ENHANCING SUPPLY CHAIN IN INDIA USING BLOCKCHAIN

TECHNICAL ANALYSIS OF REAL WORLD PROBLEM

REVIEW 3

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ABSTRACT

Often in modern times, people encounter the issue of not being able to find the products they need in nearby stores. This problem not only affects customers but also local retailers, as they lose their regular customers.
Our project aims to implement an effective supply chain management system that utilizes blockchain technology to provide a transparent view of how products are first acquired from farmers shipped to the manufacturer and distributed to the end customer. This involves the manufacturer acquiring new items from the farmers, the wholesaler purchasing the items in bulk from the manufacturer, and the retailers buying goods from the wholesalers.

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With this system, local shopkeepers will be able to anticipate when they will receive their products in the desired quantities from the manufacturer, enabling better tracking of inventory,minimizing delays in orders,etc.
With a blockchain-based system, every transaction in the supply chain can be recorded as a block in the chain, creating a secure and tamper-proof record of every movement of goods and services. This can help to eliminate the need for intermediaries and reduce costs associated with supply chain management.

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Blockchain technology has emerged as a promising solution to address some of the challenges in supply chain management. With its decentralized, transparent, and tamper-proof ledger, blockchain technology has the potential to improve transparency, traceability, security, and efficiency in the supply chain. This paper provides an overview of how blockchain technology can be applied to supply chain management, including its benefits and challenges. The paper also discusses some of the current use cases of blockchain in the supply chain, such as tracking product provenance, reducing fraud and counterfeiting, and improving logistics and inventory management. Overall, the paper highlights the potential of blockchain technology to transform supply chain management and enhance collaboration among stakeholders in the supply chain.

INTRODUCTION TO OUR PROBLEM STATEMENT

A supply chain is a complex network of interconnected parties, including manufacturers, suppliers, distributors, retailers, and customers. The process involves the exchange of goods, services, and information between these parties. The traditional supply chain system is often plagued by inefficiencies, including lack of transparency, fraud, and errors.

Incorporating blockchain technology in supply chain management can also help with inventory management, order tracking, and payment processing, among other benefits. With the potential to improve supply chain efficiency, reduce costs, and increase transparency, it is no wonder that more and more companies are exploring the use of blockchain technology in their supply chain management systems.

LITERATURE SURVEY

1. Blockchain in Industries: A survey
IEEE Access, 7 (2019), pp. 36500-36515 Al-Jaroodi and Mohamed, 2019
J. Al-Jaroodi, N. Mohamed

This paper reviews different industrial application domains where blockchain can be applied and examines the opportunities, benefits, and challenges of incorporating blockchain in various industries. The paper also identifies the requirements needed to implement blockchain for different industrial applications. While several opportunities are available for utilizing blockchain in different sectors like finance, health care, logistic, agriculture and food industry, there are still challenges that need to be addressed to achieve optimal use of this technology.

LITERATURE SURVEY

2. A Review of Blockchain-Based Systems in Transportation
Information, 11 (1) (2020), p. 21 Vittorio Astarita, Vincenzo Pasquale Giofrè, Giovanni Mirabelli, Vittorio Solina

Blockchain technology has been identified as having potential relevance for the logistics sector, particularly in terms of traceability and integrated supply chain management. The use of blockchain can enhance trust and facilitate data sharing among the different actors involved in the supply chain. Additionally, the growth of blockchain technologies is closely linked to the rise of the Internet of Things (IoT). Many experts predict that IoT devices will play an important role in connecting blockchain databases to the physical world. As vehicles become part of the IoT, blockchain is gaining popularity in road traffic management and smart cities. By enabling cooperative data sharing and secure transactions between autonomous and connected vehicles, blockchain can offer unique features that traditional databases cannot provide.

LITERATURE SURVEY

3.Transparency in food supply chains: A review of enabling technology solutions
Trends Food Sci. Technol., 91 (2019), pp. 240-247 Astill et al., 2019
J. Astill, R.A. Dara, M. Campbell, J.M. Farber, E.D. Fraser, S. Sharif, R.Y. Yada

The purpose of this article is to explain how the Internet of Things (IoT) can enhance food production transparency by utilizing various enabling technologies. It also provides an overview of other relevant technologies that are crucial for managing and utilizing food supply chain data, including blockchain and Big Data analytics. The IoT serves as the main technology for data collection across various stages of the supply chain, leading to transparent food production systems that are driven by data.

