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# Coffee Supply Chain Using Blockchain

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*Abstract— This issue of supply chain management is very important for the stakeholder groups. Due to the complexity of the supply chain, its management often requires manual work and frequent sharing of information. This paper proposes a new approach that uses block chain technology to resolve the issue and improve the efficiency of the supply chain. Block chain is a distributed database that enables users to trust each other without intermediaries. Its decentralized nature and its ability to verify transactions through automated algorithms make it a safer and more secure alternative to the existing supply chain model. Due to the complexity of the coffee supply chain, the accuracy of the data collected during the CRC process became an issue. This study proposed the use of Block chain technology to address these issues.*

*Keywords- Supply Chain, Blockchain Technology, Smart contract, Supply Chain Management, Blockchain*

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## I. INTRODUCTION

With its numerous advantages, coffee is one of the world's most valuable commodities. Its economic advantages have helped developing countries boost their economies. Despite its significance, the coffee supply chain still has several challenges [1]. Not to mention the various technologies that is being utilized by other industries to enhance the efficiency and transparency of their supply chains. The increasing complexity of business activities has led to the need for more collaboration among various supply chain members [2]. The globalization of the supply chain has also changed the structure of the supply chain. The coffee supply chain is complex and involves multiple relationships between producers, retailers, and traders. This information is gathered through various layers of data analysis and reporting [3]. Establishing a tamper-proof and transparent metadata infrastructure is an important step in the supply chain traceability of products. Current unfair ecosystem which impacts the coffee producers in the form of fluctuation in the market and the rising price from the intermediaries. The study aims to develop a block chain-based application model for the coffee industry to support its sustainable development.

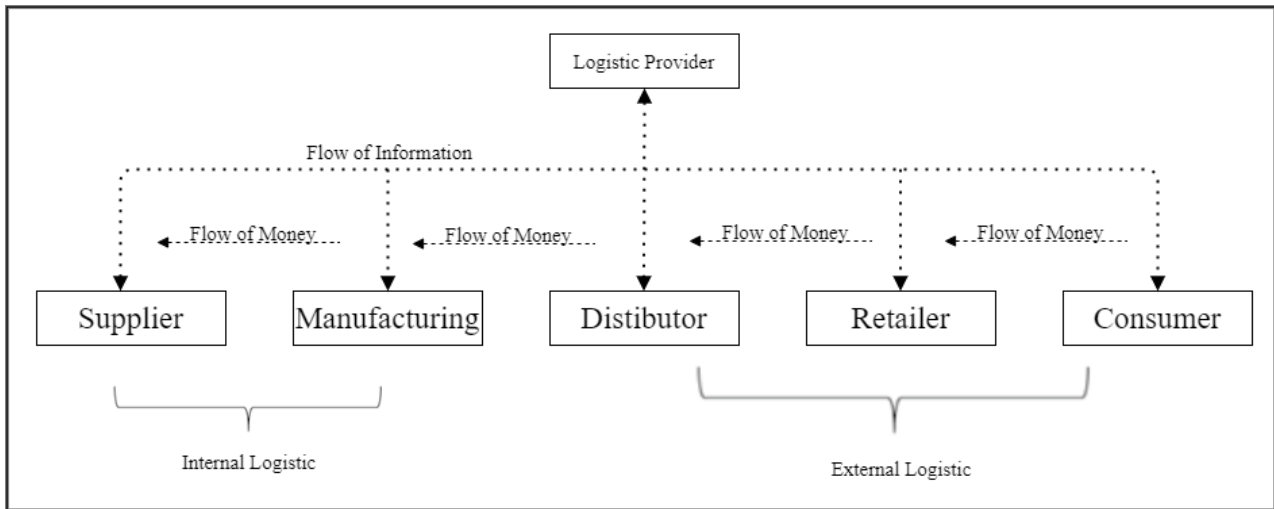


Figure 1: Current Supply Chain System.

A. *Coffee Industry:*

The coffee industry is a very important economy as it facilitates employment and earnings of foreign exchange. Its share of the African coffee export value is highest in Tanzania. The supply chain is a process that involves the sourcing and processing of finished goods [4]. This complex process involves many intermediaries. With a market value of over \$100 billion, coffee is considered the second most traded commodity in the entire world. Its supply chain has various challenges that have become its main concern.

B. *Supply Chain Challenges:*

- **Location challenge:** Farmers who are in remote areas which makes it hard to produce sustainability for coffee farmers.
- **Social challenges:** The growing number of older farmers and the migration of young farmers to the cities.
- **Economic challenges:** The lack of market information and access.
- **Market crises challenge:** Developing countries are vulnerable to market crises due to their dependence on agricultural commodities [5].
- **Environmental challenges:** soil erosion and degradation, changing weather conditions among other factors [5].
- **Time and cost Challenges:** Current CSC processes are complex and time-consuming. It takes days or weeks to perform payment between various parties.
- **Traceability Challenge:** This industry cannot be traced back to suppliers to find out who makes the defects.
- **Transparency Challenge:** The challenge of this project is to create a culture of transparency within a traditional CSC process. This involves handling multiple relationships and ensuring that the processes are transparent.

