The Rise of Blockchain Technology in Sri Lankan Food Supply Chain

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***Abstract* — This study focus on rise of blockchain technology in Sri Lankan Food Supply Chain (FSC) to increase traceability of assets. Blockchain is an evolving digital technology that allows remote untrusted parties to have secure transactions. It has grooving attention with FSC industry. Today's FSC need for and innovative traceability approach that serves as an important quality control mechanism ensuring sufficient protection in it phases. We create a blockchain model in the FSC. It can be applied across any supply chain. The proposed model provides a decentralized solution and no need for a trusted centralized authority, improving high integrity, reliability and security efficiency and protection all over production and distribution processes. All transactions are registered and maintained in the unchangeable database of the blockchain with access to a shared file network. The acceptance of blockchain in the supply chain and logistics in Sri Lanka is slow right now because of potential issues and the lack of proven models. There are so many hurdles and difficulties that impede its broader success among FSC. Technical dimensions, curriculum, legislation and legislative mechanisms are included in these challenges.**

***Keywords* — Blockchain, Supply Chain, Logistic**

I. INTRODUCTION

Blockchain is cconsidered one of the most innovative innovations available. Blockchain first showed up in 2008 when published "Bitcoin: A Peer-to-Peer Electronic Cash System". The scheme suggested was based on cryptographic proof rather than dependency, allowing any two parties to perform transactions without the need of a trustworthy third party. The plan solved the issue of double spending. This is the first application of Blockchain, Created by Satoshi Nakamoto[2]. There are many critical features that Blockchain provides. Such as Decentralized, Traceability, Consensus mechanism, Immutability, Smart contract[5] . Blockchain application contain distributed architecture. That mean of distributed architecture is the program does not rely on any centralized authority but uses a peer-to-peer application server network operated by the owners of decentralized interests. Today Blockchain is applications further than finance, as in government, health, science, arts and culture[1].

Blockchain are already generating advantages on supply chains around the world. Real-time visibility can be considered an important benefit to supply chain management[4]. Furthermore, all transactions can be observable, and consequently. The data is organized into blocks which form a chain. All the transaction of Blockchain operate in a peer-to-peer network, in a decentralized way. Smart contracts inside distributed ledger are responsible for the validate and store transaction data, and it is not needed to have a central person that validates the transactions[3]. While the challenges involved in implementing a transparent supply chain are huge, the benefits of applying Blockchain to the food supply chain far outweigh the disadvantages (initial capital investment cost and maintenance). The advantages of an active Blockchain can be narrowly defined as a financial advantage, the benefits of the authorities and the benefits of the food companies. For simplicity's sake, however, the benefits can be classified as enhancing consumer loyalty, improving food crisis management, improving dairy supply chain management, expertise and technical innovation, and contributing to sustainable agriculture. There is an emerging rich network of devices and sensors that build an ecosystem rich in data for efficient monitoring and analysis of properties, which was unlikely in supply chains several years ago. This evolution has now allowed us to use this technology to create a Blockchain network that provides as mentioned in this research a lot of possible benefits.

II. OBJETIVES

According to this, emphasis on how Blockchain affects the food supply chain. To have this done, Possible applications and implementation of Blockchain are discussed in the supply chain to help businesses understand how to achieve their business goals. Furthermore, a logistics management program based on Blockchain is applied to evaluate the viability of applying Blockchain in the food supply chain. Accordingly, the major objective of this research is to fill current research gaps, new approaches to integrate Blockchain and IoT technology within food supply chain, and food quality management in the Sri Lankan food supply chain system.

- *Provide Trust for the entire supply chain network through Blockchain agreement(consensus)*
- *Improve the privacy of the supply chain system by facilitating access control over who will have access to the information in the block.*
- *Reduce costs by ignoring additional payment for third-party persons.*
- *Make consumers happier than traditional food supply chain system in terms of transparency of the product and price.*

Enterprise globalization expanded the difficulty of the supply chain processors. Now it is a main component to improve and integrate the information system. The difficulty of taking decisions needs real-time data sharing. When information moved in a linear form in conventional supply chains and inefficiencies in one stage influenced the following cascade stages, Digital supply networks are now capable of building interconnected networks capable of overcoming the action-reaction cycle with real-time data and facilitating cooperation. The figure 1 shows the move from the traditional supply chain to the digital supply network

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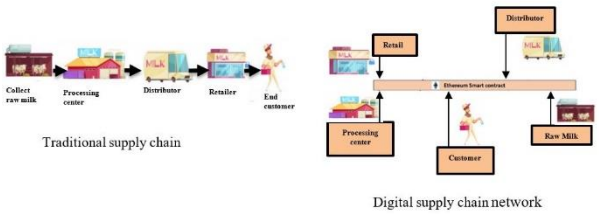

