A Proposed Model for Supply Chain using Blockchain Framework

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Abstract
The rapid increase in the use of new technology known as 'blockchain technologies' has addressed many challenges in different areas and provided benefits to users, in this paper we discuss the field of supply chains, improve confidence and transparency between participants and stakeholders significantly also in this paper we Compare between different blockchain frameworks focusing on most popular frameworks. Moreover, we proposed a model in the supply chain using a blockchain framework, the proposed supply chain model included many different resources that help to exchange information over the network. The proposed model also includes smart contracts that maintain all rules for transactions. using blockchain technology information such as transaction details, time and money are recorded and stored within the system from the beginning of the transaction entry.

Keywords:
Blockchain, supply chain, framework, smart contracts, secure transactions

1. Introduction

Blockchain is a system for recording information in such a way that makes it very difficult to hack the system. Also, it is a programmable system in which all records are individually encrypted. It keeps a distributed and decentralized record of digital transactions. it is disruptive and general-purpose technology for companies. Blockchain technology can be used in supply chains for traceability of goods and can be used to create transparency in the supply of goods. The supply chain is the flow of material, information, and services between a company and its suppliers to produce and distribute products to the final buyer. Blockchain creates trust between different entities. Blockchain is a decentralized structure. Therefore, it improves security and privacy, reduces costs for organizations, and has increased the speed of transactions. Visibility and traceability are significant benefits of blockchain. Individual control of data, Tokenization and innovation are also the benefits of blockchain. Accurate information flow in supply chains improves profitability. The architecture of blockchain technology in supply chains has been developed to test the transactions between manufacturer, distributor, retailer, and customer to accomplish real-time transparency. These are the steps for applying blockchain in the supply chain. First, we must determine the feasibility, we must find the right blockchain partner, identify suitable areas for blockchain implementation, the technology must be well-integrated into the current technology ecosystem, envision blockchain potential, understand blockchain volatility, and test the technology. Figure 1 shows the traditional supply chain mechanism.

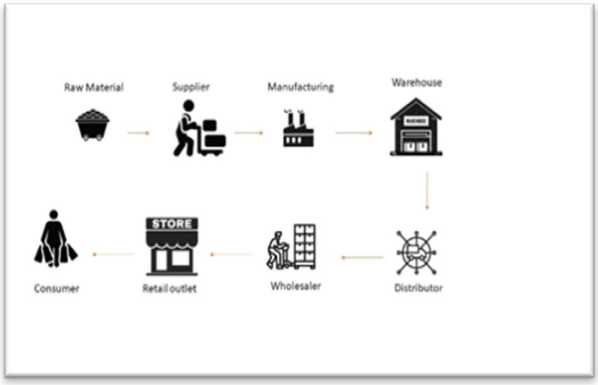

Fig. 1. Traditional Supply chain

Rest of the paper is organized as follows: section 2 presents the literature review, section 3 highlights existing frameworks. Section 4 presents the proposed and its implementation, while section 5 concludes the paper.

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2. Literature Review

There has been extensive research on Blockchain with researchers addressing the concept of blockchain, and how to adopt blockchain technology with the supply chain. This section discusses related work on blockchain and supply chain management. also, blockchain frameworks.

Authors in [1] focused on the applications within the supply chain in the manufacturing business. Also, the main characteristics of Blockchain technology and potential application areas are reviewed. They proposed A hypothetical vision of a manufacturing supply chain for a blockchain. The proposed system facilitates the collection of a massive amount of data about products and users in the manufacturing industry, which can be useful to a range of different people, organizations, governments, and researchers.

Moreover, The Authors in [2] discussed how to adopt blockchain technology to enhance quality management in the supply chain, they proposed a framework for blockchain-based on SCQI. Their framework will provide a theoretical foundation for intelligent supply chain quality management based on blockchain technology. It also serves as a framework for the development of ideas concerning information resource management in distributed, virtual organizations, particularly distributed, cross-organizational, and decentralized management theories.