The coffee industry is experiencing the same challenges affecting its supply chain. Figure 2 illustrates the current process.

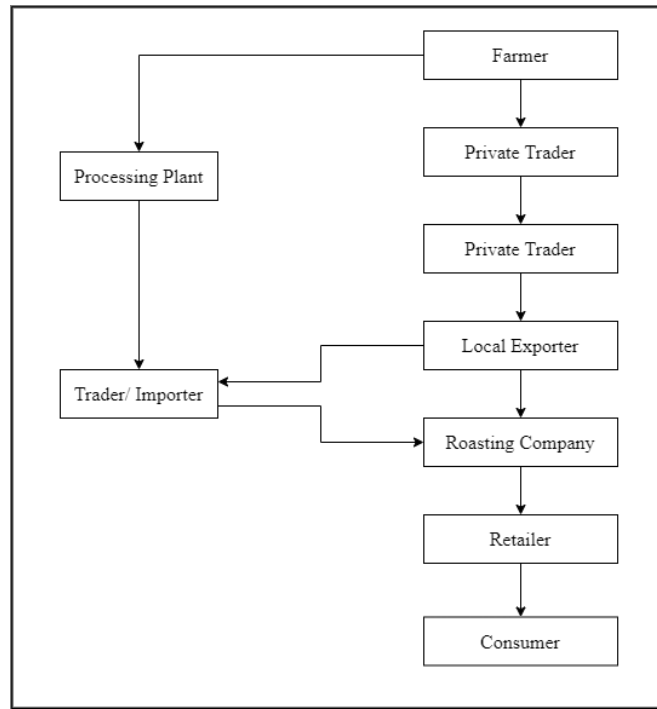


Figure 2: Current process and actors for Supply Chain

C. *Block chain Technology For Supply Chain:*

Supply chain success can help businesses lower costs and improve their efficiency. Organizations optimize the efficiency and effectiveness of its supply chain. Efficiency conducting best practices within available resources, effectiveness focuses on the outputs and how well meets the demands of stakeholders for their satisfaction. Block chain is a distributed ledger technology that records transactions in a series of distributed copies [7]. Its decentralized nature enables it to be more transparent and efficient.

The block chain is secure and tamperproof. Its network is linked to the previous ones in a secure manner. Additionally, points are updated regularly. A block chain can serve internal and external entities. It can be used in the CSC for various reasons such as self-executing contracts. It helps transactions recording and product progression from the manufacturing process to delivery. The details of a transaction such as the amount, date and time of a payment are not visible to the public since they preserve the integrity and confidentiality of the transaction. Each transaction has to be valid and agreed upon by all parties involved. This eliminates the possibility of fraudulent activities [8]. Block chain is also immune from tampering since transactions are verified and saved in the blocks. Block chain enables the transfer of payments globally, without the need for banks or intermediaries. It is also used to record and trace the origin of the coffee.

Several Block chain solutions have been used in industry for Supply chain such as:

**Bext360:** which uses a mix of mobile applications, Block chains, and robots for tracking the overall supply chain process from production to delivery for increased transparency, traceability and profitability [9].

**Crypto N’ Kafe (CNK):** a global decentralised block chain ecosystem that utilises smart contracts to improve the efficiency of the overall Supply chain [10].

**Starbuck:** a coffee industry leader is integrating Block chain in its CSC as a Pilot Program for traceability [11].

The author proposed the use of block chain technology in the coffee supply chain. Its decentralized nature and its ability to provide transparency and security make it an ideal solution for large-scale processing systems.

## II. METHODOLOGY

The study was conducted for a sample size of 66 respondents from the Burundi coffee industry. The target population was selected based on the company size, production area, and consumers. Out of 66 responses, only 49 individuals responded to the survey. This study revealed that the respondents were mainly composed of producers and traders.

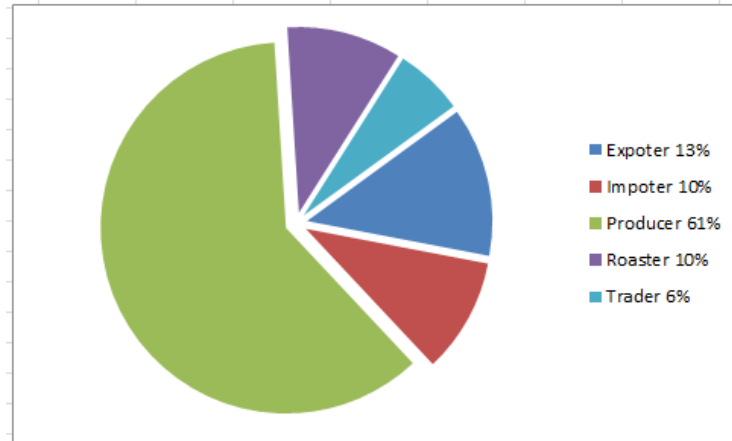


Figure 3: Respondents Types and Rates.

