

Hyperledger Fabric Blockchain Approach for Enhancing Manufacturing Supply Chain Transparency and Sustainability

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Abstract—Enhancing supply chain transparency and sustainability is crucial for corporate social responsibility and operational sustainability. However, traditional tracing systems face challenges like data opacity and tampering vulnerabilities, risking profits, reputation, and consumer trust. This study investigates a Hyperledger Fabric blockchain-based traceability platform. Results show that a consortium blockchain enhances traceability efficiency, ensures data authenticity, and improves information transparency, overcoming traditional system challenges. This approach also ensures compliance with environmental and social responsibilities, aiding in achieving ESG and SDGs objectives. Overall, this research provides insights into blockchain's role in enhancing supply chain transparency and sustainability.

Index Terms—Supply Chain traceability, Transparency, Hyperledger Fabric Blockchain, ESG (Environmental, Social, and Governance) SDGs (Sustainable Development Goals)

I. INTRODUCTION

In 2019, the United States passed the National Defense Authorization Act Section 889 (NDAA 889), with the legislative purpose aimed at safeguarding national security, preventing potential espionage activities, and cyberattacks. This legislation brought renewed attention to the issues of transparency and security in the supply chain, emphasizing the importance of supply chain security and imposing higher requirements on supply chain transparency. However, traditional tracing systems face many challenges, such as data opacity, susceptibility to tampering, and inefficiency. These issues not only hinder the efficiency and accuracy of product tracing but also pose threats to consumer trust and corporate reputation.

2. SOLUTIONS

The system architecture of this study employs the concept of a consortium blockchain, comprising multiple organizational nodes of suppliers. The brand owner functions as the primary node, responsible for roles such as Certificate Authority (CA) and Order, as well as for verifying new supplier identities and managing the addition or removal of suppliers from the consortium blockchain nodes. All nodes maintain a comprehensive blockchain ledger within the system, collaboratively ensuring the integrity and authenticity of ledger data. This traceability platform architecture is depicted in Fig. 1, and the steps and process are as depicted in Fig. 2.

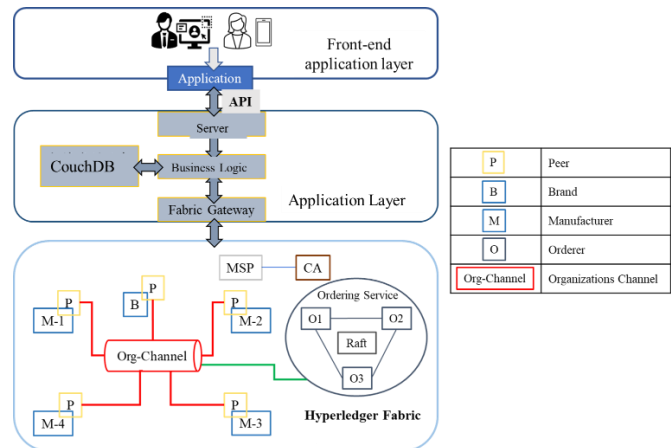


Fig. 1. Supply Chain Traceability Platform Architecture Diagram.

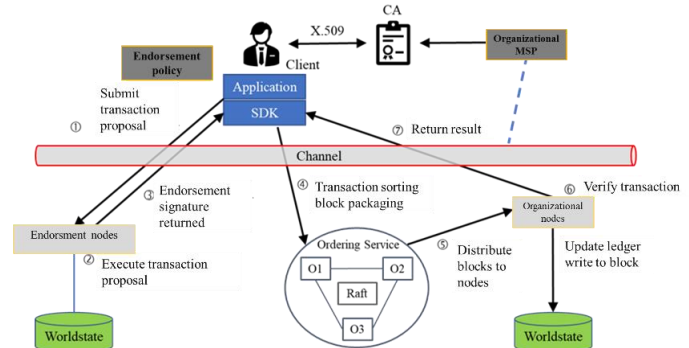


Fig. 2. Supply Chain Traceability Platform System Flowchart.

3. RESULTS

The supply chain traceability platform leverages the decentralized, tamper-proof, and transparent characteristics of blockchain to address issues encountered by traditional tracing systems, such as data opacity, susceptibility to tampering, and inefficiencies. This enhancement improves traceability efficiency, ensures data security, and enhances information transparency. Simultaneously, businesses can track products in real-time throughout the entire production process, from raw materials to final products, ensuring compliance with all environmental and social responsibility standards. This, in turn, assists companies in achieving ESG and SDGs, such as industrialization and innovation in governance, responsible consumption and production in environmental aspects, and health and well-being in social aspects.