On the other hand, Authors in [3] used hyper ledger fabric to design of blockchain framework for insurance cases. They implemented the experiments by scaling up the network to examine the strength of the system. Moreover, the analysis of the latency has been supported by a changing set of parameters. Also, they simulated different smart contracts for different policies in their model. Their solution is based on the idea of implementing an insurance company's procedures as smart contracts and storing the outcomes in a blockchain-enabled distributed platform.

However, the authors in [4] explained blockchain technology for supply chain management and the obstacles that organizations face blockchain technology .in their paper they proposed future research proposals for the adoption of blockchain technology for supply chain management as it advances the evolution of blockchain-based supply chain management that enables the creation of shared, secure, decentralized ledgers and independent digital contracts. (Smart Contracts) and Trusted and Secure Networks. In addition, it supports transactions between partners (peer-to-peer) by reducing the role of intermediaries/intermediaries in the network.

In addition, the authors in [5] explored how blockchain enables and constrains supply chain performance. The results of the study can be leveraged by noting the importance of specific enabling roles for blockchain. also, the study indicated that supply chain managers should strive to enhance the enabling powers and reduce the limiting forces of the blockchain.

For instance, the Authors in [6] proposed a model that provided a high level of security and integrity for the supply chain by allowing traceability of electronic parts. While the parts travel in the supply chain their model enables traceability, moreover, the traceability provides a unique device ID.in their work they can be manipulated device ID in many ways using one-time programmable for example or the detection of counterfeit ICS granted by ECID. the proposed solution can be applied to enable authenticity. Their work was considered the first methodology that reduces human errors, delivery, and management failures in the supply chain. also, they executed a prototype to check the possibility of the proposed model. Also, the Authors in [7] proposed the identification of Boundary conditions for the sharing of information to improve traceability in food supply chains by using blockchain technology. Blockchain technology has used the improvement in product traceability. In their paper, there are different starting points used. The main focus is to investigate Boundary conditions and the challenge of traceability in the dairy food supply chain by using BCT. The results showed that you can use blockchain technology in supply chains for traceability of goods and it can be used to create transparency in the supply of the products for that, the Authors in [8] reviewed the current digitization of the supply chain.GS1 standards and technologies are instrumental in setting standards to improve the efficiency and safety of the supply network in both physical and digital aspects. It also reviews current use cases and start-ups in the field of Blockchain-enabled supply chains. It critically analyses the technical and non-technical challenges in blockchain adoption for supply chain applications, as well as the appropriateness of different consensus

algorithms for applications in the supply chain. Describe and analyze tools and techniques in the Blockchain ecosystem. MOHBS Chain proposed a new framework for Blockchain-enabled supply chains. For more explanation, the Authors in [9] were focused on providing a survey from a blockchain and smart contract point of view mainly focusing on SCM. The key contribution of this study is a comprehensive evaluation of existing research and citation analysis to offer a better understanding of the blockchain technologies trajectories and uses. Also, Authors in [10] have proposed the factors that influenced we adoption of the blockchain in the supply chain management processes. The blockchain keeps the distributed records of the digital transaction and decentralized records of digital transactions. The working methodology consists of identifying supply chain management from the Pakistan oil sector. This paper has described the methodology for the adoption of blockchain in the SCM for improving the integration among all supply chains possesses which will lead to an increase in operational performance. Moreover, their paper provides evidence that suggests SCM practices have a positive impact on the oil industry's operational performance. Therefore, the authors in [11] focused on recent publications that combine blockchain technology and supply chain management as the main objective of recent blockchain projects is to increase supply chain transparency. In their paper, they proposed solutions when tracking complex parts and managing supply chains. An end-to-end architecture based on smart contracts can represent an important milestone in making the properties of blockchain technology accessible to all complex manufacturing networks.
More authors in [12] proposed a model for better transparency in SCM by using blockchain technology. The main objective of their study is to improve transparency in the supply chain for both suppliers and consumers by using blockchain technology. The architecture of blockchain technology in the supply chain has been established to track and monitor the supply chain. This architecture has been tested considering transactions between manufacturer, retailer, distributor, and customer to accomplish transparency. The results of this architecture show that transparency is increased. The trust of every member of the supply chain network was enhanced due to the impact of blockchain technology. Figure 2 presents the future blockchain technology flowchart.

