iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: https://doi.org/10.22214/ijraset.2026.81329

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

A Survey on Decentralized Supply Chain Information Sharing Systems Using Blockchain Technology

Shwetha A B[1], Ambika[2], Spoorthi R[3], Tejal S[4], Varsha B Gowda[5]
[1]*Assistant Professor, Dept. of CSE Sapthagiri College of Engineering* shwetha
[2, 3, 4]*Department of CSE Sapthagiri College of Engineering*

Abstract: ***The rapid expansion of global commerce and the ongoing wave of digitalization have introduced unprecedented complexity into modern supply chains. With numerous stakeholders, geographically distributed operations, and continuously growing data volumes, it becomes increasingly difficult to uphold data integrity, foster transparency, and enable seamless collaboration through conventional centralized architectures. Such centralized models are often plagued by information silos, asymmetric data access, and weak inter-organizational trust, all of which diminish the overall performance of supply chain networks. Blockchain technology presents a compelling decentralized alternative that enables secure, tamperresistant data exchange across supply chain ecosystems. Through its distributed ledger foundation, every transaction is recorded in a verifiable and permanent manner, establishing an auditable trail accessible to all authorized participants. Furthermore, programmable smart contracts enable the automated enforcement of business logic, eliminating redundant manual interventions and accelerating end-to-end processes. Notwithstanding these advantages, adopting blockchain within supply chain contexts raises challenges related to throughput limitations, integration with pre-existing enterprise infrastructure, and cost of deployment. Resolving these barriers is key to realizing the full potential of decentralized supply chain systems. This survey systematically examines blockchain- based supply chain management systems by synthesizing recent research, analyzing core technical components, and appraising their practical effectiveness while identifying open challenges and promising directions for future investigation.***

I. INTRODUCTION

The accelerating integration of global markets has fundamen- tally transformed supply chain structures into vast, multi-tiered networks that span geographic boundaries. Contemporary orga- nizations routinely engage with a diverse set of suppliers, logis- tics providers, and distributors across different regions, which amplifies the difficulty of maintaining coherent information flows and coordinated operations. Guaranteeing data accuracy, ensuring visibility across all supply chain tiers, and enabling reliable communication between stakeholders have therefore emerged as pressing operational priorities. Conventional supply chain architectures place data ownership within individual organizational silos, where each entity independently stores and manages its own records. This fragmented approach produces inconsistencies in shared data, limits end-to-end visibility, and erodes inter-party trust. As networks scale, these deficiencies manifest more acutely, resulting in processing delays, missed coordination opportunities, and heightened vulnerability to fraudulent data entry or modification. Blockchain technology has emerged as a transformative solution by furnishing a decentralized, shared infrastructure for managing supply chain information. It enables all network participants to read and write to a common, cryptographically secured ledger in which every transaction undergoes validation through a consensus mechanism before being permanently inscribed. This eliminates dependence on central intermediaries and establishes a single verifiable source of truth, supporting both data integrity and end-to-end traceability. Alongside blockchain, supplementary technologies such as IoT-based monitoring systems and rule- driven smart contracts substantially enhance supply chain performance. Continuous, sensor-driven data feeds enable real- time visibility into product conditions and locations, while smart contracts automate procedural steps that would otherwise require manual oversight, thereby accelerating workflows and reducing operational risk. This survey presents a structured examination of blockchain-enabled supply chain management systems. It synthesizes findings from recent scholarly literature, investigates concrete technological implementations, and eval- uates both the merits and limitations of existing approaches. The survey also highlights unresolved challenges and charts potential avenues for future research in this rapidly evolving domain.

