



## RESEARCH ARTICLE

### COFFEE SUPPLY CHAIN USING BLOCKCHAIN

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#### ABSTRACT

The evolution of supply chains has raised the bar significantly. However, it is still challenging to track the data and maintain its traceability. This paper presents a blockchain-based solution that enables the farmers to easily manage their supply chain. Although blockchain has many advantages, it still lacks many features that can improve the efficiency and transparency of the supply chain. This paper proposes a system that can provide reliable and secure solutions for the management of agricultural products. Its implementation is performed through a decentralized storage system called Interplanetary File System. Due to its decentralized nature and its secureness, blockchain is becoming more popular. Its integration with the supply chain is also substantial, but it is not enough to make the system sustainable. This paper proposes an incentive mechanism that will motivate the supply chain parties to adopt blockchain-based supply chain systems. Due to the increasing number of people wanting their data to be secure, it has become necessary for businesses to implement data encryption techniques. The advent of blockchain has solved this issue. One of these domains is the supply chain. Its decentralized nature enables it to be transacted with confidence by multiple parties. This paper proposes a general model for a supply chain.

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## INTRODUCTION

The primary goal of this research is to develop smart contracts that can be used to manage a supply chain. It will explore the adaptation of this concept to a supply chain model. Due to the nature of the supply chain, it is very difficult to track and record all the transactions happening in a given area. This is also an issue related to the establishment of a centralized system. It is very difficult to find out about the activities of a particular stakeholder in the supply chain. Even if other concerned parties are involved, it is difficult to get information about them. It helps the stakeholder understand the customers' needs and helps in demand management. It enhances the efficiency and effectiveness of the process. A supply chain is a network of various components that deal with the production and distribution of a product. There are various parties such as manufacturer, distributor, and designer that are required to work together to ensure the timely delivery of the product (1). Through blockchain, it is possible to integrate all the parties in a supply chain. To make this happen, there is a need to introduce attractive incentive mechanisms. This paper presents an AI-based incentive mechanism that is designed to incentivize all the supply chain participants.

Blockchain technology is an innovative platform that enables businesses to develop supply chains with various features. Its decentralized nature enables them to transact without intermediaries and verify their transactions anonymously (2). Several new applications have been introduced using blockchain and smart contracts. These include identity certification, supply chain management, legal contracts, and property ownership. Blockchain allows consumers to store their digital identity and physical properties of their products in a secure manner. Its ledger is an immutable record that can be used to verify and record transactions. A supply chain model that is supported by blockchain technology is presented. It describes the interaction between various supply chain participants, including the producer, distributor, and carrier. Smart contracts can help control unethical behaviour among supply chain participants. Blockchain is a type of data structure that enables transferring information across networks. Its distributed trust network allows people to securely store and manage their digital transactions. Blockchain is a distributed ledger that enables anyone on the network to easily read transactions (3). Its secure and time-verifying features make it exceedingly obedient to a user. A supply chain management system is a set of processes that enables organizations to manage the flow of products and their aids. It includes the various steps involved in the conversion of raw materials into finished goods.

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## MOTIVATION

There are many blockchain-based supply chain systems which are integrated using this technology, such as the Product Ownership Management System or POMS. It is a system which suggests the incentive to the supply chain participants to follow the protocol. The smart contract-based secured supply chain system is a type of platform that enables consumers to buy and pay for products from the seller (4). It uses a blockchain-based mechanism for managing transactions and rewards. Blockchain is a secure digital ledger that enables people to record and track transactions. Its various use cases make it very useful for decentralized applications. One of the most critical factors that need to be considered when developing a blockchain-based incentive mechanism for peer-to-peer transactions is how it will incentivize users. Rewarding users who are indispensable in a user-oriented network will encourage them to share their assets and services so that the entire system can work seamlessly. Due to the existence of fake products in the supply chain, the influence of a manufacturer in the market has decreased. To avoid this, blockchain-based supply chain protocols were suggested. But, implementing these protocols would require the manufacturers to give incentives to the various parties in the chain.

Blockchain technology is an opto record transactions securely and efficiently (5). Its decentralized nature enables it to be verifiable in a verifiable manner. Another key aspect of blockchain is decentralization. It is controlled by a distributed network of nodes, each of which acts as a stakeholder. Active nodes receive the information about pending transactions and verify them before adding them to the database. Each transaction is added to the system in the form of blocks (6). The system uses a unique chain structure to store and update the transactions. A block contains the main data and hash of the previous block, as well as the current block. It is also used to define the details of the application. Time of block generated is included in every new or modified block (11). This feature lets the user define various information about the block. Smart contract is a computer-implemented transaction protocol that enables the execution of complex transactions. It can be deployed in a decentralized network like Ethereum. Each contract is identified using its address, which is computed in a deterministic way (10). Each transaction is associated with a set of rules that are designed to implement the contract's terms. After the transaction has been verified, the smart contract is initiated (7). Due to its decentralized nature, blockchain technology is widely used in various computing domains. Its continuous evolution can be combined with smart contract to create a distributed platform for various processes.

Microsoft is exploring the use of blockchain to streamline its future business operations. It developed a block chain as a service (BaaS) platform to experiment with its new business processes. When it comes to handling sensitive data, blockchain technology can help us protect it (8). For instance, a decentralized smart contract called Hawk was developed by Kosba and his team to ensure the privacy of transactions. Blockchain and smart contracts enable us to develop a more secure and traceable supply chain. This paper presents a conceptual model that uses Ethereum smart contracts (9). We introduce the concept of smart contracts as a framework for this model.