Fig 1:Traditional supply chain to the digital supply network

Table 1 shows the benefits would Blockchain brings to resolve the current problems in the supply chain

Table 4: Current problems and Blockchain impact in supply chain system

Supply chain actor	Current Problems	Blockchain impact
Famer/ Supplier	Capability to prove the origin and quality metrics of goods using a global and clear process.	Benefits from the improved trust by maintaining track by raw material production and supply chain from the raw material to the end customer.
Processor	Poor ability to track the goods produced to the final destination. Small ability to analyze measured content from raw material.	Value added from shared facts system with suppliers of raw materials and distribution networks.
Distributor	Customized monitoring devices with limited ability to work together. Limited certification skills and confidence issues.	Ability to have proof of position recorded in the database, and conditions certifications.
Wholesaler	Lack of confidence, and certification of the product path.	Capacity to test the origin of the products and the conditions for transformation or transportation.
Retailer	Lack of confidence, and certification of the product path.	Tracking any single commodity between the wholesaler and the final customer. Capacity to manage the returns of malfunctioning goods efficiently.
Consumer	Lack of trust about the product's compliance with the requirements and origin defined for the origin, quality and enforcement of the product.	Complete and clear view of the sources of the product and its entire journey from the raw material to the purchased finished product.

III. METHODOLOGY

This chapter lays forth the methods used to perform this analysis. Getting a good technique is essential for achieving a reliable outcome from the study. Figure 2 shows how propose model work in food supply chain. We apply it in diary supply chain as proof of the concept.

This architecture captures information regarding traceability using a range of IoT devices based on the type of event to be recorded. A transaction could be a movement of milk product, processing or store of milk, Distribute. Multiple data recorded from an IoT checkpoint is converted into a transaction and pushed to the etheteum network. All the transaction data check and validate within the smart contract and then publish to the public ledger. The contract layer monitors every transaction data, to execute the smart contracts when an initial event takes place and it ensures expected data about the raw milk or milk product from the supplier, manufacture and distributor in the supply chain according to terms of trade agreed upon connecting to the blockchain network. Each entity involved plays a role, relationship, and interactions with the smart contract. Propose model contain only five participating entities named milk supplier, milk processor, distributer, retailer, customer.

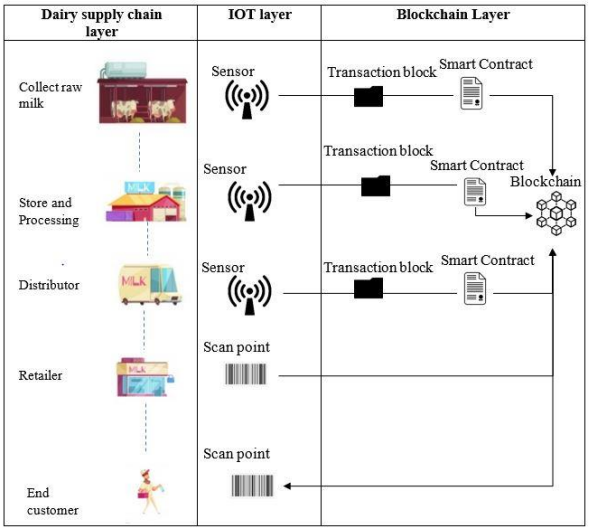

Fig 2:Supply chain solution with IOT model architecture

Figure 3 describe the transaction data processing flow of storing data in the blockchain. IoT devices generate data such as density, temperature, volume, etc. After digital signing and the hashing, such data will be sent directly or through the IoT gateways to the entire blockchain network nodes, Where they are verified, connected to the Transaction Pool and stored in blockchain.

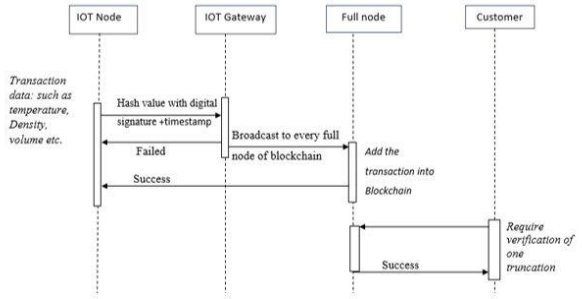

Fig 3: Transaction Data Processing Flow

Customers can access and validate all transaction data via their laptops or mobile phones. For example, one buys a package of milk from a supermarket and then he / she can use a mobile to check the 2-D barcode to gather all the transaction data relevant to it, including the farm from which the raw material was made, the day and time it was delivered, processing the manufacture, the collection of computer information, the packaging information. All of those information can be verified without human intervention by the blockchain system.

