

Chapter 9

Leveraging Blockchain Technology and Smart Contracts for Intelligent Supply Chain Management

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ABSTRACT

The current manual process of the traditional supply chain system, from raw material manufacturing to product delivery, lacks sufficient data and transaction security while being time-consuming. This outdated procedure is ineffective and unreliable for consumers. However, integrating blockchain and smart contract technologies into traditional supply chain management systems can significantly enhance data security, authenticity, time management, and transaction processes. By leveraging decentralized blockchain technology, the entire supply chain management (SCM) process becomes more trustworthy, ensuring consumer satisfaction. This study utilizes a peer-to-peer encrypted system in conjunction with smart contracts to ensure data immutability and prevent unauthorized access. Moreover, cryptographic methods are employed to enhance transaction security and address these issues. Ultimately, this chapter demonstrates how to maintain a highly secure, transparent, and efficient supply chain management process.

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INTRODUCTION

Supply chain management (SCM) holds immense importance in today's global market, significantly influencing the global economy. SCM involves the movement of goods from producers to consumers and encompasses various stages (Swan, 2017). However, traditional supply chain management has limitations, especially in terms of facilitating customer reversals and ensuring the quality of supplied items. It primarily focuses on forward flows, i.e., the movement of products from senders to recipients (Zheng et al., 2021). However, supporting reverse flows and transactions for every consumer is equally crucial.

The advent of blockchain and smart contracts has the potential to disrupt traditional supply chain management systems (Croman et al., 2016). Blockchain's transparency and immutability can bring substantial benefits to the supply chain. By providing a secure mechanism for data collection and enabling the development and execution of programmed scripts or applications known as smart contracts, blockchain technology aids in modernizing the supply chain. Smart contracts empower supply chain managers to effectively track the origin and security of their products (Swan, 2017). We have addressed these issues and proposed a solution in our discussion.

The aim of this research is to create a conceptual framework for a supply chain management system that capitalizes on blockchain and smart contracts to facilitate safe transactions and ensure the delivery of high-quality products (Zyskind et al., 2015). By adopting this framework, customers will have the confidence to return products and receive refunds, leading to a trustworthy global market. Notably, our proposed paradigm will bring about a significant transformation in the entire supply chain management system (Panarello et al., 2018).

A blockchain is a dynamic collection of blocks that are cryptographically connected and secured, forming an unbroken chain of records. These blocks are cryptographically linked together, and they undergo validation by a majority of network nodes in the blockchain network. Once a block is verified, it becomes part of the shared chain that is accessible to all network nodes (Heilman et al., 2015). The processing of each piece of data on the blockchain involves significant computational effort and time to ensure its integrity. Blockchain systems offer distinct qualities that set them apart from other technologies. For example, data stored on the blockchain is immutable, resistant to tampering, and relies on a decentralized network. It is also safeguarded through encryption, making it challenging to compromise. In general, there are three main types of blockchains: public or permissionless, private or permissioned, and consortium blockchains. Each type has its own specific characteristics determined by the nature of the network participants and the geographical context in which it operates.

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