©IJRASET: All Rights are Reserved

II. BACKGROUND AND MOTIVATION

Supply chain management has historically been governed by centralized paradigms in which individual organizations exercise exclusive control over the information relevant to their portion of the chain. These systems operate on a restricted data- sharing model, often described as a single authoritative source, which naturally constrains the visibility available to other participants. While adequate for relatively simple operations, such architectures prove illsuited to the scale and dynamism of contemporary global supply networks. As international trade has expanded and supply chains have grown to encompass a broader array of participants and geographic regions, the underlying networks have become markedly more volatile and data-intensive. This evolution has given rise to recurring operational vulnerabilities: inadequate inter-partner coordina- tion, challenges in tracking goods across complex multi-tier chains, and a heightened susceptibility to data discrepancies that can propagate errors and undermine decision-making. The absence of a unified, secure mechanism for crossorganizational data sharing further weakens the collaborative capacity of supply chain participants and exerts a measurable adverse effect on overall network performance. Without a trusted, shared information infrastructure, partners are compelled to recon- cile conflicting datasets, slowing processes and introducing friction at every handover point. Blockchain addresses these structural shortcomings by providing a decentralized platform for recording and validating supply chain transactions. Each entry is appended to a shared, append-only ledger in a manner that is both permanent and verifiable, creating an accountable and transparent data environment. Since every authorized participant holds access to the same validated records in near real time, the platform strengthens collaborative decision- making and substantially reduces the risk of fraudulent activities or unauthorized data alterations. In pursuit of supply chain excellence, a growing number of enterprises are harnessing blockchain in conjunction with smart contracts to address longstanding inefficiencies, sharpen inventory management practices, and elevate operational performance. The integra- tion of smart contracts and real-time monitoring capabilities with broader digital infrastructure enables more agile and selfregulating supply chains, in which predefined rules trigger automated actions, reducing cycle times and reliance on human intervention.

III. LITERATURE SURVEY

A. *Assessing the Impacts of Blockchain Technology on Supply Chain Efficiency*

Author and Year: Babaei et al. (2025)

Methodology: This study investigates blockchain integration within supply chain settings through a quantitative optimization framework grounded in empirical evidence. The authors employ Data Envelopment Analysis (DEA) to systematically bench- mark operational performance across multiple supply chain configurations, evaluating the joint influence of blockchain and IoT adoption. A composite set of Key Performance Indicators encompassing transaction transparency, resource utilization efficiency, inter-partner coordination, and cost reduction — is applied to assess how these technologies collectively re- shape supply chain operations from both technological and managerial perspectives. The empirical results demonstrate that blockchain-enabled supply chains consistently achieve superior transparency, reduced dependency on intermediaries, and more informed operational decisions supported by timely, validated data. Limitation: While the analytical framework is comprehensive, the study remains largely theoretical, relying on modeled scenarios rather than live system deployments. The scalability dynamics inherent to large, heterogeneous supply chain ecosystems are not sufficiently

B. *Blockchain Technology from the Supply Chain Perspective*

Author and Year: Ç odur et al. (2025)

Methodology: This work conducts a systematic literature review of blockchain applications in supply chain settings, focusing specifically on how distributed ledger infrastructure can enhance data transparency, inter-party trust, and information integrity without central coordination. The study examines the role of smart contracts in streamlining validation workflows and reducing the reliance on manual approval processes. The authors also detail how blockchain underpins comprehensive product traceability, enabling all supply chain actors to monitor item movement and authenticate provenance at each stage of the value chain.

Limitation: The review is entirely literature-based and lacks empirical corroboration. Privacy-preserving considerations and the practical barriers associated with enterprise-scale rollouts receive limited attention.

C. *Blockchain for Sustainable Supply Chain Management*

Author and Year: Sahoo et al. (2022)

Methodology: This paper investigates the application of blockchain as an enabler of sustainable supply chain practices. The authors conduct a systematic review and comparative analysis of multiple blockchain frameworks capable of delivering transparent resource

tracking while reducing waste and inefficiency within production and distribution stages. A central focus is placed on traceability mechanisms that ensure goods are ethically and sustainably produced, thereby minimizing negative environmental externalities. Drawing on cross-sector industry examples, the study demonstrates how blockchain can reinforce accountability structures and foster the adoption of environmentally responsible supply chain strategies.
Limitation: While the sustainability insights offered are valuable, the paper stops short of detailing implementation path- ways or performance benchmarks for the reviewed frameworks. Questions of scalability and compatibility with established enterprise systems are not addressed.