LITERATURE SURVEY

4. The power of a blockchain-based supply chain
Comput. Ind. Eng., 135 (2019), pp. 582-592 Azzi et al., 2019
R. Azzi, R.K. Chamoun, M. Sokhn

This paper explains how the integration of blockchain technology into supply chains has been implemented to enhance transparency, authenticity, and trustworthiness. The aim of this study is to investigate how the incorporation of blockchain technology can result in a more reliable and authentic supply chain system. Blockchain ensures that all transactions are recorded and cannot be altered or tampered with. Product and shipping information are collected using various technologies and verified before being recorded permanently on the blockchain.

LITERATURE SURVEY

5. DL-Tags: DLT and smart tags for decentralized, privacy-preserving, and verifiable supply chain management
IEEE Access, 7 (2019), pp. 46198-46209 **Benčić et al., 2019**
F.M. Benčić, P. Skočir, I.P. Žarko

The paper presents a practical solution for verifiable supply chain management based on IoT and DLT that prevents the sale of counterfeit goods while protecting the privacy of stakeholders. The solution enables stakeholders to share product-related data directly without the need for a trusted third party. A public ledger serves as an intermediary to provide proof of existence for significant events occurring on the supply chain, with only data hashes based on actual product-related data exchanges being stored on the ledger. This ensures that the actual data's integrity can be easily verified using proofs of existence.

OBJECTIVE

Our project aims to solve the problem by decentralizing the entire supply chain network using blockchain technology. This will provide the following benefits:

1. Transparency: All stakeholders will be able to track the product at every stage, promoting transparency.
2. Increased security: The system will be tamper-proof, providing increased security.
3. Risk management: The blockchain will enable us to monitor and manage risks within the supply chain.
4. High-quality products: By implementing blockchain, we can ensure the delivery of the best quality products.
5. Instant payment: Smart contracts will enable instant payment between stakeholders upon buying and selling.

SCOPE

The project aims to increase visibility and maintain accurate records of products using blockchain technology. By doing so, we can eliminate the inefficiencies in the current supply chain and save firms a significant amount of money. This will involve replacing traditional paper-based systems with digital document transfer at every level of the supply chain hierarchy.

NOVELTY

In India, cryptocurrency is not widely used because the Reserve Bank of India has prohibited banks from dealing with cryptocurrency exchanges, and there is no specific legal framework for cryptocurrencies in the country. So, implementing a blockchain over the generic supply chain without any digital currency is next to impossible. This is where we introduce our novelty.

Digital Rupee is a proposed digital currency in India that will be issued by the Reserve Bank of India. It is also called an E-rupee. This is what would replace Ethereum and our complete blockchain can be deployed in this Digital Rupee network.

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Digital Rupee is an innovative solution that leverages blockchain technology to provide a decentralized and secure platform for supply chain management. One of the key features of Digital Rupee is the use of smart contracts to automate and enforce contractual obligations between different stakeholders in the supply chain. These smart contracts are self-executing and programmable, allowing for real-time monitoring and tracking of products as they move through the supply chain.