IV. RESULTS AND DISCUSSION

In this section, an evaluation will be made of the framework created and enforced. The experiments presented

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here will first assess if the smart contract model performs as it should when users engage with its techniques. The first checks to be conducted on the smart contract system are on the performance of its execution. The features I have mentioned in the last chapters should be done effectively. So I set out the strategies of the smart contract to assess if these systems were really functioning as they should. What these tests did was effectively make a registrar user allocate distinct positions to a variety of other user accounts for testing this method. Then these user accounts were used to evaluate the various different approaches that altered the condition of the deal. It was checked that the blockchain network would also refuse his transaction if the user calling those methods did not have the required function or authorization to do so.

Figure 4 Shows part of the code that user on part of this tests. Some of the input functions are skipped to make it easy to read.

```
// 1st Test
it("1. Testing smart contract function supplyItem() that allows a farmer to supply raw milk", async() => {

    var event = supplyChain.RawMilk()
    await event.watch((err, res) => {eventEmitted = true })
    await supplyChain.supplyItem(originFarmerID,originFarmInformation,productNotes,{ from: originFarmerID })

    assert.equal(resultBufferOne[3], originFarmerID, 'Error: Missing or Invalid originFarmerID')
    assert.equal(resultBufferOne[5], originFarmInformation, 'Error: Missing or Invalid originFarmInformation')
    assert.equal(resultBufferTwo[5], itemState, 'Error: Invalid item State')
    assert.equal(eventEmitted, true, 'Invalid event emitted')
})

// 2nd Test
it("2. Testing smart contract function processItem() that allows a manufacture to process milk", async() => {

    var event = supplyChain.Processed()
    await event.watch((err, res) => {eventEmitted = true itemState = 1 })
    await supplyChain.processItem(upc, { from: originFarmerID })

    assert.equal(resultBufferOne[2], originFarmerID, 'Error: Missing or Invalid ownerID')
    assert.equal(resultBufferOne[3], originFarmerID, 'Error: Missing or Invalid originFarmerID')
    assert.equal(resultBufferTwo[5], itemState, 'Error: Invalid item State')
    assert.equal(eventEmitted, true, 'Invalid event emitted')
})
```

Fig. 4.JavaScript code used for testing the methods and function

Tests on this front were satisfactory and shown that information was maintained as needed, with improvements in state / tracking and correctly managed clearance or quality management. Features for function base access control also worked correctly. An overview of the framework built and applied will be made in this portion. First, the experiments presented here will establish whether the reference implemented system performs as it should when users communicate with its processes.

For validate the proposed model, create simple web application, and provides ability to track the origin of the milk product. Here user can read details of each transaction. With the complete details, create RFID tag for each and product. Customers can access and validate all transaction data using that RFID tag.

V. CONCLUSION

The Blockchain based supply chain network focused in reference implementation. This research methodology was chosen in this research because Blockchain is still in its infancy. Companies must poses the knowledge and capability in Blockchain to adopt it. Moreover, It is important to realize that industrial solutions based on Blockchain should start with the willingness of the stakeholders to cooperate and to be involved. They need to reach a consensus on building knowledge and capabilities in Blockchain with a focus on providing value for all stakeholders. So, creating a culture of collaboration is critical.

According to the characteristics of Blockchain, stakeholders who use this Blockchain based supply chain system will advantage more when the number of joining users grows in this community. When more and more players in the supply chain participate, Blockchain becomes more relevant and credible and develops into market practice. This can be especially difficult as there are legacy processes, regulations and laws that regulate different facets of the company as stakeholders can incur costs as transitioning from legacy systems and combining with new systems and practices. In the future, due to the competitive nature of industry, many companies will be putting effort into the Blockchain based logistics network, not just in the private sector but also in public agencies. To ensure interoperability between different Blockchain based platforms, it is, therefore, necessary to establish standards and agreements.

Food provenance is one of the most challenging questions that companies in the FSC are trying to solve today and this research is a contribution to answering that question. The primary aim of this research is to establish a blockchain platform that can be applied within a Sri Lankan FSC and include its advantages and disadvantages in terms of food provenance and product traceability over conventional tracking systems It is clear from this research initiative that blockchains can be more effective in monitoring food provenance, avoiding significant degradation of food items, detecting and eliminating the source of foodborne disease in seconds, whereas contemporary systems may take as many weeks. It would also provide greater customer confidence that reflects the satisfaction of sales and customers.

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