D. HalalChain: A Blockchain Model for Food Supply Chain
Author and Year: Yakubu et al. (2025)
Methodology: This study presents a purpose-built blockchain architecture designed to bolster traceability and regulatory compliance within the halal food supply chain. The proposed system integrates IoT sensing capabilities with blockchain storage, leveraging smart contracts to automate compliance verification procedures. A Proof of Authority (PoA) consensus mechanism is selected for its efficiency and governance suitability.
The framework is designed to deliver granular, real-time visibility throughout the supply chain while making product information accessible to end consumers in a trustworthy and transparent format. By using this proposed model, systems will be able to create real-time visibility into all parts of the supply chain while improving consumers' level of trust due to the availability of product information in a transparent format.
Limitation: The architecture introduces non-trivial computa- tional overhead, which may impede performance in large-scale deployments. The absence of real-world pilot testing means that practical compliance and reliability have yet to be rigorously validated.

E. Establishing Buyer-Supplier Self-Organization through De- centralized Technologies
Author and Year: Swierczek (2025)
Methodology: This research investigates decentralized co- ordination frameworks for supply chains, with blockchain as the enabling infrastructure for information sharing.
Through distributed data exchange and autonomous decision-making mechanisms, the study advances a model for enhancing buyer-supplier relationship management. The proposed framework champions self-organizing network architectures in which stakeholders interact peer-to-peer without centralized oversight, thereby gaining flexibility, adaptive responsiveness, and im- proved systemic efficiency.
Limitation: The study is predominantly conceptual in scope, with limited translation from theoretical constructs to practical implementation. Integration challenges with existing supply chain management platforms are not explored.

F. Decentralized Identity Management Using Blockchain Tech- nology
Author and Year: P. Chinnasamy et al. (2025)
Methodology: This paper introduces a blockchainanchored identity management framework tailored to supply chain environments. The system employs SelfSovereign Identity (SSI) and Zero-Knowledge Proof (ZKP) cryptographic techniques to ensure that participants can authenticate themselves and share credentials in a privacy-preserving manner. SSI empowers users to exercise direct control over their identity data, while ZKP allows counterparties to verify identity claims without gaining access to sensitive underlying information. Together, these mechanisms facilitate decentralized trust and improve access governance across supply chain participants.
Limitation: The framework faces interoperability challenges when deployed across heterogeneous blockchain platforms. Regulatory compliance complexities and scalability constraints for large-scale adoption remain open concerns.

G. Blockchain Innovations in Supply Chain Management
Author and Year: Narendra Kumar et al. (2025)
Methodology: This work examines the synergistic potential of integrating blockchain with IoT, artificial intelligence, and fifth-generation communication networks to elevate supply chain performance. The combination of live data acquisition from IoT sensors, advanced analytics powered by AI, and the high-bandwidth, low-latency capabilities of 5G networks is envisioned to produce supply chains that are more transparent, responsive, and predictive.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

The resulting ecosystem enables enhanced tracking accuracy, anticipatory demand management, and an elevated degree of process automation in supply chain decision-making.

Together, these technologies will allow for enhanced tracking and prediction and automate much of the decision-making process within supply chain operations.

Limitation: Concrete implementation guidance and costben- efit analyses are not provided. Broader adoption challenges including substantial energy requirements and the lack of cross-platform standardization — are underexplored.

H. Blockchain Technology for Supply Chain Management: A Comprehensive Review

Author and Year: Aichih (Jasmine) Chang et al. (2022)

Methodology: This article delivers an exhaustive review of blockchain's role within supply chain management, analyzing how the technology can augment product traceability, data security, and operational efficiency. The review evaluates a range of architectural frameworks that combine blockchain with cloud computing and IoT platforms, discussing their design principles and performance trade-offs.

It also addresses the practical considerations surrounding the deployment of blockchainbased supply chain systems, including system design choices and integration requirements.

Limitation: The study is predominantly descriptive and does not subject the reviewed frameworks to experimental validation. Challenges arising from integration with legacy enterprise systems and limitations related to blockchain's capacity to handle high-throughput supply chain data are acknowledged but not resolved.

