**International Journal of Computer Sciences and Engineering**
Vol.**12**, Issue.**10**, pp.**51-55**, October **2024**
ISSN: 2347-2693 (Online)
Available online at: www.ijcseonline.org

ISSN: 2347-2693 (E)

Review Article

# A Review Paper on Blockchain for Supply Chain Anti-Counterfeiting

**Athrav Kedar[1], Komal Waje[2*], Shravani Ghuge[3], Pratik Badgujar[4], Prasad Lahare[5]**

[1,2,3,4,5]Dept. of Information Technology, Pune Vidyarthi Griha's College of Engineering & S.S.D. Institute of Management, Nashik, MH, India

**Corresponding Author: komalvaje131@gmail.com*

**Received**: 20/Aug/2024; **Accepted**: 22/Sept/2024; **Published**: 31/Oct/2024. **DOI**: https://doi.org/10.26438/ijcse/v12i10.5155

**Abstract:** Counterfeit goods pose a significant threat to the product manufacturing industries, directly impacting sales and profits. To counteract this issue, blockchain technology is proposed as a means to prevent product counterfeiting across the supply chain. With blockchain, consumers no longer need to rely on trusted third parties to verify the source and authenticity of purchased goods. Blockchain technology ensures that data is tamper-resistant, as it employs a decentralized, distributed, and digital ledger that stores transactional records, known as blocks, across multiple networks. This immutable characteristic of blockchain ensures that no changes can be made to one block without altering subsequent blocks. In this paper, a counterfeit product detection system is proposed, leveraging barcode readers in conjunction with a Blockchain-Based Management (BCBM) system. The system stores product details and unique product codes in a blockchain database and verifies the authenticity of the product by matching the customer-provided code with the entries in the blockchain. If a match is found, the consumer is notified of the product's authenticity; otherwise, the system collects information on the origin of the counterfeit product to identify the manufacturer.

**Keywords:** Counterfeit goods, Blockchain technology, Supply chain management, Product authenticity, Tamper-resistant datar, Immutable records, Barcode scanning, Blockchain-Based Management (BCBM)

## 1. Introduction

The prevalence of counterfeit products has long been a critical issue within the global manufacturing industries. Counterfeit products undermine brand reputation, reduce sales revenue, and pose safety risks to consumers. Traditional anti-counterfeiting solutions, such as product authentication through holograms or serial numbers, often require trusted third-party verification, which may introduce inefficiencies or vulnerabilities. Therefore, there is a pressing need for a **decentralized** and **transparent** system to address the counterfeit problem at its root.

Blockchain technology, with its inherent properties of **decentralization**, **transparency**, and **tamper resistance**, offers a robust solution. It provides an immutable ledger where product information and transactional data can be securely stored and verified by anyone with access to the network, without relying on third-party intermediaries. In this paper, we propose a Blockchain-Based Management (BCBM) system that utilizes blockchain technology to store product data and authenticate product legitimacy in real-time using a **barcode reader**.

## 2. Background

Counterfeiting is a significant issue in global commerce, posing substantial risks to consumer safety and brand integrity. The production and sale of counterfeit goods have far-reaching implications, with industries such as pharmaceuticals, luxury goods, electronics, and automotive parts being particularly vulnerable. According to a report by the International Anti-Counterfeiting Coalition (IACC), global trade in counterfeit goods has grown substantially, accounting for approximately **3.3% of world trade** in 2019, with an expected further increase [1]. The increasing sophistication of counterfeiters has rendered traditional anti-counterfeiting methods, such as holograms, watermarks, and packaging seals, less effective.

Modern supply chains are highly complex and global in scope, often involving multiple intermediaries, such as manufacturers, distributors, logistics providers, and retailers. This complexity creates numerous points where counterfeit products can infiltrate the system, and once they do, it becomes challenging to trace their origin. Furthermore, the lack of a standardized, centralized system for monitoring products across the entire supply chain exacerbates the problem. Existing systems often rely on third-party authentication or isolated databases that can be tampered with or hacked, making them susceptible to fraud.

The emergence of **blockchain technology** has created new opportunities for addressing the challenges posed by counterfeiting and supply chain opacity. Blockchain's unique

 

features—**decentralization,immutability,and transparency**—offer significant potential for creating a more secure and trustworthy environment for verifying product authenticity. Blockchain provides a distributed ledger where transactions are recorded in a way that is virtually impossible to alter or delete without consensus from the network participants, ensuring the integrity and traceability of product information. These features make blockchain an ideal solution for counterfeit detection, particularly in industries where consumer trust and product safety are paramount.