Roasters and traders regarded the coffee's sustainability as being 100% traceable, social, economic, and environment-friendly. Only the traders did not consider the premium price when it comes to choosing the coffee. 2.4% of the respondents wanted to know about the prices of coffee, its sustainability, and market access. The majority of them also stated that they lack knowledge about the traceability of their coffee. Based on the survey results, respondents expect to gain greater visibility and access to the market, as well as premium pricing for their coffee. They also aim to improve the transparency and efficiency of their supply chain.

There are three smart contracts that are written: Supplier Smart Contract, Buyer Smart Contract, and Logistic Smart Contract. These contracts are designed to increase the transparency among supply chain participants. However, it is causing to increase the transparency among involved supply chain members. In this scheme, the first data share the ledger of supply chain participants with the help of block chain. Secondly, smart contracts are written to serving as a state machine; they are also monitoring and update the status change of logistics details.

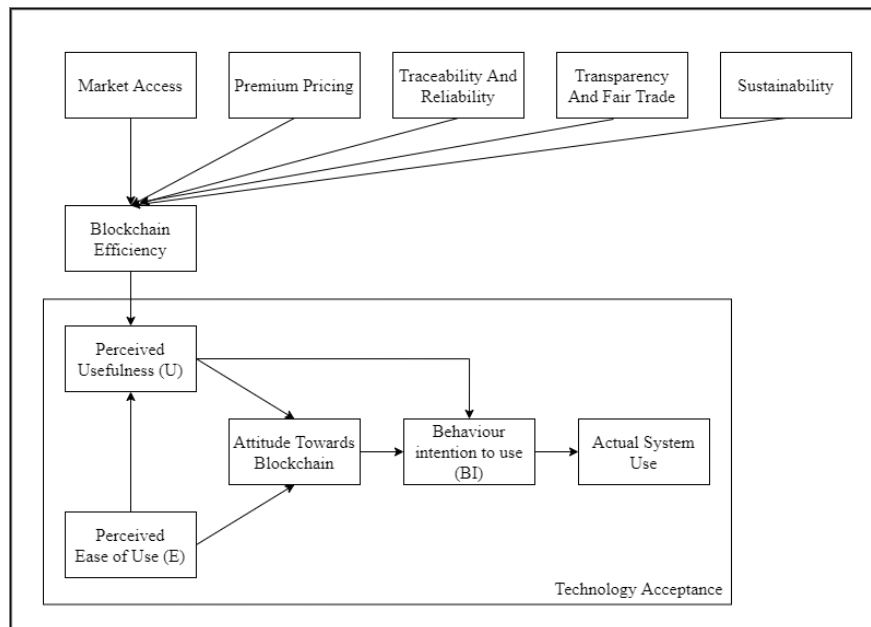


Figure 4: Block chain acceptance model derived

Smart contracts are the key components of block chain technology that enable businesses to implement new processes. They will help in reducing the complexity of the process and provide a level of transparency. They will also allow the users to manage the intermediation and provide a consistent view of the ledger. Smart contracts are designed to deliver events. They can also send and receive information about the event.

**Transaction process:** The order ID, time, and date of order are all recorded in the transaction process. After the shipment is initiated, it is followed by the logistic step which is responsible for the acceptance of the order. A payment contract is beneficial for payment executions. It establishes the payment terms and conditions.

**Data accessing process:** To increase the efficiency of block chain data, some optional data is provided on-chain. This path is provided to enable the users to easily access the external database.

### III. RESULT

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.

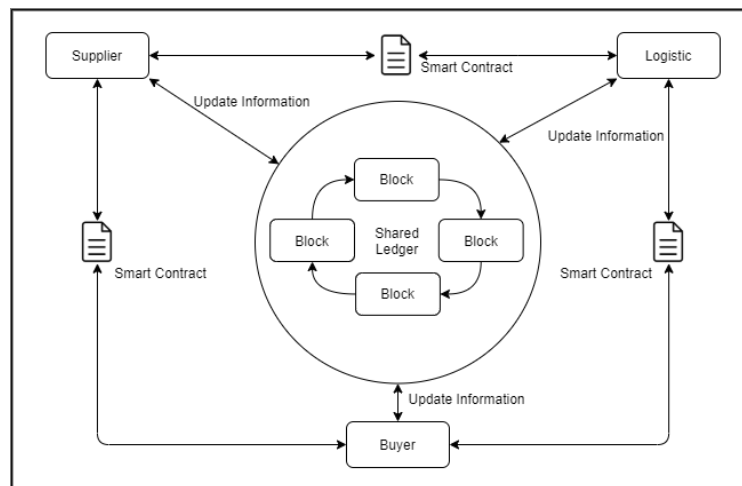


Figure 5: Blockchain-based the Conceptual Framework for Supply Chain

### IV. 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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