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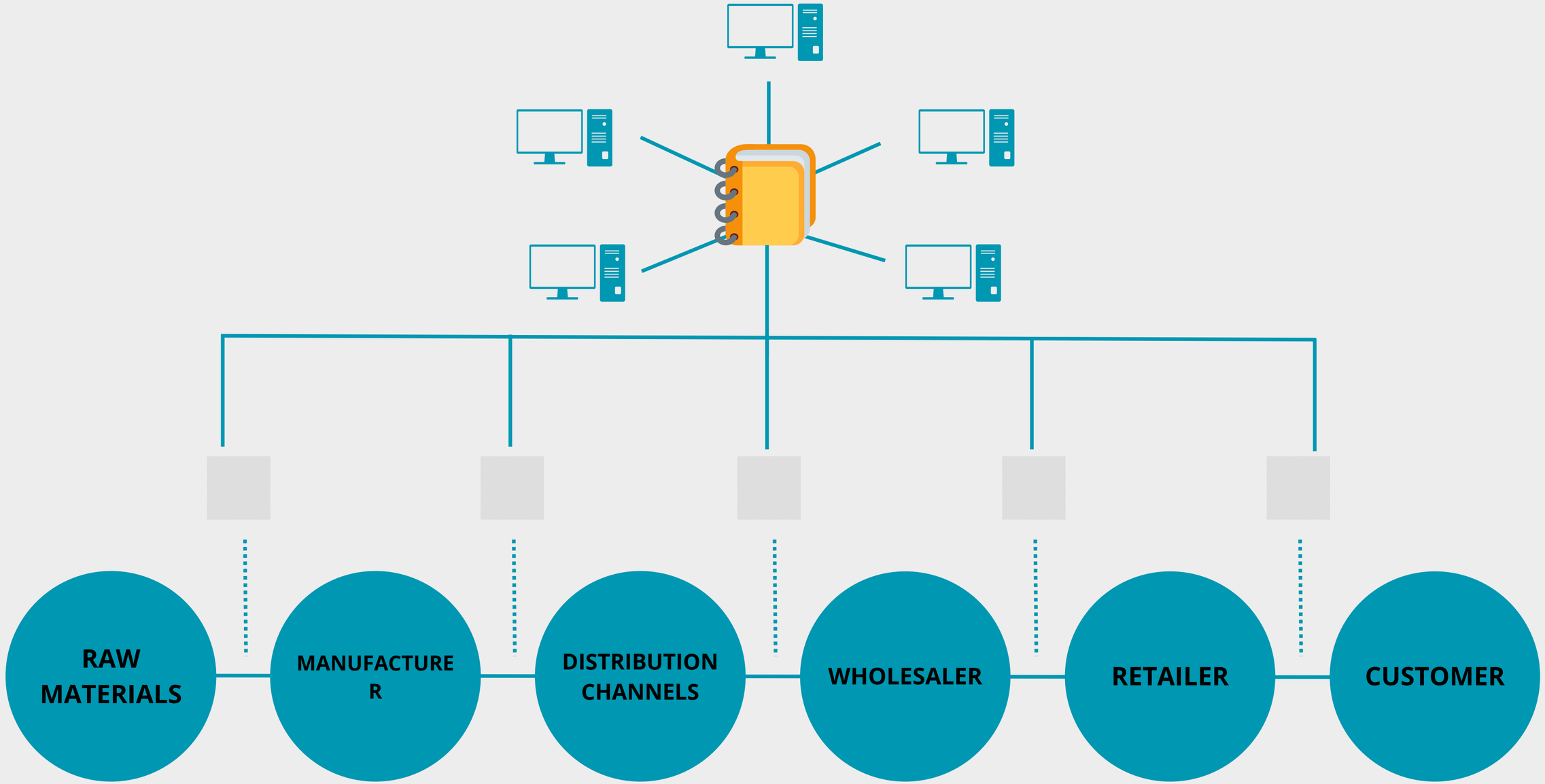
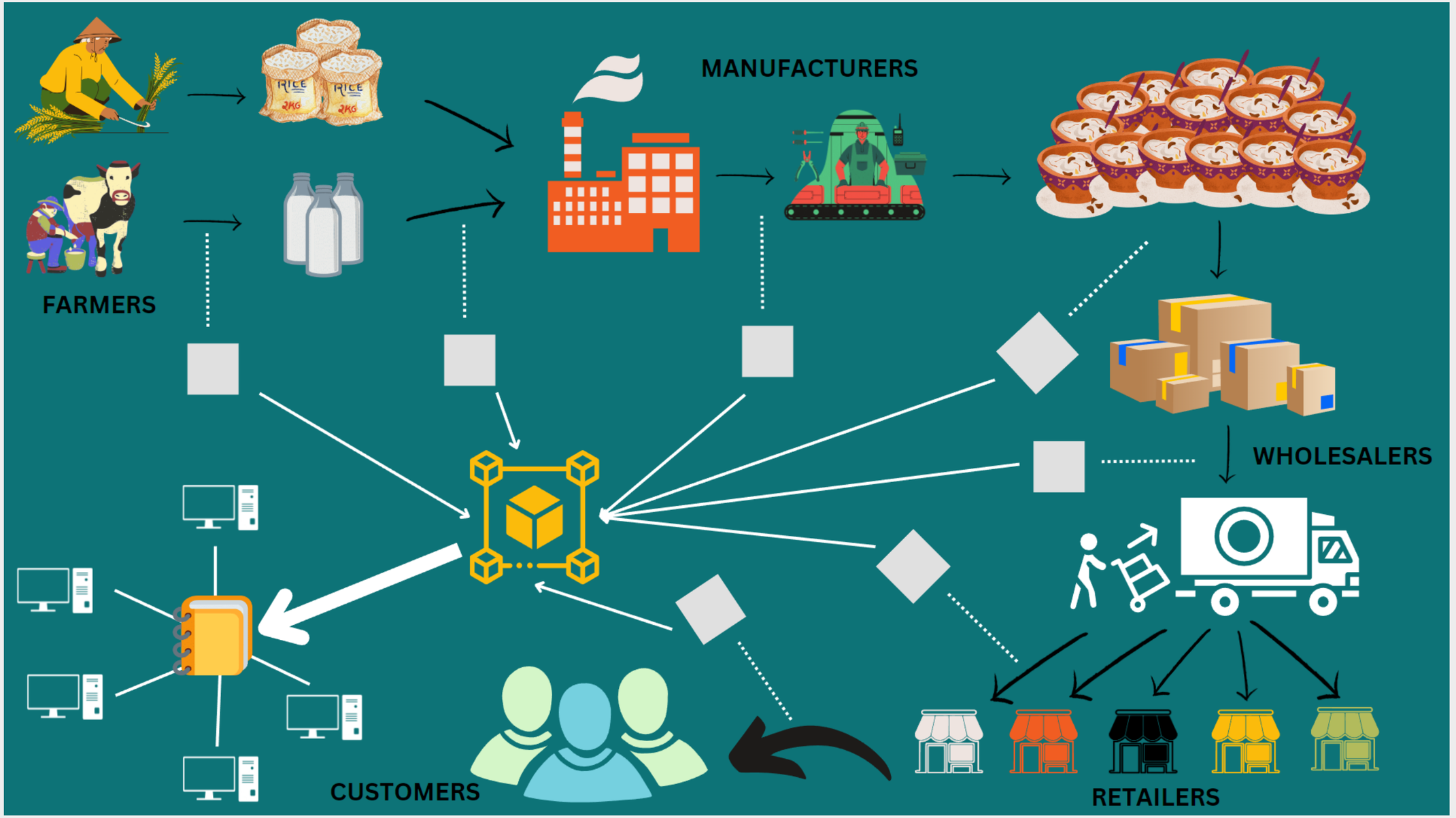
The novelty of using smart contracts in Digital Rupee lies in their ability to improve supply chain efficiency and transparency. By automating the contract execution process, Digital Rupee eliminates the need for intermediaries and reduces the likelihood of disputes and errors. This leads to faster transaction times and reduced costs for all parties involved. Additionally, the use of smart contracts enables real-time tracking of products and automatic updates to the blockchain ledger, providing stakeholders with complete transparency and accountability throughout the supply chain. Overall, the use of smart contracts in Digital Rupee is a novel and innovative approach to supply chain management that has the potential to revolutionize the complete industry in India.