I. Blockchain-Based Information Sharing Mechanism for Sup- ply Chains

Author and Year: Xin Guo et al. (2025)

Methodology: This paper develops a structured information- sharing framework leveraging blockchain to strengthen data security and collaborative coordination across supply chain entities. The proposed architecture relies on distributed storage and smart contract logic to facilitate encrypted, privacy-aware data exchanges while maintaining the transparency needed for stakeholder accountability.

By enabling verifiable access to shared records, the framework reduces the potential for data manipulation and strengthens inter-organizational trust.

Limitation: The system is projected to entail high de- ployment costs, and both scalability constraints and adoption barriers in real-world settings represent significant hurdles that require further investigation.

Blockchain Technology for Global Supply Chain Management

Author and Year: Dudczyk et al. (2024)

Methodology: This study investigates strategies for embed- ding blockchain within global supply chain systems to improve interoperability, cross-border transparency, and multinational coordination. It examines how decentralized network architec- tures can facilitate direct engagement among geographically dispersed stakeholders, removing reliance on centralized coor- dination bodies and enabling more agile international supply chain governance.

Limitation: Persistent interoperability gaps between differ- ent blockchain protocols are identified, yet the study does not offer concrete technical pathways for bridging these divides or enabling seamless multi-system integration.

IV. METHODOLOGY

The methodology presented here outlines the design of a holistic blockchain-based supply chain management system conceived to overcome the inherent limitations of centralized supply chain architectures — specifically, insufficient transparency, susceptibility to data tampering, slow product status propagation, and the inefficiencies associated with central administrative control. The solution integrates distributed ledger technology, programmable smart contracts, and real-time track- ing capabilities into a cohesive platform that delivers secure, traceable, and dependable supply chain data management.

The system is organized around a modular, multi-tier architectural model engineered to provide scalability, operational flexibility, and the capacity to process large volumes of transactional data efficiently. The overall system architecture is illustrated in Fig. 1.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

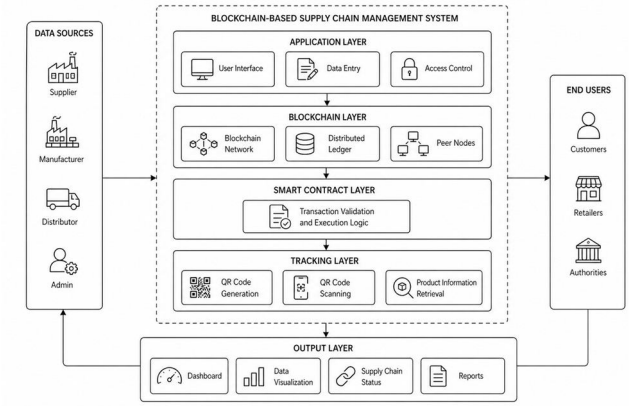


Fig. 1. Proposed architecture of the blockchain-based supply chain management system.

A. Data Acquisition and Collection

The initial phase of system operation involves the structured collection of supply chain data contributed by diverse partici- pants, including raw material suppliers, production facilities, logistics operators, and regulatory authorities. Since all par- ticipants continuously generate data across the full product lifecycle, the system is designed to ingest and record this information in a persistent, structured manner. Modern supply chains generate heterogeneous data that may be classified as:

- Structured Data: Product identifiers, timestamps, ship- ment records, pricing details, and transaction logs.
- Semi-Structured Data: JSON/XML files, blockchain metadata, and system-generated logs.
- Unstructured Data: Documents such as invoices, quality certifications, compliance reports, and multimedia records.

Ongoing data ingestion ensures that every event within the supply chain is captured in real time, supporting accurate product tracking and movement monitoring throughout the system.

B. Data Validation and Preprocessing

Prior to committing any information to the blockchain, all incoming data must pass through a rigorous preprocessing and validation pipeline designed to guarantee accuracy, consistency, and reliability. This stage prevents erroneous, incomplete, or redundant records from corrupting the immutable ledger. The preprocessing workflow encompasses:

- Data Cleaning: Removal of duplicate or inconsistent records.
- Validation: Verification of input data against predefined formats and constraints.
- Normalization: Standardizing data to maintain uniformity across different sources.
- Access Verification: Ensuring that only authorized users can submit or modify data.

