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Smart Contracts in Supply Chain Management

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Contents

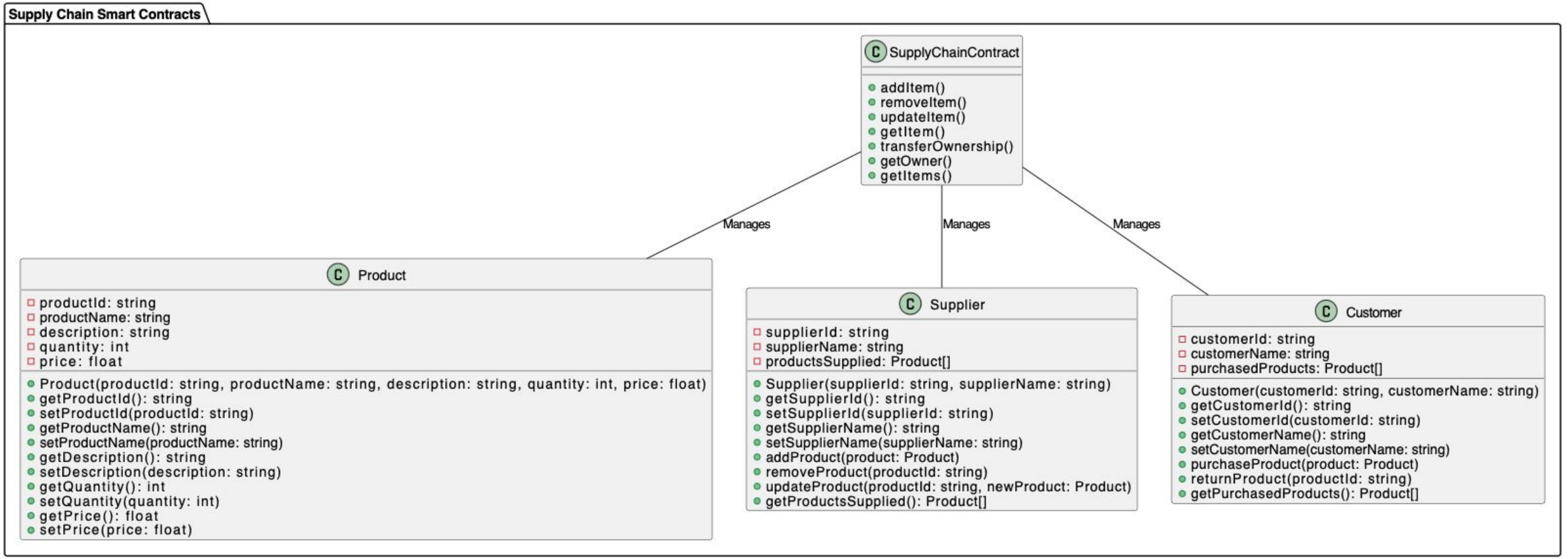
Introduction

- **Definition of Smart Contracts**: Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. They automatically execute and enforce the terms of the contract once predefined conditions are met.
- **Importance of Smart Contracts in Supply Chain Management**: Smart contracts have the potential to revolutionize supply chain management by automating processes, reducing costs, enhancing transparency, and improving trust among stakeholders.
- **Brief Overview of the Presentation Structure**: This presentation will explore the background and motivation behind the use of smart contracts in supply chain management, review relevant literature, identify research gaps, discuss pros and cons, highlight applications, and conclude with future directions.

Background / Motivation

- **Challenges in Traditional Supply Chain Management**: Traditional supply chain management faces challenges such as lack of transparency, inefficiencies, manual processes, and fraud.
- **Introduction to Blockchain Technology**: Blockchain is a decentralized and distributed ledger technology that provides immutability, transparency, and security. It forms the underlying technology for smart contracts.
- **Role of Smart Contracts in Addressing Supply Chain Challenges**: Smart contracts leverage blockchain technology to automate and streamline various supply chain processes, including procurement, logistics, payments, and contract management.

Architecture Block Diagram of SCM



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Literature Review

Sr. No.	Title	Publication	Year	Positive Points	Research Gaps
1	Secure Data Sharing in Collaborative Blockchain Enabled IIoT	T. Yao, Y. Zheng, X. Zhang, J. Xie, and J. Chena,IEEE Transactions	2021	Increased data integrity, confidentiality, and authenticity.	1. This paper focuses on secure data sharing in the Industrial Internet of Things (IIoT) using blockchain technology. However, it lacks exploration on how this mechanism integrates with existing supply chain management (SCM) systems. 2. Additionally, there is a scarcity of studies assessing the cost-benefit analysis of implementing such a mechanism in supply chains. Moreover, there's a need for further exploration of the regulatory and legal implications of utilizing blockchain-enabled secure data sharing in the IIoT context.
2	A Smart Contract Framework for Supply Chain Collaboration	S. Y. Park, C. H. Lee, and H. J. Kim,IEEE Access	2021	Enhanced supply chain transparency and traceability.	1. While this paper presents a smart contract framework for supply chain collaboration and data provenance, it overlooks the integration challenges with existing SCM systems. 2. There's also a gap in conducting comprehensive studies on the cost-benefit analysis of implementing the proposed smart contract framework. Additionally, exploring the regulatory and legal implications associated with using smart contracts for supply chain collaboration and data provenance is necessary for broader adoption.

