Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 16, Issue. 1: 2025
ISSN : **1906-9685**

The Role of Blockchain in Electronics Supply Chain Management: A Systematic Survey

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In this paper author is giving huge survey on utilizing Blockchain technology in supply chain management as all existing supply chain systems are dependent on Centralized servers where all orders, manufacturing and supply details will be recorded. Different manufacturers or retailers may use different servers and may not have transparency of all orders coming and going which will lead to inaccurate order supply and inventory management. In centralized servers there is no direct or possible way to trace about product supply chain as malicious admin or employee can easily alter centralized server data with fake products supply. 1)disputes.In propose paper to manage supply chain author describing different users such as Supplier, Producer, Distributor, Retailer and consumer. Extension 1: in above para we can see author describe about different users exists in Supply Chain but who will manage all those different users that information is not provided by author. So as exetnsion1 we are suggesting to define extra module as SUPER ADMIN who will login to system and then manage details of all different users and those different users are called as Stakeholders of the supply chain system. Extension 2: in propose paper author has not suggested any information about locating the product location which is traversing through various steps like Raw material to manufacturing, supplying, selling and retailer. So as extension 2 we are providing another option to add location while updating product tracing details at different steps so consumer can see what all locations product has traverse to reach to him.

INTRODUCTION

Supply chain management plays a crucial role in the global electronics industry by ensuring that raw materials, components, and finished products move smoothly from suppliers to manufacturers and ultimately to consumers. Over the past century, the supply chain has evolved significantly from a simple transactional system (Supply Chain 1.0) to the highly connected and digitized system we see today as Supply Chain 4.0. This version features global integration, real-time tracking, and digitized records. However, despite these advancements, the supply chain still faces

several challenges, such as lack of transparency, poor traceability, and vulnerability to fraud and cyber-attacks due to the reliance on centralized systems. The electronics industry, in particular, involves complex supply networks, where products often pass through multiple stages and locations before reaching end users. In such a dynamic environment, centralized data storage models lead to fragmented communication, data tampering risks, and limited visibility across the supply chain. These shortcomings emphasize the need for a secure, transparent, and efficient alternative to traditional systems. Blockchain technology has emerged as a promising solution to address these issues. By creating a decentralized, tamper-proof, and transparent ledger, blockchain enables better tracking, verification, and coordination among all stakeholders involved in the supply chain. This paper presents a comprehensive survey of how blockchain is being applied in the electronics industry's supply chain management. It analyzes various blockchain implementations based on network types, platforms, security models, authentication techniques, and cost-effectiveness. Moreover, the paper explores privacy concerns, current limitations, and future research directions in blockchain-powered supply chain systems. By focusing on the integration of blockchain in electronics supply chains, this survey aims to highlight the benefits of decentralization, improve product traceability, and offer insights into how future supply chain systems can be made more secure, efficient, and resilient. The proposed system uses Blockchain to create a decentralized ledger for supply chain management. Transactions are securely recorded in immutable, cryptographically linked blocks. This replaces centralized servers, allowing stakeholders to access a shared ledger. Smart Contracts and encrypted data storage enhance collaboration, accountability, and efficiency.

1. Giannakis et al. (2019) Title: A cloud-based supply chain management system: effects on supply chain responsiveness Abstract: The supply chain is the flow of both information and material through a manufacturing company, from the supplier to the customer. Traditionally the flow of material has been considered only at an operational level, but this approach is no longer adequate. It is now essential for businesses to manage the supply chain in order to improve customer service, achieve a balance between costs and services, and thereby give a company a competitive advantage. Managers must work to integrate the supply chain – i.e. to ensure that all the functions and activities involved in the chain are working harmoniously together. To develop an integrated supply chain means managing material flow from three perspectives: strategic, tactical and operational. At each of these levels, the use of facilities, people, finance and systems must be co-ordinated and harmonised as a whole. The article describes how this can be achieved in practice by working through three phases: (1) evaluation of the competitive environment; (2) diagnostic review of the supply chain; (3) development of the supply chain, which involves

functional integration, internal integration and finally external integration. Companies which develop an integrated supply chain, with all that this involves, will benefit hugely in the marketplace. Those that do not will get left behind in the struggle for survival. Advantages: • Emphasizes real-time data access and improved responsiveness using cloud technology. • Enhances collaboration between different supply chain entities.

• Scalable and flexible infrastructure for dynamic supply chain needs. Disadvantages: • Still relies on centralized systems—vulnerable to single point of failure. • Limited data immutability and transparency compared to blockchain.May involve third-party cloud providers, raising concerns over data security and ownership.

