

A Review on Supply Chain Management using Blockchain

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ABSTRACT

Supply chain management is a process of transporting goods and products from source to destination. There are several problems that we encounter with current supply chain management (SCM) systems which include security, traceability, transaction transparency, stakeholder involvement, fraud, and instabilities. Blockchain emerges as a technology that can effectively and transparently manage data and foster trust. It can also help with payments made without the need for a third party or transaction authorization and verification in the supply chain. This study presents an overview of the literature on blockchain in the context of supply chains, including its benefits and challenges.

Key words: Supply chain, Blockchain, Smart Contracts

1. INTRODUCTION

Supply Chain Management (SCM) refers to the process of moving goods and services from one point to another, involving various stakeholders. This process has been in existence since ancient times when the very first product or service was created and sold. With the advent of industrialization and digitalization, SCM has become more sophisticated, allowing companies to produce and deliver goods and services more efficiently. For instance, Henry Ford's standardization of automobile parts was a game-changer that enabled mass production to meet the demands of a growing customer base. Over time, incremental changes have brought additional levels of sophistication to SCM systems. However, SCM has essentially remained a linear and siloed function that was managed by supply chain specialists for generations. An efficient SCM can bring tremendous changes and profits to the organization.

Despite its advantages, current SCM has many drawbacks, including issues related to transparency, security, traceability, and reliability. To improve SCM, integrating Blockchain technology is one solution that can help overcome various challenges in the process.

Blockchain was invented by Satoshi Nakamoto in 2008 to track the data which is also known as serve public transaction ledger of cryptocurrency bitcoin which is known as the first digital currency which solved the double spending problem without using any third-party interaction. Blockchain is used in various fields like payment and money transfer, monitoring supply chains, digital ID's data sharing, copyright, IoT management, health care, etc.

A blockchain is defined as a distributed ledger that maintains a continuous connection between the list of data called blocks. These are interconnected using cryptographic techniques. Each block contains the address of the previous block which is known as Hash. Hash is a timestamp of the transaction. Each block containing a hash has a unique identifier, password, or fingerprint. The previous block's hash link is connected to the next block like this the whole blockchain is internally linked.

There are four key components behind blockchain they are:

- Shared ledger: It will store the overall data of each transaction.
- Permission: Permission ensures the transaction is secure.
- Smart contracts: It is the set of rules created and used by a business transaction which is stored in blockchain and they are automatically executed.
- Consensus: Here all parties should agree to verify the network for transactions.

Blockchain technology allows for self-validation of transactions and involves multiple nodes. It provides transparent information to all users and stores data in multiple locations, making it less risky. Additionally, the data on blockchain cannot be changed or deleted once it is recorded.

On the other hand, traditional databases require third parties to validate transactions and operate on a single node. The information is not transparent for users and the data is stored in a single location, which makes it easy to access but also high-risk. Moreover, the data on traditional databases can be changed or edited.

2.LITERATURE SURVEY

1. Hald and Kinra et al. concentrated on the impact of blockchain technology on supply chain performance by conducting standardized literature review(SLR) on 48 papers. By this research, they could report different blockchain ID's Likewise, pournader et al (2020) organized a standardized literature review along with bibliometric and co-citation analysis were performed on 48 articles to investigate blockchain technology. Applications in supply chain, transportation and logistics they confer about new topics together with application of blockchain in supply chain, transportation and logistics[11].
2. Additionally, Dutta et al. a standardized literature review conducted on 178 papers to explore blockchain technology integration, applications, and challenges in supply chain operation. They relevantly stated that all major industries could be redecorated blockchain technology with targeted business process management and transparency. However, this study differs from previous literature in that it considers and conducts an in-depth study into the adoption, implementation, and future applications of blockchain[11].
3. Satoshi Nakamoto et al. and other researchers highlight the significant impact of blockchain technology, which is best exemplified by the creation of Bitcoin. The focus is on how this technology is increasingly important in the financial sector, indicating a shift in the dynamics of centralized systems. The survey highlights transparency as a key feature, where copies of data are shared across the entire blockchain network, requiring all nodes to maintain this shared data. The authors position blockchain as a departure from traditional centralized models, with the transparent and decentralized nature of the technology seen as revolutionary[4].
4. Tian et al. proposed a food safety system for supply chain traceability that is based on Hazard Analysis and Critical Control Points (HACCP), blockchain technology, and the Internet of Things (IoT). The system aims to improve transparency and enhance food safety by automatically collecting and storing information using blockchain. The study also examines the advantages and disadvantages of RFID technology in this context[3].
5. Xiaoyi Wang et al. Grains play an important role in the food cycle of humans and all living beings. It is necessary to provide proper information about the grains, their importance, and their details to the users. This system aims to study the agriculture fields and grains to produce a new system architecture. The entire grain supply chain has been designed with a multimode storage mechanism that combines supply chain storage. The system has been tested and verified using actual scenarios and applications. When compared to the traditional system, this new system offers improved data security, reliability, information interconnection, and communication. The system is highly significant, safe, traceable, and efficient[3].
6. Zeeshan Raza. et al. In this by using blockchain, smart contracts, IOT, and other advanced technology which is in current trend using all those in the field of traditional agriculture practice method to increase the quality of agriculture in the method 4G agriculture[4].
7. Ibrar Yaqoob et al. In the year 2020, we all experienced the COVID-19 pandemic and realized the crucial need for a proper supply of medical equipment and supplies. Such supplies should possess characteristics such as traceability, reliability, operational transparency, security, and trust. It is also important for the supply to be centralized to prevent any potential single line problems. In response, an algorithm has been developed for COVID-19 waste management and security analysis using advanced technologies such as smart contracts and the Ethereum platform[1].

