security and legal uncertainty.

Blockchain technology and its benefits:

Monika J (2024) highlights transparency, security, and efficiency of blockchain technology provide benefits to improve trust and security by reducing costs through operational efficiencies. Wamba (2021) investigates the adoption of blockchain technology the effects of transparency among stakeholders and the operational outcome of the successful implementation. The researcher explores the application of blockchain technology and the benefits of the

efficiency of implementing the technology and identifies the challenges for scalability and regulatory issues (Casino F, 2019). Triebлмаier H, 2018 focuses on the impact of the supply chain on blockchain's role in sustainability and ethical practices.

The paper explores the application of sustainability in supply chain management and the adoption of blockchain technology in KOuhizadeh, M (2019). Azzi R discusses the transformation of blockchain technology in supply chain management emphasizing transparency and traceability. Hilary G (2019) explores the business and financial implications of blockchain in supply chain and operations management. Hughes A (2019) highlights the application of blockchain in consumer protection and innovation of the value chain.

Role of blockchain in supply chain management:

Transparency and traceability:

Krishna D Mittal (2024) explores vendor relations in supply chains to enhance transparency and trust and address the challenges with fraud prevention and data security. Jia L et al (2024) highlight the advantages and challenges of implementing the cost of blockchain technology and future trends in integrating technologies. Shaharudin M R et al. (2022) initiating the digital transformation enhances the transparency and traceability in supply chain challenges in stakeholder coordination and technical complexities to increase the efficiency of the supply chain.

Fraud Prevention:

Sharabati A et al (2025) emphasize the challenges of scalability issues, high implementation costs, regulatory hurdles, and integration complexities to overcome the adoption of blockchain technology. Han X (2025) concludes the adoption of blockchain technology is influenced by individual, organizational and social factors for sustainability and innovation in supply chain management.

Smart Contracts:

Avvanhi H et al. (2024) explore the importance of smart contracts enhancing efficiency, minimizing fraud, and building trust among the supply chain stakeholders to enable tamper - proof transactions. Singh A K et al (2024) focuses on the transformative role of supply chain management in smart contracts through transparency, efficiency, and trust among stakeholders. Taherdoost H (2023) identifies the gaps and discusses the challenges of scalability, security, and legal framework for adopting smart contracts in supply chain management in blockchain technology.

Cost efficiency:

Kukman T et al. (2025) identify blockchain as enhancing the quality, security, and cost efficiency in the automation process and reducing the support of the stakeholders. Sakarneh B et al (2024) examine the role of blockchain technology in improving efficiency and reducing costs in the banking sector by focusing on automation, transparency, and fraud prevention. Juneja M (20240 highlights the blockchain's ability to reduce costs through automation processes and eliminating intermediaries.

Challenges in adoption:**Issues in scalability:**

The researchers explain in their study scalability is a greater challenge in supply chain management because blockchain networks struggle to handle a high volume of transactions efficiently in large - scale supply chains.

Integration Complexity:

The management struggles to integrate the new automation process because the existing system and resource intensive a technical challenge to adopt the blockchain technology. The lack of trust and knowledge to implement the technology effectively is complex.

High costs:

The routine maintenance and implementation of blockchain technology systems are too expensive for small and medium - sized enterprises.

Regulatory and legal authority:

The lack of unclear regulations and frameworks of blockchain technology creates uncertainty for business. Data privacy and transparency are a greater challenge for technology adoption.

3. Discussion

Babei et al. (2025) conclude investment cost and blockchain deployment are major problems in utilizing blockchain in renewable energy supply chains. Hua X et al. (2025) found that supply chain learning is leverage between the adoption and sustainability of blockchain. Organizational inertia negatively impacts adoption and supply chain learning. Polas MRH et al. (2025) conclude that the enterprises enhanced by blockchain technology increase strategic value in sustainability and competitiveness to promote resource efficiency and meet the consumer experience in electronic companies. Ali MR et al (2025) found that industry practitioners develop new strategies for adopting blockchain technology for sustainability in supply chains. Wamba SF et al (2020) integrate and impact the new business models, and improve the performance and stakeholder relationship by providing an in - depth discussion of operational supply chain management.

4. Suggestions

Developing standardized frameworks to facilitate the integration of supply chain systems reducing technical complexities. An efficient mechanism as proof - of - stake solution helps the large - scale sectors improve the blockchain ability. Multiple organization share their infrastructure and expenses through the adoption of cost - sharing models in blockchain technology. The government provides subsidies and benefits to small and medium enterprises for the adoption of blockchain. The policymakers establish a well - defined framework and promote trust in the businesses. Enhancing data privacy to balance the transparency to access the restricted authorized participants. The management conducts training programs and awareness campaigns for stakeholders and customers to resist blockchain literacy. These solutions help to adapt the barriers and unlock the supply chain globally.

5. Conclusion

Blockchain technology provides a decentralized and tamper - proof fosters trust among stakeholders through transparency, traceability, and efficiency in supply chain management. Blockchain networks integrate with large transactions to support complex supply chains and existing systems. The clear framework and cost - sharing models create trust in the adoption of technologies. The energy - intensive process of blockchain helps to adapt and overcome the challenges for sustainability in supply chain management.

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