These processes improve data quality and ensure that only verified information is forwarded to the blockchain layer.

C. Application Layer and User Interaction

The application layer serves as the primary interface through which end users — including supply chain managers, logistics personnel, auditors, and regulators — interact with the under- lying blockchain infrastructure. It provides mechanisms for data submission, retrieval, and access governance. The core capabilities provided by this layer include:

- Providing a user-friendly interface for data input and retrieval
- Enforcing role-based access control to restrict unautho- rized actions
- Managing authentication and authorization of users
- Facilitating communication between users and the blockchain network

This layer acts as a bridge between end users and the underlying blockchain infrastructure, ensuring smooth system interaction.

D. Blockchain Network and Distributed Ledger

The blockchain layer constitutes the persistent storage backbone of the system, maintaining a distributed copy of all recorded transactions across a network of participating nodes. Rather than consolidating data ownership within a single entity, the architecture distributes data custody collectively across all peers, ensuring no single party can unilaterally control or manipulate the shared

record. Each node validates and stores transaction data independently, and incoming transactions are aggregated into cryptographically linked blocks forming a continuous, tamper-evident chain. The mathematical linking of consecutive blocks using cryptographic hash functions ensures structural consistency and mutual verification across all nodes. The key characteristics of this layer include:

- Immutability: Data cannot be altered once recorded.
- Transparency: All authorized stakeholders can verify transactions.
- Decentralization: Eliminates reliance on a central author- ity.
- Security: Cryptographic techniques protect against unau- thorized access.

This layer significantly enhances trust and accountability within the supply chain ecosystem.

E. Smart Contract Design and Execution

Smart contracts are deployed within the blockchain to automate the execution and validation of transactions according to a defined set of rules and conditional logic. As self-executing programs that operate deterministically on the blockchain, they eliminate the need for manual oversight in routine supply chain processes. The smart contract subsystem performs the following functions:

- Automatic validation of transactions
- Enforcement of business rules and agreements
- Triggering actions such as payment processing or shipment confirmation
- Eliminating manual verification processes

For instance, a smart contract can automatically verify delivery completion and initiate payment release, reducing delays and ensuring process efficiency.

F. Product Tracking and Traceability Mechanism

To deliver comprehensive end-to-end visibility, the system incorporates a QR code-based tracking mechanism. Each product receives a unique QR code at the point of initial registration. The tracking workflow includes:

- Generating a unique QR code for each product
- Scanning the QR code at various checkpoints
- Retrieving product history and status from the blockchain

This mechanism allows stakeholders and consumers to verify product authenticity and track its movement across the supply chain, thereby reducing fraud and improving transparency.

G. Data Retrieval and Query Processing

Efficient retrieval of stored ledger data is essential for enabling real-time monitoring and informed decisionmaking. The system offers query interfaces that allow users to extract specific information on demand. Key query capabilities include:
Key functionalities include:

- Searching transaction history based on product ID or timestamp
- Retrieving supply chain status in real time
- Generating reports for analysis and auditing

Efficient query processing ensures that users can quickly access relevant information without delays.

H. Visualization and Monitoring Dashboard

A dynamic, interactive dashboard layer transforms the processed blockchain data into accessible visual formats that support operational insight and strategic decisionmaking. Standard dashboard capabilities include:

- Live tracking displays showing current product locations and status across the supply chain.
- Graphical performance analytics for evaluating supply chain KPIs.
- Automated alerts for anomalous events or deviations from expected operational parameters.
- Historical trend analysis and customizable reporting tools.

This layer enhances decision-making by providing actionable insights to stakeholders.

I. System Workflow and Integration

All architectural layers are tightly integrated to form a seamless, end-to-end operational pipeline. The system workflow originates with multi-source data ingestion, proceeds through validation and preprocessing, and culminates in verified data being committed to the blockchain. Smart contracts then autonomously execute predefined business processes, while the tracking layer provides continuous real-time monitoring of product movement. The visualization layer aggregates operational metrics and presents them in a coherent dashboard format. This integrated, multi-layer design ensures continuous, low-friction data flow, promotes operational transparency, and drives measurable improvements in supply chain efficiency and coordination.