3. BENEFITS OF USING BLOCKCHAIN TECHNOLOGY IN SCM

Using blockchain technology for supply chain management has numerous advantages. Here are some of them:

1.Inventory sharing:

With the help of inventory status, it enables real-time, transparent access to a shared ledger, providing all the participants in the supply chain with visibility into inventory levels and also preventing duplicate stocks in the inventory[9].

2.Reduces risk:

Sources, transportation, processing, and distribution are the four main channels from which supply chain risks come. Enterprises can use blockchain technology to securely and decentralized monitor and validate each stage of the supply chain process, from sourcing to delivery. Blockchain eliminates information discrepancies and lowers the risk of fraud by recording transactions on a distributed ledger, which guarantees that all participants have access to the same information. Blockchain data's immutability guards against

manipulation and unauthorized changes, giving every transaction a trustworthy and auditable record[2].

3. Traceability:

Each transaction in a supply chain is time-stamped and linked to previous transactions, creating an immutable audit trail that can be verified by all parties involved. This shared and tamper-proof record of transactions allows blockchain technology to facilitate increased trust among supply chain participants. Traditional supply chains frequently suffer from information disparity, where participants have limited visibility into the activities and transactions of others, leading to inefficiencies and potential fraud[7].

4. Transparency:

A traditional supply chain includes several entities, each with its databases and systems, including suppliers, retailers, distributors, manufacturers, and customers. This distribution frequently results in ineffectiveness, hold-ups, and a lack of cooperation between the parties. Every participant in a blockchain transaction has access to a shared ledger that instantly records and validates each transaction.

Blockchain improves stakeholder coordination and communication by providing transparent and safe data sharing. This partnership makes it possible to track items efficiently, manage inventories effectively, and estimate demand accurately, all of which increase productivity[10].

5. Reducing counterfeiting: For products to be checked for quality and dependability, provenance is crucial. The provenance of items may be accurately verified thanks to blockchain technology, which enables traceability of every stage in a supply chain. Because it makes it possible to quickly determine the provenance of suspected goods, it helps lower the amount of counterfeiting. According to OECD (Organization for Economic Cooperation and Development) research, in 2016 6.8% of all EU(European Union) imports and 3.3% of global commerce consisted of counterfeit and pirated goods. This suggests that there is an urgent need to stop counterfeiting, and blockchain technology can help with that.

6. Quality assurance:

Supply chain logistics using blockchain gives all authorized parties transaction access to vital information that helps them verify the process's milestones. For example, we have a repair depot and are getting spare parts supplied to us and we are doing repairs for some critical devices. We can ensure that the repair has been validated, and tested, and maybe we include the test results at the repair facility in a public blockchain or a supplier blockchain. Accordingly, blockchain must validate the test findings, the provenance of the components, and possibly even the repairman's certification[10].

8. Automation:

Smart contracts in blockchain can even automate transactions, boost productivity, and simplify the procedure even further. The transaction or process advances automatically to the next stage when certain requirements are satisfied. Smart contracts reduce the need for human intervention and depend on outside

parties to certify that the terms of an agreement have been fulfilled. For instance, an insurance claim may be immediately resolved and paid after the client submits all required paperwork.

4. LIMITATIONS OR CHALLENGES

1. Erroneous data entry:

Though blockchain is secure it is still prone to error. It does not have a mechanism to ascertain whether the raw data inputted is correct. So, there is a requirement for a verification system to check whether input data is correct or wrong. Once the wrong data is entered it cannot be changed due to the immutable property of blockchain.

2. Issues with blockchain-IoT integration:

Integration of IoT with blockchain for real-time data collection proves to be very useful and faster[7]. But it faces technical issues that need to be resolved. Most IoT devices have less storage and processing speed and collect huge amounts of data that cannot be processed by the network.

3. Scalability:

Blockchain works efficiently when implemented on a small scale. But when there are large networks it becomes difficult to maintain and takes a large amount of time and computational power. Small disruptions in the network which may be logical or physical become very difficult to resolve.

4. Storage:

The System has to store the information of all the blocks even if it is redundant which takes up a large space due to its decentralized nature it becomes even more difficult to manage these redundant data. At the same time, a traditional database requires less space compared to it due to its centralized nature.

5. Limited capability of smart contracts:

Smart contracts are used to automate transaction that takes place between two nodes or parties. These contracts sometimes cannot represent the real world as it. Small changes in smart contracts may incur high costs. It also depends on the ongoing situations where it has to be implemented this may not be consistent throughout[8].

5. CONCLUSION

Supply chain systems are created by several businesses and include several kinds of flows, including financial, goods, and information. To improve overall performance and give different organizations a competitive edge, it is critical to work together with different business forms and connect the flows. The blockchain's remarkable qualities that can be applied in a variety of industries were examined in the literature review. Additionally, the report has emphasized the potential benefits of blockchain technology for supply chain integration and collaboration. The primary themes of this study are transparency, benefits, and problems. The explanation has additionally demonstrated that one of the newer technologies is the blockchain.

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