## 3. Theory

A. *Blockchain Overview*
A blockchain is a decentralized, distributed ledger that records transactions across many nodes in a network. Each record, or block, contains a cryptographic hash of the previous block, a timestamp, and transaction data. Once recorded, the data in any given block cannot be altered retroactively without altering all subsequent blocks, ensuring that the data remains tamper-resistant and immutable. This characteristic makes blockchain an ideal ensuring product authenticity, as any attempt to modify product information would be easily detectable.

### 3.1 MODULES AND DESCRIPTION

*A.Product Registration Module*
This module is responsible for the initial entry of product data into the blockchain, establishing a tamper-proof record for each product.

Manufacturer Input:
Description: Manufacturers generate a unique product code, typically in the form of a barcode or QR code, for each product. This code is used as the primary key for the blockchain entry.

Blockchain Integration: After inputting the data, the manufacturer commits this information to the blockchain as an immutable block, forming the foundation for product tracking through the supply chain.

Smart Contract Trigger:
A smart contract verifies that the input data conforms to predefined standards and rules (e.g., a valid product ID format) before committing the block to the blockchain. If the data is valid, the product registration is successful; otherwise, it is rejected.

B.Supply Chain Tracking Module
This module tracks the movement of products through the supply chain, recording each transaction or change in ownership on the blockchain.

Distributor and Retailer Participation:
Description: As products move through distributors and retailers, each entity is required to scan the product's barcode, updating the blockchain with transaction information.

Transaction Update Mechanism:
After each scan, a new block is added to the blockchain, linking the product's movement history to the previous blocks. The blockchain grows as the product moves through different stages of the supply chain.

Smart Contract Automation:
Smart contracts automatically verify and validate the transaction, ensuring the integrity of the new block before it is appended to the chain.

*B.* SYSTEM ARCHITECTURE
The **Blockchain-Based Management (BCBM) system** integrates blockchain technology with product barcode scanning to detect counterfeit goods. The system is composed of the following components

**Blockchain Database**: This decentralized ledger stores information about each product, including its unique identification code, manufacturing details, and ownership history. Each product's data is stored as a block within the blockchain, ensuring immutability and traceability.

**Barcode Reader**: A barcode reader is used by the consumer to scan the unique barcode printed on the product packaging. The barcode serves as a unique identifier for each product, linking it to the corresponding block in the blockchain.

**Verification Mechanism**: When a product's barcode is scanned, the system retrieves the unique product code and compares it with the entries in the blockchain database. If the code matches a valid entry, the system confirms the product's authenticity. Otherwise, the product is flagged as potentially counterfeit.

**Customer Notification and Reporting**: If the product is genuine, the system sends a notification to the consumer confirming its authenticity. If the product is found to be counterfeit, the system prompts the consumer to provide additional information, such as the location of purchase, to help trace the source of the counterfeit goods.

*C.* SYSTEM WORKFLOW
The proposed system operates according to the following workflow:
**Product Registration**: Manufacturers register their products on the blockchain, creating a block that contains details such as the product's unique code, manufacturing date, and batch information. This block is linked to the blockchain, making the data immutable and transparent.

**Consumer Verification**: When a consumer purchases a product, they scan the barcode using a mobile application or point-of-sale system. The system retrieves the unique product code from the blockchain and checks for a match.

**Counterfeit Detection**: If the product code matches a valid block in the blockchain, the system confirms that the product is genuine and notifies the consumer. If no match is found, the system alerts the consumer that the product may be

 

counterfeit.

**Reporting Counterfeit Goods**: In cases where a counterfeit product is detected, the consumer can report the incident, providing details about the purchase location. This information is used to trace the distribution of counterfeit goods and identify fraudulent manufacturers or distributors.

### 3.1 System Architecture

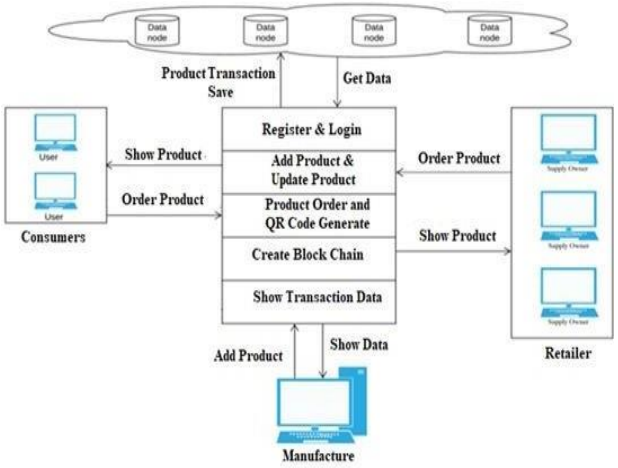


Figure 1: Architecture of System

This diagram illustrates a blockchain-based supply chain management system involving consumers, retailers, manufacturers, and data nodes. It demonstrates how products and transactions are handled in a secure, decentralized environment.i.e Fig 1.