## APPLICATION OF BLOCKCHAIN TO SUPPLY CHAI:

An uncertainty of consumer demand can create supply and demand disparity which can affect the profitability of a business. This paper discusses the various challenges involved in planning and implementing a supply chain management system. The complexity of the supply chain and its increasing complexity are some of the factors that challenge the management of such events. In 2010, Akkerman et al. worked on the quality and safety control of the Agri-food supply chain. In 2016, Tianjiayi established an RFID-based traceability system for the food industry. This model supports the traceability of goods and realizes the safety and quality of the food that we consume. It avoids the use of manual processes and is therefore silent about the overall process. Maersk uses a system to track the movement of its cargo. Walmart uses a system to track the supply chain of its products.

**PROPOSED MODEL:** The model shows the various roles that various stakeholders play in the supply chain and its various stages. Each product has its own unique identifier which can be used to map relevant information about it. The central authority (CA) maintains a unique identity for each stakeholder on the network. These individuals can then be given their own digital profile, which can be used for various purposes.

- The producer, distributor, wholesaler & retailers enter product specific data in the blockchain at different stages.
- The carrier transports products from one stakeholder to the next.
- The consumers purchase products and can enter product data to the blockchain. They can be the End User who can verify the product s/he is using.

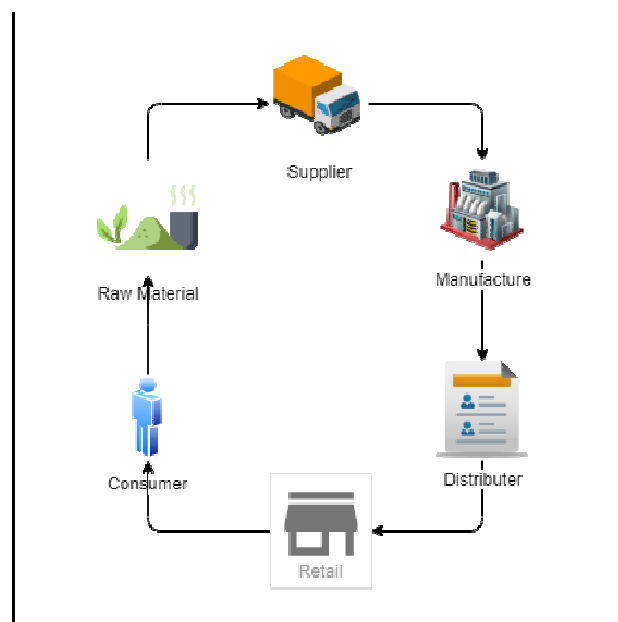


Figure 1. Supply Chain Management System

Successful supply chain systematization involves multiple exchanges of information from various parties involved in the supply chain. Before the systematization can be achieved, the various stakeholders need to be understood and their needs assessed.

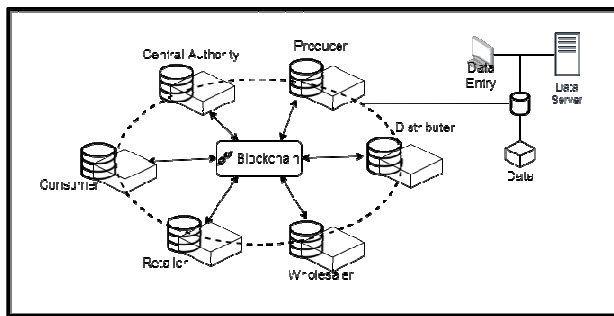


Figure 2. Blockchain Enable Supply Chain

This study is focused on the interaction between three parties involved in the supply chain: the producer, the carrier, and the wholesaler. Through the use of blockchain, these stakeholders can transact with each other without intermediaries. After getting a quote, the producer contacts the seller and issues a sales order. The producer then broadcasts a bid and initiates a smart contract. For the Bidding Contract, the owner will assign an arbitrary value for the reputation factor of each carrier. This factor will be used to evaluate the bid amount and will be collected for further work. Reputation factor and bid amount are also considered as trigger events for smart contracts.

## RESULTS

The researcher stated that the lack of adoption of the coffee certification as a symbol of sustainable production has been identified. This study also noted that the use of this certification can help improve the living conditions of the farmers and consumers. The findings of the study revealed that the actors in the Burundi coffee industry need to adopt technology to improve the transparency and fair trade in the supply chain. The researcher believes that the introduction of block chain in the coffee industry will reduce the cost of doing business and provide a better environment for coffee producers. The proposed model will provide a secure and tamper-resistant environment for transferring funds and goods. It will also ensure the authenticity of transactions. The existing supply chain management practices have numerous shortcomings such as lack of trust, data fragmentation, and inefficient use of processes. Block chain technology can solve these problems by providing various characteristics like transparency, decentralized processing, and immutability. A smart contract is an automated contract that enables the interaction between various parties in the supply chain. It is fully transparent and immutable.

## CONCLUSION

Coffee industry is still lacking technological adoption supply chain process by digitisation and automating its processes such as payment and auditing of the inventory. It ensures fair trade and pricing for all. The adoption of Block chain in the Coffee industry will streamline the supply chain and allow for greater transparency and efficiency. It will also allow for fair trade and price equality for all stakeholders. The study focused on the transaction issues faced by executives in Supply chain Management.

We proposed various solutions and methods to address these issues. The block chain as a technological feature should be considered when solving these problems. A prototype of our model will be presented in our next work. We will also collaborate with business stakeholders to implement our model in a case. We have identified the various problems faced by executives in the work process of SCM and proposed a set of solutions that will help solve these issues. The goal of this paper is to introduce a secure and automatic framework that enables various forms of transactions to be conducted using blockchain technology. This paper will be used in a real case study to implement our model. Resolving this is a proposed solution that uses block chain technology to address the issues of supply chain management. Its main advantage is that it is open to all, and anyone can participate in the supply chain.

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