J. Performance Evaluation Metrics

The operational effectiveness of the proposed system will be assessed using the following performance dimensions:

- Latency: Time required to process and retrieve transac- tions
- Scalability: Ability to handle increasing data volume
- Throughput: Number of transactions processed per unit time
- Security: Resistance to unauthorized access and data tampering
- Reliability: Consistent performance under varying condi- tions

These metrics help assess the system's capability to operate efficiently in real-world environments.

K. Expected Outcomes

Upon full implementation, the proposed system is anticipated to produce the following measurable improvements:

- Substantially enhanced transparency and traceability across the entire supply chain.
- Strengthened data security mechanisms and improved overall data integrity.
- Reduction in operational delays through end-to-end pro- cess automation.
- More informed and timely decision-making enabled by real-time data visibility.
- Greater confidence and trust among all supply chain participants.

In aggregate, the proposed methodology establishes a resilient and scalable management framework that equips modern supply chains with the capabilities needed to operate efficiently, securely, and transparently.

V. CONCLUSION

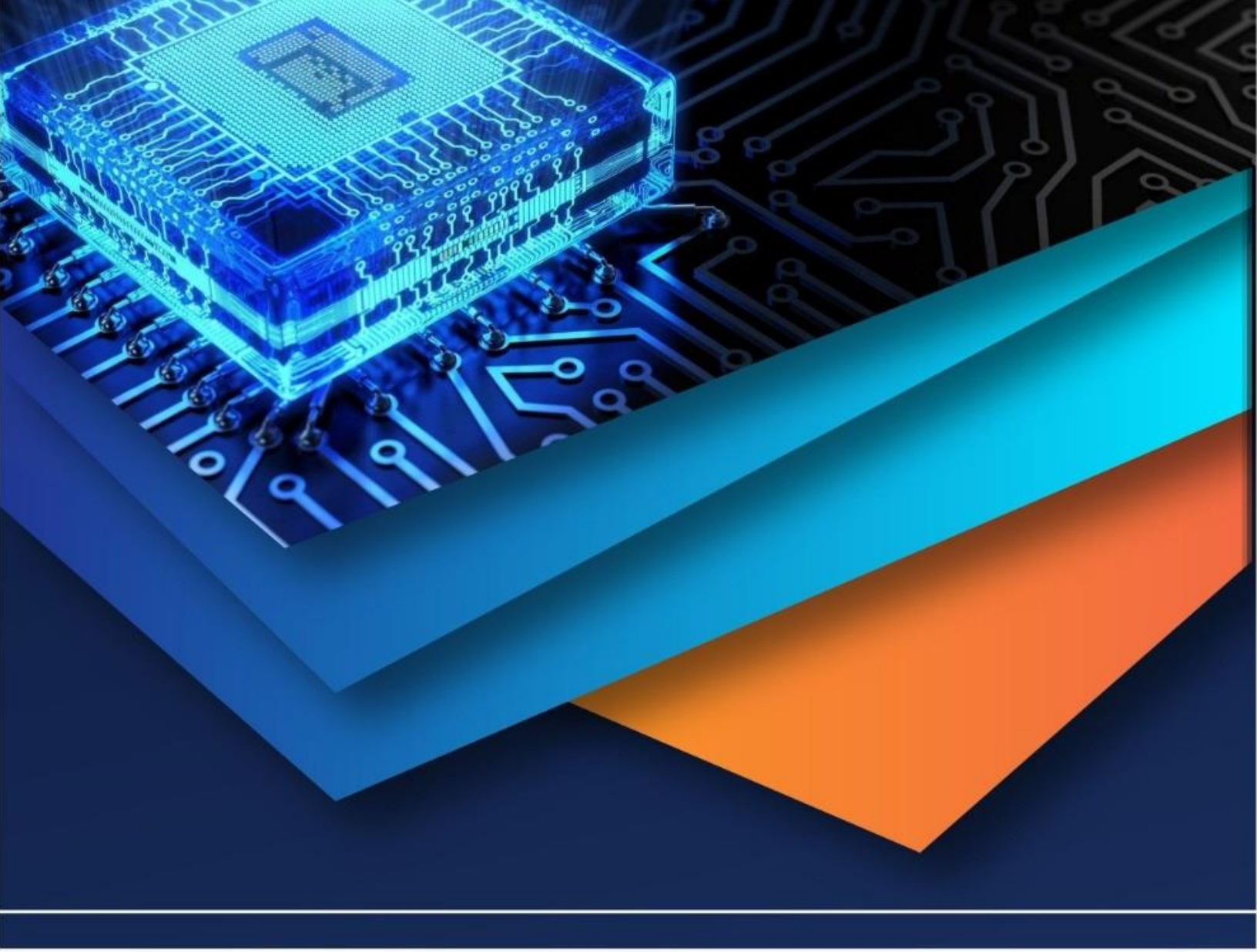
This paper identifies a viable and technically grounded approach to improving supply chain transparency and oper- ational efficiency through the deployment of a blockchain- based management platform. By harnessing blockchain's core properties — cryptographic security, immutable record-keeping, and real-time data visibility — the proposed system offers a compelling alternative to traditional centralized supply chain models, enabling lowfriction, cost-effective product tracking with markedly enhanced auditability. The multi-tier architec- tural design facilitates smooth data exchange among diverse supply chain actors, supports the automated enforcement of business agreements through smart contracts, and enables continuous monitoring of product status — reducing manual workloads, accelerating operational cycles, and fortifying data integrity throughout the chain. Interactive dashboards and visualization tools further extend the system's value by enabling proactive supply chain monitoring and evidence-based inventory management, ultimately supporting more agile and responsive decision-making at all organizational levels. While the proposed blockchain-based system offers substantial improvements over conventional supply chain management approaches, two prin- cipal challenges — scalability under high transaction volumes and seamless integration with incumbent enterprise systems will require dedicated attention in subsequent development phases. Future research efforts are expected to concentrate on optimizing system throughput and exploring the incorporation of emerging technologies such as AI-driven analytics to further enhance the platform's capabilities. In conclusion, the proposed decentralized framework constitutes a feasible and forward- looking solution for managing the complexities inherent in today's global supply chains.