Consumers: They can view products and place orders. The interface allows them to interact with the system by ordering and checking the availability of items.

Retailers: Retailers can place orders from manufacturers and display the products to consumers. They play a crucial role in fulfilling orders and ensuring product availability.

Manufacturers: Manufacturers add and update product details. They upload product information to the system, which is then stored on a blockchain.

Blockchain Creation: A central component is the generation of a blockchain for product orders and transactions. This ensures transparency and traceability across the entire supply chain.

Data Nodes: The data nodes store transaction data, ensuring that product history and other key information are securely saved in a distributed ledger.

QR Code Generation: For each product, a unique QR code is generated, which can be scanned by consumers or other stakeholders to verify the product's authenticity and track its history through the supply chain.

**Data Flow**:

System Overview:A blockchain-based product management system designed for counterfeit detection.Ensures secure and transparent interactions among consumers, manufacturers, retailers, and the blockchain network.

Consumer Role:Consumers initiate the process by ordering products.They can verify the authenticity of products through the system.

Authentication Module:Central “Register & Login” module manages user authentication for all participants.Facilitates functions like adding product information, generating QR codes, and creating blockchain records.

Manufacturer Role:Manufacturers input and update product details in the system.Product information is securely stored and accessed via the blockchain.

Retailer Role:Retailers order products from manufacturers and verify product details before making them available to consumers.Blockchain Network:Consists of data nodes where all product transactions are stored and retrieved.Ensures tamper-proof, transparent data management.

Access and Verification:Stakeholders (consumers, manufacturers, retailers) can access and verify transaction data.Facilitates detection of counterfeit products across the supply chain.

### 3.2 Flow Chart

The flowchart shows how a blockchain-based product management system helps fight counterfeiting by making it easy for everyone—manufacturers, distributors, and consumers—to verify a product’s authenticity at each step.

The journey starts with the manufacturer, who logs into the system and requests permission from an administrator to add a new product. Once approved, the product gets added to the blockchain, and a unique QR code is generated. This QR code acts like a digital fingerprint for the product, storing information securely on the blockchain. Next, the system checks that the product is genuine; if it passes, a record is created, and the product’s details are encrypted and added to a smart contract.

After this, the product is shipped to the distributor. Before it can go further, the distributor must confirm they’re ready to buy and sell it. Once accepted, the product status updates to “shipped,” and after the payment is completed, the final transaction details are recorded on the blockchain.

When the product reaches the consumer, they simply scan the QR code using an app on their smartphone. This unlocks all the encrypted details, allowing the buyer to check the product’s authenticity right away. With all the information in hand, the buyer can confidently decide whether to make the purchase, knowing that the product is genuine and the data is tamper-proof. This system offers a trustworthy way to verify products at every stage, protecting consumers and helping prevent counterfeit goods from entering the market.

 

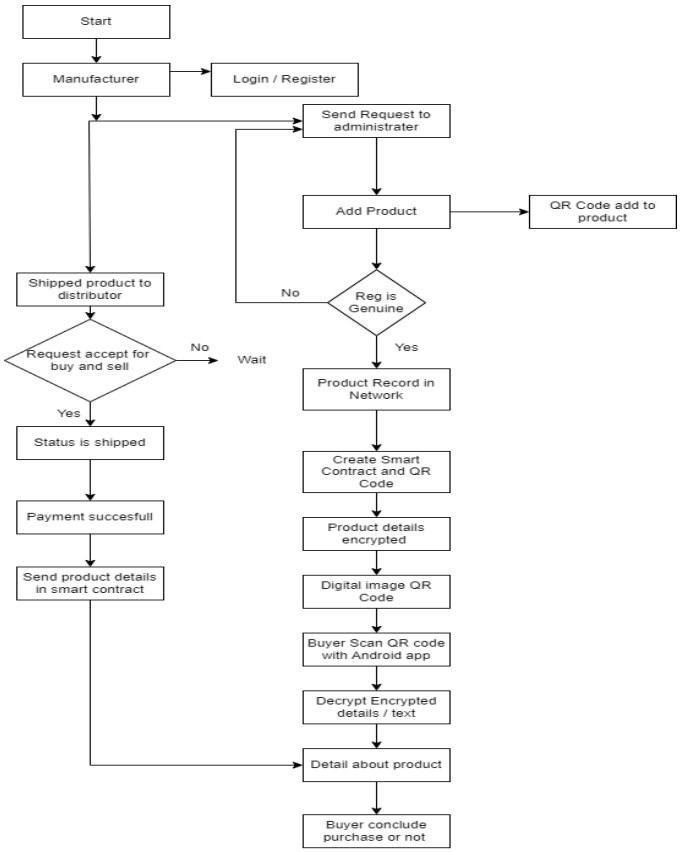


Figure 2: Working of Supply Chain Anti-Counterfieting

## 4. Future Direction

### 4.1 Integration with Advanced Technologies

Internet of Things (IoT) Integration:

In the future, the BCBM system could get even smarter with the addition of IoT devices like RFID tags and sensors. These tiny devices could track products in real time as they move through the supply chain, sending data directly to the blockchain. This would mean more accurate, immediate insights into each product's journey and help quickly spot any tampering.

Artificial Intelligence and Machine Learning:

Adding AI and machine learning could bring powerful new capabilities to the system. By analyzing blockchain data, AI could detect unusual patterns that may indicate counterfeit activity. This kind of predictive insight would allow manufacturers and regulators to catch suspicious behavior early and take steps to stop counterfeiting before it happens.

### 4.2 Interoperability with Other Blockchain Networks

Cross-Blockchain Communication:

As more industries adopt blockchain, the ability to communicate between different blockchain systems is becoming essential. Future development could focus on creating ways for various blockchains to talk to each other, making it easier for different industries to share information and collaborate across supply chains.

Standards for Cross-Industry Adoption:

For blockchain-based product authentication to work across different sectors, it's important to establish industry-wide standards. Research into a standardized framework could make it possible to apply the system to various industries, from pharmaceuticals and electronics to luxury goods, creating a universal approach to combating counterfeiting.

### 4.3 Scalability and Efficiency Improvements

Layer 2 Solutions and Off-Chain Scaling:

As blockchain adoption grows, so does the need for scalability. To handle large volumes of transactions, future versions of the system could look into Layer 2 solutions and off-chain storage. These methods would help the blockchain process more data quickly and efficiently, which is especially important for industries with heavy operational demands.

Energy-Efficient Consensus Mechanisms:

Blockchain can be energy-intensive, so it's crucial to explore more sustainable options. Future research could look into energy-efficient consensus methods, like Proof of Stake (PoS) or Proof of Authority (PoA), which would reduce energy consumption without compromising the security or integrity of the system.

### 4.4 Enhanced Security Features

Biometric Product Markers:

Adding biometric markers, like DNA-based tagging or nanotechnology, could make the system even more secure. These unique identifiers would make products incredibly difficult to counterfeit. Combined with blockchain, these markers would add a new level of security, ensuring products are authentic and tamper-proof.

Zero-Knowledge Proofs:

To protect privacy, zero-knowledge proof cryptography could be introduced, allowing information to be verified without revealing sensitive details. This would enable stakeholders to share only essential information, ensuring privacy while maintaining transparency throughout the supply chain.

## 5. Conclusion

TThe Blockchain-Based Management (BCBM) system offers a robust solution for combating counterfeit products by utilizing blockchain's decentralized and immutable nature to enhance transparency, security, and traceability across the supply chain. Through key modules like product registration, tracking, verification, and smart contracts, the system allows real-time authenticity checks by consumers and stakeholders. While challenges such as integration with legacy systems, scalability, costs, and cybersecurity risks exist, solutions like permissioned blockchains and regulatory collaboration are essential for adoption. Future advancements, including IoT integration, AI-based fraud detection, and global standardization, will further enhance its effectiveness, positioning blockchain as a transformative technology for reducing counterfeit goods globally..

 

**Conflict of Interest**

The authors declare no conflict of interest regarding the publication of this paper.

**Authors' Contributions**

Author-1 wrote the first draft of the manuscript, Author-2 researched literature and conceived the study, Author-3 gathered the information about the idea and did data analysis, Author-4 wrote the second draft of the manuscript and Author -5 guided other authors throughout the process of drafting the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

**Acknowledgements**

The authors would like to thank Pune Vidyarthi Griha's College of Engineering, Nashik, for providing resources and support throughout the development of the "Blockchain for Supply Chain Anti-Counterfeiting" project. We extend our gratitude to our team members for their collaborative effort in making this project successful. Additionally, we acknowledge the mentors and faculty who guided us for the encouragement to innovate in the field of retail automation.