3	Blockchain Based Decentralized Privacy Preserving Authentication	R. Xu, Y. Chen, T. Zhang, and X. Xie,IEEE Transactions	2020	Improved privacy preservation in vehicular fog computing.	1. The paper introduces a blockchain-based decentralized privacy-preserving authentication scheme for vehicular fog computing. 2. However, it lacks detailed exploration of the regulatory and legal implications of deploying such a scheme in real-world scenarios. Additionally, further studies on the cost-effectiveness and Return on Investment (ROI) of implementing this authentication scheme in vehicular fog computing environments are needed.
4	Blockchain Enabled Data Sharing for IIoT	L. Guo, H. Shen, H. Lin, W. Wang, and X. S. Shen,IEEE Transactions	2020	Dual encryption ensures data confidentiality and blockchain transparency.	1. While proposing a dual encryption-based approach for blockchain-enabled data sharing in the IIoT, this paper overlooks integration challenges with existing SCM systems. 2. Additionally, there's a need for more comprehensive studies on the cost-benefit analysis of adopting this approach in industrial settings. Moreover, exploring the regulatory and legal implications of utilizing dual encryption for data sharing in the IIoT is essential for ensuring compliance and trust.
5	Fine Grained Access Control Scheme for IIoT	H. Shen, L. Guo, H. Lin, W. Wang, and X. S. Shen,IEEE Transactions	2020	Precise control over data access permissions.	1. This paper introduces a fine-grained access control scheme for blockchain-based IIoT environments. However, it lacks detailed exploration of how this scheme integrates with existing SCM systems. 2. Additionally, there's a scarcity of studies assessing the cost-effectiveness of implementing this access control scheme in industrial settings. Moreover, exploring the regulatory and legal implications associated with fine-grained access control in blockchain-based IIoT environments is necessary for broader adoption.

6	Smart Contracts and Edge Computing for Supply Chain Traceability	C. H. Lee, J. Y. Park, and H. J. Kim,IEEE Access	2020	Integration of smart contracts and edge computing enhances supply chain traceability.	1. While proposing smart contracts and edge computing integration for supply chain traceability in smart factories, this paper lacks detailed exploration of integration challenges with existing SCM systems. 2. Additionally, there's a need for more comprehensive studies on the cost-benefit analysis of adopting smart contracts and edge computing in smart factory environments. Moreover, exploring the regulatory and legal implications associated with smart contracts and edge computing integration in supply chain traceability is essential for ensuring compliance and trust.

Pro’s

1. **Increased Transparency**: Smart contracts provide transparency by recording transactions on a tamper-proof blockchain ledger, allowing all stakeholders to access and verify transactional data in real-time.

2. **Enhanced Traceability**: Blockchain-enabled traceability ensures the origin and movement of goods throughout the supply chain, enabling stakeholders to track product provenance, authenticity, and compliance with regulatory standards.

3. **Reduced Transaction Costs**: Automation of contract execution and settlement reduces intermediaries and associated costs, leading to cost savings and efficiency gains for supply chain participants.

Con’s

1. **Technical Complexity**: Developing and implementing smart contracts require specialized technical expertise in blockchain development, programming, and security, which may pose challenges for organizations lacking in-house capabilities.

2. **Security Concerns**: Smart contracts are vulnerable to security breaches, bugs, and hacking attacks, leading to potential financial losses, data breaches, and reputational damage for organizations. Ensuring the security and robustness of smart contracts is crucial to prevent unauthorized access and manipulation of sensitive data.

3. **Legal and Regulatory Challenges**: Legal enforceability and regulatory compliance of smart contracts vary across jurisdictions and industries, posing challenges in terms of contract validity, jurisdictional issues, and dispute resolution mechanisms. Clarifying the legal status of smart contracts and establishing regulatory frameworks is essential to foster trust and confidence in smart contract-based transactions.

Applications

Real-World Applications of Smart Contracts in SCM:

- **Supply Chain Traceability**: Tracking and tracing products from manufacturer to end consumer to ensure authenticity and compliance.
- **Procurement and Purchasing**: Automating procurement processes, including sourcing, ordering, and payment settlement.
- **Payment and Settlement**: Facilitating automatic and secure payment settlements between buyers and suppliers based on predefined terms and conditions.

Conclusions

- Summary of Key Points: Smart contracts offer promising solutions to address challenges in traditional supply chain management by enhancing transparency, traceability, and efficiency.
- Importance of Smart Contracts in Transforming SCM: Adoption of smart contracts can lead to a more resilient, agile, and trustworthy supply chain ecosystem.
- Future Directions for Research and Implementation: Further research is needed to address identified research gaps and overcome challenges to widespread adoption of smart contracts in supply chain management.

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