ARCHITECTURE



WORKING MODEL



EXPLANATION OF WORKING MODEL

The farmers produce the raw materials like rice and milk.The Manufacturer buys the raw materials from these farmers. But this process of buying happens through a smart contract where the transaction is instant and is validated and stored in a block.The manufacturer does the processing and create a product called ‘Kheer’ from the raw materials. The manufacturer then makes the product in bulk and packages them. In between there are multiple data points which collect vital information from the manufacturing plant. These are done with the use of IOT devices and sensors which collect data from the data points.

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Then these products are bought in bulk by the Wholesalers/Distributors with instant payment with the help of the smart contract.The Wholesalers then ship the product to their warehouse from where the retailers order their quantity.The complete shipment process is tracked with data points and all these are stored in a private/public cloud.The retailer lists their product in the shop from where the customers buy them.So, from the starting till the end point, every movement of the product is tracked and stored in multiple blocks and the transactions are validated and converted into blocks and added to blockchain.This blockchain is a Distributed Ledger System which is available throughout all the stakeholders. Hence the complete system becomes transparent, trackable and much more secure.

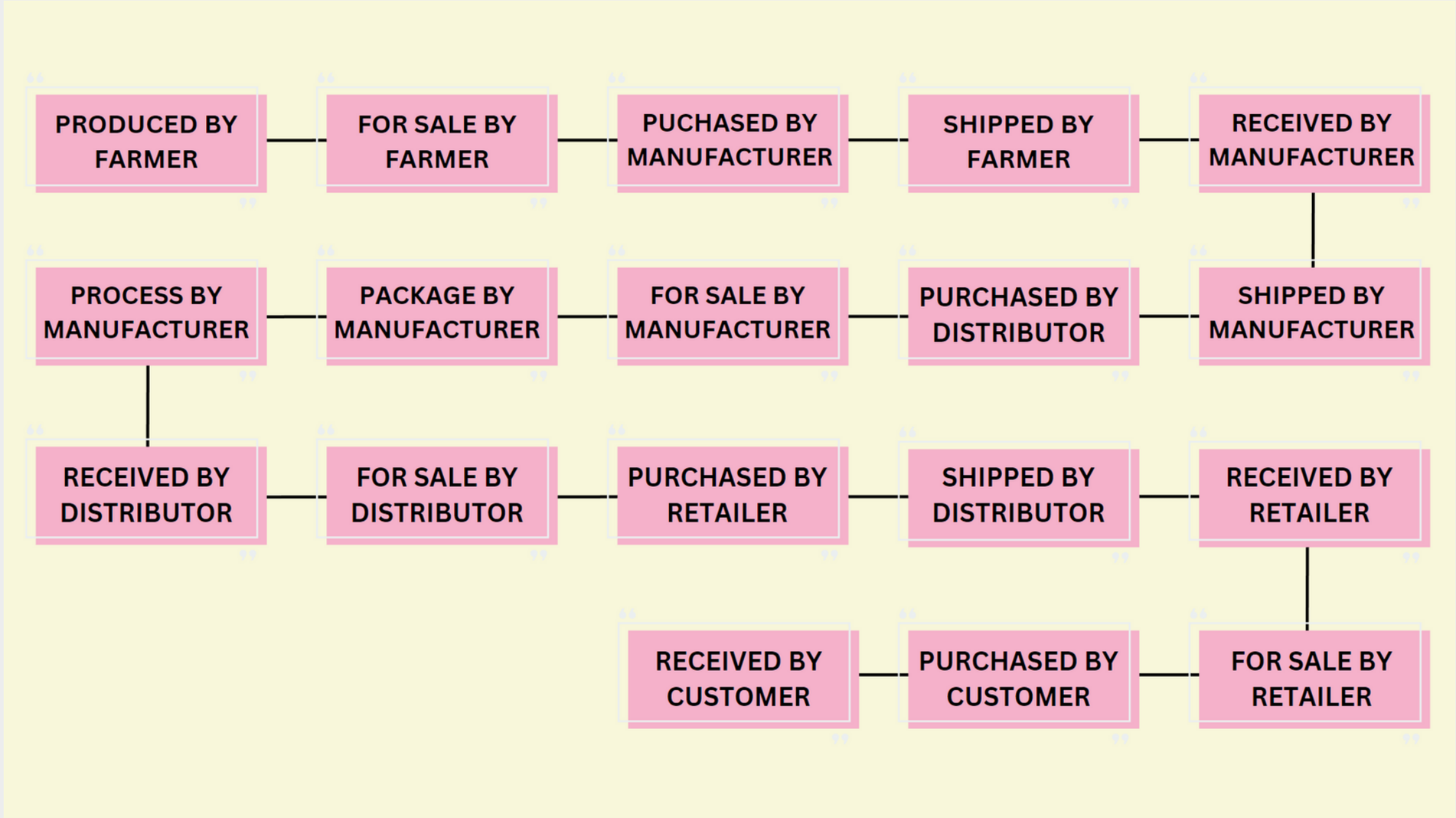
SMART CONTRACT

This smart contract is based upon Ethereum and can be deployed into any Ethereum network for testing purposes.

This smart contract can have multiple stakeholders of the supply chain including Farmer(Producer), Manufacturer, Distributor(Wholesaler), Retailer and Customer(Consumer).

The stakeholders can add themselves into the network without the consent of any central authority. Also each of them are defined with specific set of roles.

WORK FLOW OF SMART CONTRACT



RESULTS AND DISCUSSION

Firsty, the study analyzed a generic supply chain management system using an appropriate dataset of a product based company.The company offered 4 modes of shipping the product namely- standard, same, first and second class. However, every mode of delivery shows some level of inefficiency. Therefore, there is a delivery data variance associated for all the modes of shipping.The study also analyzed the best model for prediction for the given dataset,the model was found out to be XGBoost with an accuracy of 99.65%. Using this model forecasting was done between predicted and actual sales.

SMART CONTRACT RESULTS

In the complete scenario, starting from raw materials produced till the finished product with the customer, everything can be tracked. A function called getState returns the state of the product after every specified action. This enhances the transparency and trackability of the complete supply chain.

Also at every state the ownership of the product can be checked which enhances the single source of truth.

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