REFERENCES

[1] Babaei, E. B. Tirkolaee, V. Simic, H. Golpˆıra, and F. Anka, "Assessing the Impacts of Blockchain Technology on Supply Chain Efficiency: A Data-Driven Integrated Decision-Making Framework," *Group Decision and Negotiation*, vol. 34, pp. 871–902, 2025.
[2] S. C¸ odur and B. Erkayman, "Blockchain Technology from the Supply Chain Perspective: A Systematic Literature Review," Spectrum of Decision Making and Applications, vol. 2, no. 1, pp. 268–285, 2025.
[3] S. Sahoo et al., "Blockchain for Sustainable Supply Chain Management: Trends and Ways Forward," Electronic Commerce Research, vol. 24, pp. 1563–1618, 2022.
[4] Yakubu et al., "HalalChain: A Blockchain Model for Halal Food Supply Chain," 2025.

[5] A. Swierczek, ”Establishing Buyer-Supplier Self-Organization through LSP Brokered Learning,” Journal of Purchasing and Supply Management, 2025.
[6] P. Chinnasamy et al., ”Decentralized Identity Management Using Blockchain Technology,” 2025.
[7] N. Kumar et al., ”Blockchain Technology in Supply Chain Management: Innovations, Applications, and Challenges,” 2025.
[8] J. Chang et al., ”Blockchain Technology for Supply Chain Management: A Comprehensive Review,” 2022.
[9] X. Guo, G. Zhang, and Y. Zhang, ”Blockchain-Based Information Sharing Mechanism for Complex Product Supply Chain,” Electronics, vol. 14, 2025.
[10] Dudczyk et al., ”Blockchain Technology for Global Supply Chain Management,” 2024.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)