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Reflect: Supply Chain Management Tool

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Abstract - *For any business to be an effective one of the most important parts is customer satisfaction. The main factor for customer satisfaction is the supply chain. Handling an effective supply chain is not an easy task. The customer needs more transparency, accurate traceability of the product, detailed information about the product. Different technologies have been used to control the supply chain more successfully, and they are also unable to handle these challenges correctly. This problem can be solved by new emerging technology such as blockchain technology. Previously, this technology was only considered for the finance sector. But nowadays its usage is being expanded to other sectors also. Backtracking of the product can be easily done in the blockchain. Blockchain manages each detail accurately. In this paper, we explore how this technology can be used in the supply chain to make it more effective and suggest a blockchain-based supply chain management tool. To increase security, one of the most effective permissioned blockchain solutions is Hyperledger Fabric. In this, network participation is controlled by predefined rules. This feature makes this technology more effective than other technologies.*

***Key Words*: Supply Chain, Blockchain, Hyperledger Fabric, Smart Contract, Docker composer, Docker.**

1. INTRODUCTION

Managing a supply chain isn't easy, even when you're running a small company. It is a crucial sector of an organization and is described as managing and overseeing all interactions between manufacturers, suppliers and customers to deliver greater customer value at a reasonable rate to the supply chain as a whole. The functional efficiency is measured through its performance against the greater demand ambiguity, higher supply risk, and increasing a competitive intensity. Therefore, increased transparency through better information exchange is necessary. This consistent need for transparent traceability due to inconsistent or unavailable data, lack of interoperability, and limited information on the product's lifecycle or transport history will continue to present a main goal for future supply chains. These particular problems have actually been addressed through the application of blockchain technology that has shown to counter transparency and security inefficiencies. Blockchain appeared as a leading technology layer for financial applications. Though, in the past years, the focus of researchers and practitioners moved to the application of this technology to other domains. This technology is a distributed, decentralized ledger allowing transparent direct peer-to-peer transactions between participants without the presence of a third-party. The use of this technology is currently setting a new foundation for transparent and trustworthy vendor-supplier relationships. Another advantage of using a blockchain is the exclusion of single points of failure due to the blockchains decentralized nature. Aside from the widely known permission less blockchains in which anyone can join the network such as Bitcoin and Ethereum, permissioned blockchains are becoming progressively popular. In a permissioned blockchain, multiple organizations work together on shared, distributed ledgers whose permissions can be composed per organization and its members. This setting is attractive to associating businesses and organizations, as the governance for who can join the network can be technically executed. Popular frameworks for building permissioned blockchains include Tendermint, Quorum, Corda, and Hyperledger Fabric. We are going to use Hyperledger Fabric, an open source project managed by the Linux Foundation, which is reported to be the most widely used framework for enterprise consortia. Hyperledger Fabric introduces its own architecture, during which many components are pluggable and configurable, including the consensus protocol and therefore the code to execute and validate transactions. In this framework, a proposed transaction or change to the ledger is only executed by a subset of network peers, before the transaction is added to the shared ledger. Hyperledger Fabric's modularity helps the development of permissioned blockchains, tailored to the specific requirements of a business in a wide variety of fields and use cases.

2. LITERATURE SURVEY

- Shivani Bhalerao, Siya Agarwal, Shruthi Borkar, Shruti Anekar, Nikita Kulkarni, Sumedha Bhagvat, developed the supply chain management system for dairy products. They have provided system that is easy to learn and use for non-technical people. They used react-native to build the app so that they can target both Android and iOS both in a single app. For the server-side blockchain implementation they have chosen Hyperledger Composer. Transparency and security throughout the supply chain is achievable through the project.[1]

- Guido Perboli, Stefano Musso, Mariangela Rosano, first, they incorporate the latest digital strategy literature, creating a traditional Blockchain technology use case design approach that isn't relevant to financial applications. Secondly, they present the findings of a use case in the distribution of fresh food, demonstrating the important aspects of the Blockchain solution implementation. The study explores how the Blockchain helps minimise logistics costs and maximise operations and the complexities of science. [2]
- Xin Zhang, Pengcheng Sun, Jiping Xu, Xiaoyi Wang, Jiabin Yu, Zhiyao Zhao, Yunfeng Dong, proposed a new system architecture in the entire grain supply chain based on blockchain technology and designed a multimode storage framework that incorporates chain storage. This prototype system was tested and verified using real cases and application scenarios. As such, this system is highly significant and has reference value to guarantee food quality and safety-process traceability. [3]
- Miguel Caro, Muhammad Ali, Massimo Vecchio, Raffaele Giaffreda, presents AgriBlockIoT which is completely decentralized, blockchain-based traceability solution for Agri-Food, capable of seamlessly integrating IoT devices that produce and consume digital data along the chain. First, they specified a classical use-case within the given vertical domain, namely from-farm-to-fork, to effectively evaluate AgriBlockIoT. Then, using two separate blockchain implementations, namely Ethereum and Hyperledger Sawtooth, they built and implemented those use-cases, achieving traceability. Finally, in terms of latency, CPU, and network usage, they analysed and compared the performance of both deployments, even highlighting their key pros and cons. [4]
- Mark Soelman, Vasilios Andrikopoulos, Jorge Perez, Vasileios Theodosiadis, Karel Goense, Arne Rutjes, discusses how vulnerable endorsement policies can lead to admitting inauthentic data on the ledger. Several approaches for combining integrity with restricted disclosure of sensitive information, with or without directly hosting a network peer, are suggested to solve this problem. In addition, the idea of multi-tenancy in blockchain networks is implemented as a way to reduce the technological obstacle to the adoption of technology.[5]
- Thomas Bocek, Bruno Rodrigues, Tim Strasser, Burkhard Stiller, modum.io, a start-up that uses IoT sensor devices to exploit blockchain technology to claim temperature record data immutability and public accessibility while reducing operating costs in the supply chain of pharmaceuticals, is presented. To fully ensure GDP regulations, the sensor devices control the temperature of each parcel during the shipping. All data are moved to the blockchain, where the product attributes are assessed by a smart contract. Since modum.io is not the only non-financial start-up that deals with blockchains, it offers a list of areas and other start-ups that seek to eliminate bureaucracy, share the infrastructure, and use blockchains to save costs. [6]
- Soha Yousuf, Davor Svetinovic, discusses the problems prevalent at each point of the supply chain and uses blockchain technology to verify their candidacy for implementation. To form a generalized structure, the analysis is carried out in terms of the characteristics of confidence and decentralization. To benefit from further research and development, the key contribution of this work is to create a conceptual overview of the areas in which blockchain interacts with supply chain management. [7]