2. V. Fore et al. (2016) Title: Intelligent supply chain management system Abstract: Internet of Things aims at integrating networked information systems to real world entities. It connects objects such as smart phones, sensors, Light Emitting Diodes (LED) displays, vehicles through the internet allowing them to interact and exchange information among themselves. In today's times IoT has found its application in practically every walk of life and supply chain management is no exception. At present, supply chains are becoming increasingly complex, where suppliers and customers stretch between various countries and continents. The biggest problem faced by manufacturers is to optimize supply chain performance and reduce operational costs over such large geographical stretches. IoT acts as a solution to this problem as it facilitates the use of Wireless Sensor Networks (WSN) in order to interconnect all the various actors in a supply chain. This humongous network of interconnected devices generate massive amounts of data which is difficult to store and process. Cloud computing here plays a role of a facilitator and provides great help in addressing challenges related to storage and processing capabilities. In this paper, we present an Intelligent Supply Chain Management System (ISCMS) that benefits from the amalgamation of IoT and Cloud and provides real time monitoring, tracking and managing of goods from the perspective of a supplier, customer and shipper. We also propose an algorithm that depicts the working of our system. The proposed Intelligent Supply Chain Management System along with the algorithm are simulated using the iFogSim simulator. To this end, we illustrate the working of our proposed system along with the simulated results. Advantages: • Integrates AI and automation for intelligent decision-making. • Improves operational efficiency by reducing manual intervention. Enhances forecasting and planning abilities. Disadvantages: • Focus is more on AI; lacks discussion on decentralized data integrity. • Data can still be altered or manipulated in traditional systems. • Limited traceability if not combined with blockchain or immutable storage.

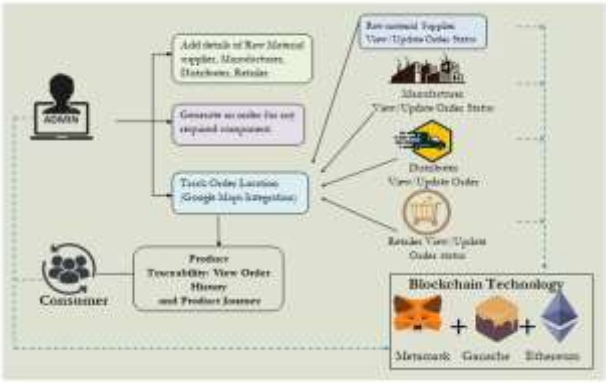
3. Khan et al. (2023) Title: Application of Internet of Things (IoT) in Sustainable Supply Chain Management Abstract: The traditional supply chain system included smart objects to enhance intelligence,

automation capabilities, and intelligent decision-making. Internet of Things (IoT) technologies are providing unprecedented opportunities to enhance efficiency and reduce the cost of the existing system of the supply chain. This article aims to study the prevailing supply chain system and explore the benefits obtained after smart objects and embedded networks of IoT are implanted. Short-range communication technologies, radio frequency identification (RFID), middleware, and cloud computing are extensively comprehended to conceptualize the smart supply chain management system. Moreover, manufacturers are achieving maximum benefits in terms of safety, cost, intelligent management of inventory, and decision-making. This study also offers concepts of smart carriage, loading/unloading, transportation, warehousing, and packaging for the secure distribution of products. Furthermore, the tracking of customers to convince them to make more purchases and the modification of shops with the assistance of the Internet of Things are thoroughly idealized. Advantages: • IoT enables real-time monitoring of goods and assets. • Improves sustainability through better resource tracking. Enhances data collection at every supply chain touchpoint. Disadvantages: • Without blockchain, collected data is still prone to tampering. • High cost of IoT device deployment and maintenance. • Vulnerable to data breaches if security layers aren't robust.

4. Hwang & Seruga (2011) Title: An intelligent supply chain management system to enhance collaboration in textile industry Abstract: The recent challenge in textile supply chain management is the development of collaboration network which accommodates diverse concerns of various participants while explicitly recognizing interdependencies and promoting effective relationship management. This study is designed to suggest a collaboration network model for textile industry and apply it to establish a desirable framework for the textile supply chain management. The collaboration network model, proposed in this study, is designed to facilitate positive collaboration from the supply chain of the textile industry. Utilizing the collaboration model, an intelligent textile supply chain management system is designed to improve customer services and delivery time, and to promote information sharing, and shorten product life cycle time. The primary goal of an intelligent textile supply chain management system is to promote corporate innovation and information sharing, and generate infrastructure which reduces the gap of the competitiveness across the textile supply chain and enhance the collaboration, which in turn improve the competitiveness of the textile industry as a whole. Advantages: • Highlights improved stakeholder collaboration using intelligent systems. • Focus on sector-specific challenges and practical solutions. • Introduces frameworks to manage supplier-retailer relationships better. Disadvantages: • Lacks a decentralized trust mechanism. • Collaboration can break down if centralized data is manipulated or lost. • Security and transparency limitations remain unaddressed.