In addition, the authors in [13] proposed the study to check the adoption of the blockchain and hurdles in operations and supply chains in an emerging representative country. For this purpose, it has been developed a validated UTAUT model. This proposed model showed good power in the prediction for blockchain adoption in operations and supply chain management. It has examined the supporting conditions of trust, social influence, and effort in blockchain technology adoption. Their study contributed to advancing and stimulating the theory about blockchain technology adoption in supply chains for emerging economies. from the security aspect, the Authors in [14] provided a study focused on security attacks realized by traditional supply chains also in their study they discussed the privacy issues within the area of supply chain with easy exploitation and categorized for attendees for understanding, on other hand, they shared the recommendation to improve the supply chain infrastructure securely. Moreover, they identified three technologies Machine learning (ML), Blockchain physical unclonable function (PUFs) all these technologies have been considered as the solution for supply chain security and adoption. Moreover, the authors in [15] focused on increasing the safety of pharmaceutical products and reducing the manual operation of the supply chain with the most efficient model. Their paper, it was compared the existing proposed architecture of blockchain and internet of things-based supply chain management systems. The ledger was implemented for sharing and storage of data for maintaining the transparency of data and increasing the safety of products. That will address the need for a blockchain-equipped supply chain system in the pharmaceutical industry.

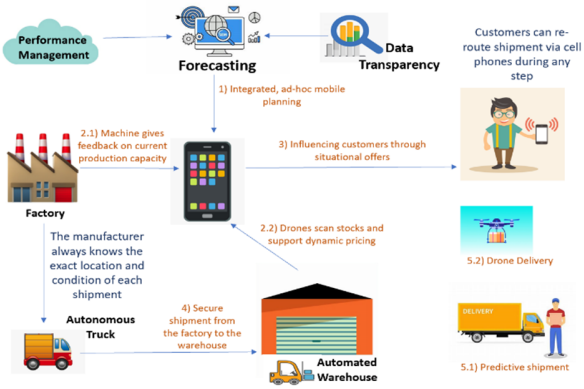

Fig. 2. Future Blockchain Technology

3. Existing Frameworks

This section provides the background regarding the existing frameworks involving blockchain. There are six frameworks in this regard, presented one by one.

3.1 Ethereum Framework

Ethereum is an open-source operating system that is based on the functions of smart contracts. The Ethereum platform is helpful to support the development of decentralized digital applications with the help of blockchain technology. It provides a virtual machine that could operate the script and use international network public nodes. Ethereum is considered a decentralized software application that is helpful to build smart contracts and decentralize the application without the interference of third parties. Ethereum permits the developer to create the application for the next generation. Ethereum is based on different key terms such as it is used to manage and monitor the currency issuance in the central bank and its basic objective is to operate without any hierarchical management (Li, Wong, & Guo, 2020). Smart contracts are digitally signed between different parties based on the Ethereum framework. It provides different types of advantages such as permits to help the user to create visual data sharing and build a highly secure decentralized app. Its applications are in banking, agreements, the stock market, and digital identification of management. Although, it is helpful in a different phase of work it also faces difficulty as its speed is slow in large computations it faces difficulty. Blockchain storage is also expensive and difficult to fix the bugs [16].

3.2 Hyperledger Fabric Framework

Hyperledger fabric framework is an open source blockchain framework that was established in 2015 by the Linux foundation. It is a general-purpose framework that provided several types of identity management and access control features that are helpful for the application of tracking and tracking supply chain and other types of work in the businesses and settlement of the financial assets. The Hyperledger framework has several types of benefits such as it is an open source blockchain framework that is actively growing in the community of developers. The framework permits the participation of different members after confirmation of authentication and is useful in the healthcare industry banking industry and insurance industries. The framework is based on different channels that are governed by exclusive access and communication between different members and teams are considered private and confidential. It provides an additional layer of access control and provides limited exposure to data which is considered a significant feature of the framework. Hyperledger fabric is helpful to support the enterprise and transactions throughout the mechanism [17].