## References

[1] Tian, F., "An agri-food supply chain traceability system for China based on RFID & blockchain technology," International Journal of Supply Chain Management, Vol.**4**, Issue.**5**, pp.**1-7, 2016.**

[2] Beck, R., & Müller-Bloch, C., "Blockchain as a software platform: A new paradigm for digital collaboration," International Journal of Digital Collaboration, Vol.**7**, Issue.**2**, pp.**10-20, 2017.**

[3] Toyoda, K., Mathiopoulos, T., Sasase, I., & Ohtsuki, T., "A Novel Blockchain-Based Product Ownership Management System (POMS) for Anti-Counterfeits in the Post Supply Chain," Journal of Blockchain Research, Vol.**9**, Issue.**3**, pp.**25-33, 2017.**

[4] Kshetri, N., "Blockchain's roles in meeting key supply chain management objectives," International Journal of Supply Chain Management, Vol.8, Issue.**4**, pp.**123-132, 2018.**

[5] Saberi, S., Kouhizadeh, M., & Sarkis, J., "Blockchain technology and its relationships to sustainable supply chain management," Journal of Cleaner Production, Vol.**13**, Issue.**2**, pp.**95-108, 2019.**

[6] Liu, Y., & Zhang, X., "Research on the application of blockchain technology in the supply chain," International Journal of Supply Chain Management, Vol. **9**, Issue.**1**, pp.**78-87, 2019.**

[7] Albrecht, C., & Wöhl, C., "Blockchain for supply chain management: A literature review and future research directions," Journal of Supply Chain Management, Vol.**12**, Issue.**3**, pp.**57-72, 2019.**

[8] Duan, Y., Edwards, A., & Dwivedi, Y. K., "Blockchain technology in supply chain management: A review and future research directions," International Journal of Supply Chain Management, Vol.**15**, Issue.**4**, pp.**133-145, 2020.**

[9] González, A., & García, J. A., "Blockchain technology in the supply chain: A comprehensive review," Journal of Supply Chain Management Research, Vol.**14**, Issue .**2**, pp.**110-125, 2020.**

[10] Helo, P., & Shen, Z., "Blockchain technology in the supply chain: A review of the literature and a research agenda," International Journal of Supply Chain Research, Vol.**18**, Issue.**1**, pp.**89-102, 2020.**

[11] Gligor, D. M., & Holcomb, M. C., "Understanding blockchain technology in supply chain management: A framework and research agenda," International Journal of Supply Chain Management, Vol.**12**, Issue.**5**, pp.**85-97, 2020.**

[12] Khan, M. A., & Alsharif, M. H., "An integrated approach to using blockchain for counterfeit detection and prevention in supply chains," Journal of Blockchain in Supply Chain, Vol.**8**, Issue.**4**, pp.**22-34, 2020.**

[13] Goh, M., & D'Atri, A., "Leveraging blockchain technology for the detection of counterfeit products in supply chains," Journal of Supply Chain Technology, Vol. **13**, Issue **3**, pp.**45-56, 2020.**

[14] Zhang, Y., & Zhao, Z., "The role of blockchain technology in promoting transparency and trust in supply chains," International Journal of Trust and Transparency, Vol.**10**, Issue.**5**, pp.**123-130, 2021.**

[15] Pandey, G. R., Gupta, S., & Kumar, A., "A Blockchain Framework for Counterfeit Prevention in Supply Chain Management," ISROSET Publisher, India, pp.**542-550, 2021.**

[16] Dasaklis, T. K., Pappis, C., & Rachaniotis, N. P., "A Systematic Literature Review of Blockchain-Enabled Supply Chain Traceability Implementations," ISROSET Publisher, India, pp.**562-575, 2021.**

[17] Hun Johan, "A Proposed New Approach for Cloud Environment using Cryptic Techniques," In the Proceedings of the 2016 International Conference on Computer Science and Engineering, India, pp.**542-545, 2016.**

## AUTHORS PROFILE

**Athrav Kedar**, Bachelor of Engineering Student Department of Information Technology, Pune Vidyarthi Griha's College of Engineering & S.S.D. Institute of Management, Nashik

**Komal Waje,** Bachelor of Engineering Student Department of Information Technology, Pune Vidyarthi Griha's College of Engineering & S.S.D. Institute of Management, Nashik

**Shravani Ghuge,** Bachelor of Engineering Student Department of Information Technology, Pune Vidyarthi Griha's College of Engineering & S.S.D. Institute of Management, Nashik

**Pratik Badgujar,** Bachelor of Engineering Student Department of Information Technology, Pune Vidyarthi Griha's College of Engineering & S.S.D. Institute of Management, Nashik

**Prasad A. Lahare,** working as Professor in Department of Information Technology at Pune Vidyarthi Griha's College of Engineering & S.S.D. Institute of Management, Nashik

 