5.Stevens (1990) Title: Successful supply-chain management Abstract: The supply chain is the flow of both information and material through a manufacturing company, from the supplier to the customer. Traditionally the flow of material has been considered only at an operational level, but this approach is no longer adequate. It is now essential for businesses to manage the supply chain in order to improve customer service, achieve a balance between costs and services, and thereby give a company a competitive advantage. Managers must work to integrate the supply chain – i.e. to ensure that all the functions and activities involved in the chain are working harmoniously together. To develop an integrated supply chain means managing material flow from three perspectives: strategic, tactical and operational. At each of these levels, the use of facilities, people, finance and systems must be co-ordinated and harmonised as a whole. The article describes how this can be achieved in practice by working through three phases: (1) evaluation of the competitive environment; (2) diagnostic review of the supply chain; (3) development of the supply chain, which involves functional integration, internal integration and finally external integration. Companies which develop an integrated supply chain, with all that this involves, will benefit hugely in the marketplace. Those that do not will get left behind in the struggle for survival. Advantages: • Foundational understanding of what constitutes a successful supply chain. • Emphasizes coordination, integration, and process alignment. • Useful baseline for evaluating new SCM technologies. Disadvantages: • Outdated in the context of digital and decentralized technologies. • Does not address modern challenges like cybersecurity, real-time visibility, or automation. • Assumes manual or semi-automated systems with centralized control.

System Architecture:



Execution Procedure: To run project double click on ‘run.bat’ file to start python and get below page

In above screen python server started and now open browser and enter URL as http://127.0.0.1:8000/index.html and press enter key to get below page

In above screen click on 'Admin Login' link to get below page

In above screen admin is login and after login will get below page

In above screen admin can click on 'Add New Stakeholder' link to add stake holders and get below page

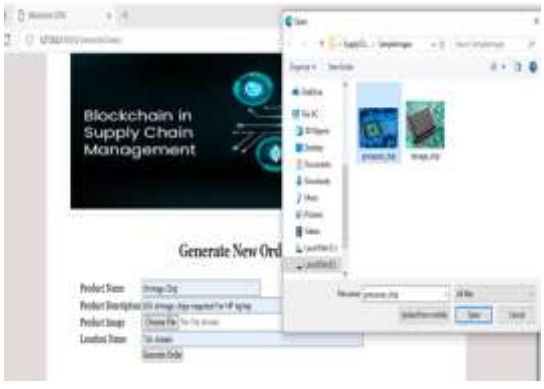
In above screen adding stake holder as 'raw material supplier' and then press button to get below page

In above screen raw material supplier details added and for your understanding purpose I am printing all log output received from Blockchain as Block No, Transaction address etc. Similarly add all stake holders like distributor, retailers etc.

In above screen adding manufacturer details and similarly add all stakeholders

In above screen manufacturer details added and now click on 'View Stakeholders' link to view all stake holders like below page

In above screen can view details of all available stake holders and with login details and now click on 'Generate Orders' link to generate new order by admin and this order will receive and process by supplier by sending raw material to manufacturer



In above screen admin generating new product order and uploading related image and then enter its order location name so user can view on map while tracing for order generation and then press button to get below page

In above screen order generated in Blockchain and now admin can click on 'View Tracing' link to get below tracing details

In above screen admin will select desired product id to view tracing like below screen

In above screen admin can view order details and can see tracing status as order received by 'Raw Material supplier' and once raw material supplier complete this

order then he will update tracing to manufacturer and admin can click on 'View On Map' link to view current location of order

In above screen admin can view order generated from 'Toli chowki' Area and similarly he can view all tracing and location from raw material till sold to customers and now logout and login as Raw Material supplier to complete order

In above screen raw material supplier is login and after login will get below page

CONCLUSION AND FUTURE SCOPE:

The project effectively integrates Blockchain technology into supply chain management, transitioning from a centralized to a decentralized, immutable ledger.The system enables tamper proof recording of every step, enhancing traceability and accountability from origin to consumer.Encrypted, immutable data storage protects sensitive information and reduces risks of unauthorized access and data manipulation.The "SUPER ADMIN" module and location tracking features enhance user management and real-time product monitoring, improving decision-making and operational efficiency.

FUTURE SCOPE: Integration of Artificial Intelligence for Predictive Analytics • AI algorithms can be integrated to forecast demand, detect supply chain anomalies, and automate inventor management. • Machine learning models can also enhance decision-making by analyzing historical supply data and identifying patterns.

Global Interoperability with Multi-Blockchain Networks • Future systems can support collaboration between different Blockchain platforms for global supply chain interoperability. • This will allow seamless product tracking and verification across international suppliers and stakeholders.

Enhanced Scalability with Layer 2 and Sharding Techniques • Scalability can be improved using Layer 2 solutions and sharding to process more transactions in parallel. • These techniques reduce latency and cost, making Blockchain more practical for large-scale supply chains.

Smart Contracts for Automated Supply Chain Operations • Smart contracts can automate purchase orders, payments, and product quality checks without manual intervention. • This ensures real-time execution of operations based on predefined conditions, reducing delays and fraud.

Decentralized Identity Management for Stakeholders • Blockchain-based identity systems can offer secure and self-sovereign digital identities to manufacturers, suppliers, and retailers. • This enhances authentication, reduces dependency on central authorities, and ensures data privacy.

Real-Time Tracking with IoT and Blockchain Integration • IoT sensors can be used to collect real-time data on product movement, temperature, and condition. • This data can be stored on Blockchain, enabling end-to-end visibility and quick response to disruptions.

Support for Eco-Friendly and Sustainable Supply Chains • Blockchain can be leveraged to verify sustainable sourcing and ethical practices in the supply chain. • Stakeholders can trace the environmental impact of products, helping build consumer trust and regulatory compliance.

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