3.3 Hyperledger Sawtooth

Hyperledger Sawtooth is an open-source project that works with the help of a blockchain system by creating distributed ledger applications. These frameworks are specifically used by the organization to perform specific functions. Hyperledger sawtooth is developed by the Linux Foundation and its design is at aiming the implementation of blockchain as a service (BaaS). It provides flexibility to the platform and implements the transaction that is helpful to share the data between the coordinated parties. Its supported language includes Java, C++, JavaScript Python, and Rust. The system permits the application to use blockchain and select the transaction rules that are necessary to define the algorithms and finalize the working of the digital ledger that is helping to support the needs of the organization. Hyperledger Sawtooth stored the necessary information and perform it to boost the security of cryptocurrency networks. Sawtooth is helpful to select permissions to deal with different clusters on a similar platform of blockchain. The performance of the framework is used to handle the high-level volume with popular cryptocurrency networks [18].

3.4 EOSIO

EOSIO is a high-performance open-source blockchain platform launched in 2018 by Block. One. It is a fast, reliable, and highly secure platform for building blockchain applications that deliver industry-leading transaction speeds and a transfer rate of less than a second, allowing developers to conduct transactions at a lower cost by managing resources efficiently. EOSIO is one of the most technically

advanced projects in the blockchain industry as EOSIO is designed to allow for a higher degree of configurability, especially value for creating and managing programmable infrastructures. This allows architects to deploy public or private blockchain networks and implement a suitable virtual or custom protocol through executable smart contracts. EOSIO contracts are written in the C++ programming language. EOSIO uses its Proof of Delegation consensus (DPoS) consensus methodology and features a cutting-edge blockchain system This is with many advanced features such as EOS Virtual Machine, Nodes, and EOSIO smart contracts that interact with several protocol components [19] [20].

3.5 Corda

Corda is an open-source and authorized blockchain platform developed primarily for legal contracts and cross-data between organizations. This makes it possible for a variety of applications to interwork on a single network. Corda is a platform that runs inside the Java Virtual Machine (JVM). Corda was launched in 2015 by the R3 Consortium (R3CEV LLC) to record, monitor, and synchronize financial agreements between financial institutions. The consent algorithm uses "documented" contracts to verify and sign contracts. Corda has a lot of capabilities compared to other frameworks, and the platform doesn't have a mining feature, so part of the transactions can't be seen in most nodes. In other words, Corda transactions are not open to all nodes. One of the advantages of Corda is the ability to search for consensus on individual contracts, access is restricted and built on the industry standard R3 tool but has limited use in the financial sector Corda supports a written decentralized application development format (CorDapps) in Kotlin [19][21][22].

3.6 Quorum

Quorum is an open source blockchain platform based on Ethereum. Created in 2016 and developed by JP Morgan for financial use cases, designed to serve the finance industry and enable organizations to “use Ethereum for blockchain applications [19]. Quorum provides support for organizations that want to adopt a blockchain platform for their business. Quorum supports both public and private networks as well as smart contracts. The consensus algorithm is based on voting; approval of Transaction and block depending on the number of votes a transaction gets and block from the contract brings several improvements: (1) Privacy: it is possible to create private contracts and transactions whose payload is visible only to participants specified in a parameter of the transaction Public transactions are still possible (i.e. visible from by all participants in the authorized network, not through the public Ethereum blockchain); (2) alternative consensus protocols: provide protocols for a blockchain federation; (3) permission: only known and authorized peers, defined in smart contracts, can join the network; and (4) Higher performance and enhanced privacy in transactions and contracts but its disadvantages include anonymity, limited use of framework capabilities, and limited block size [22]. Table 1 summarizes the blockchain frameworks.

Table 1: Summary of Blockchain Frameworks

Framework	Programming language	OS	Ledger type	Consensus
Ethereum, 2013	C++, Python, Ruby, Go, and Java	Cross-platform	Permissioned	Proof-of-work Proof-of-stake
Hyperledger Fabric, 2015	Go, Java, Python, Rust	Linux	Permissioned or private	Allow users to choose a consensus algorithm
Hyperledger Sawtooth, 2015	Java, C++, JavaScript Python, Rust	Linux	Permissioned	Proof of Elapsed Time (PoET) Dev mode PoET Simulator
EOSIO, 2018	C++	EOSIO Core Arbitration Forum (ECAF)	Permissioned	Delegate proof of stack
Corda, 2015	Java Virtual Machine (JVM).	R3 Consortium	Permissioned	Pluggable
Quorum, 2016	Developed by J.P. Morgan	Ethereum developers & JP Morgan	Permissioned	Voting

4. Proposed System Architecture

The goal behind our suggested model is to turn Supply chain procedures into smart contracts and store them on a blockchain-enabled distributed platform for both efficiency and security. Figure 3 presents the proposed blockchain mechanism.