3. RELATED WORK

Over the last few years, there has been an explosion in research and development activities around Blockchain technology, primarily in the financial technology industry. Indeed, its inherent capacity to deliver immutable and tamper-proof records, combined with its potential to allow trust and reliability among untrusted peers, is too enticing to prevent this technology from remaining relegated to a single vertical sector. For this reason, many industries outside the financial technology field have already described the Blockchain technology as a paradigm shift engine. The use of some IoT devices and innovations in the supply chain management field has also drawn a great deal of research attention in recent years. The fusion of blockchain technology and modern supply chain management has become a recent trend. Nestle, IBM (International Business Machines Corporation), and Walmart jointly developed a pork supply chain management system based on the Hyperledger Fabric blockchain system.

4. PROPOSED SYSTEM APPROACH

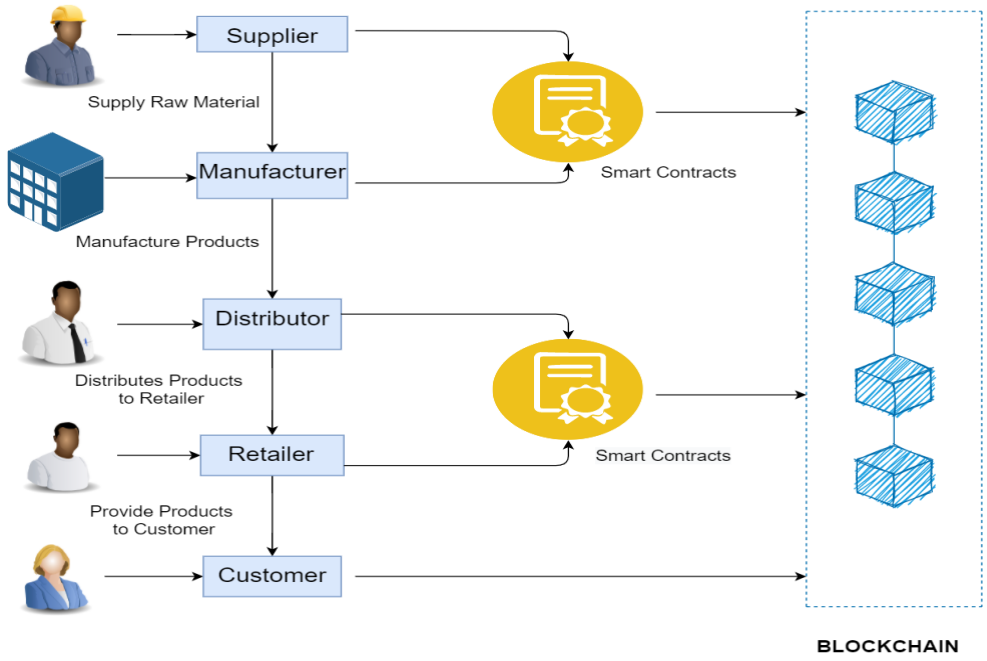

Fig -1: Overview of Supply Chain Management System with Blockchain

The figure above demonstrates, conceptually, how the different actors of the supply chain will cooperate and communicate within a block chain network. Each participant submits transactions on the blockchain network in a particular manner, based on the operation being completed. In the raw materials phase, suppliers that pre-process natural resources are undertaking transactions in the ledger relating to the initial process. These transactions contain tags such as name of raw material, quantity, cost, place of origin, and others. The required transactions shall be submitted as soon as the raw materials begin their journey to the producer. In this way, each network party can verify important details of the specific raw material they have received or that their product is made from. Similarly, at the manufacturing level, the producer has similar experiences with the next chain member, Blockchain and Logistics. By reading and checking all the tags that the latter uses in their transactions, the manufacturer is able to validate crucial information about the natural resources they obtained, and then proceed to the proper execution of the manufacturing phase. New transactions with new information tags, such as the name of the manufacturer, field experience and others, are submitted after completion of the point. Following this, the goods are handed over to the distributors. The role of distributors is described as selling goods to middlemen, which means not the end user. At this point, as at any stage of the supply chain, the distributor may check up to that stage useful tag information on the progress of the product; information such as the geolocation of the origin of the raw material, the popularity of the manufacturer 's business, the name of the distributor, and others. Retailers should immediately audit the consistency of the natural resource of the commodity and receive sufficient input before selling it to the customer.

5. CONCLUSIONS

This study provides a comprehensive review of advantages of Blockchain technology via analyzing its salient features of transparency, traceability, security, efficiency, confidentiality and immutability. Our work explored a preliminary framework to evaluate the suitability of blockchain based on its characteristics of providing increased trust and decentralization in the supply chain. Transparency and security throughout the supply chain is achievable through the project. Also, smart contracts can help eliminate costly delays and waste currently due to manual handling of paperwork.

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