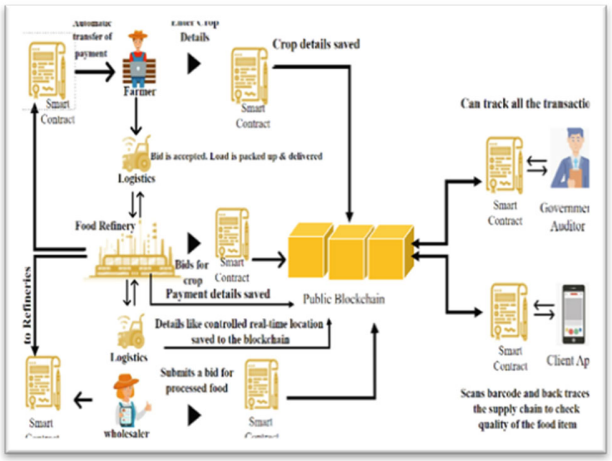

Fig. 3. Proposed Blockchain Concept

4.1 Entities in the Model

The proposed model contains the customer, who is submitting the requests and receives the products. Second entity is the Agent, who acts on the customer's behalf and handles the customer's blockchain network requests. An agent can work with different customers.

4.2 Components of the Model

The main component in our model contains,

- **Database (DB)**
  Upholds the supply chain contracts and all customer transaction results (Key, Value).
- **Distributed blockchain ledger**
  That keeps track of all transactions' execution.
- **Peer nodes**
  That checks the smart contracts (SC) transaction requirements.
- **Orders**
  That constructs transaction blocks and ranks transactions chronologically.
- **Validators**
  That confirms transaction blocks and stores them on the blockchain ledger.
- **Algorithms**
  To authenticate users and offer access control, cryptographic techniques are utilized.

4.3 Framework for Supply Chain

The proposed supply chain framework included many different resources that help to exchange information over the network. The proposed model also includes smart contracts that maintain all rules for transactions. In the supply chain network, a Block has been created by validating peer node values across collections of transaction results [1][2]. Each smart contract has endorsement (or verification) logic that describes the criteria under which the smart contract can perform a transaction. The endorsement logic is conducted with the help of endorsers who utilize the blockchain to check whether the criteria is met. Figure 4 illustrates the proposed model.

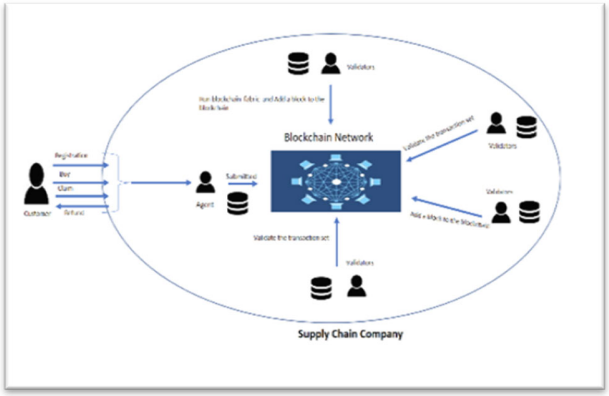

Fig. 4. Proposed Model

5. Conclusion

Supply chain leaders continue their journey in technical development and digital transformation, and it is expected that shortly, blockchain technologies will become an important part of daily business. Better for the scenario of supply chain management using the blockchain, where this paper addresses the various challenges facing the supply chain and the areas of safety in it. In addition, the proposed model has been added, the goal of which is to transform supply chain actions into smart contracts, and display and store them on a distributed platform that supports

blockchain to achieve efficiency and safety. In future, other technologies may also be investigated [24-50].

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