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Tracing the original source of FMCG-SCM using Blockchain

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ABSTRACT

Fast Moving Consumer Goods come a long way from the production of their raw materials to finally being bought by the end user, that is. the customer. Their Supply Chain Management is a tedious task and doesn't really provide you with an auditable trail. The source and thus the quality of the product raises few questions. The paperwork involved in this leads to days of auditing for even a small discrepancy arising in the whole SCM. One of the obvious solutions to this is the digitalization of the whole process. But that still doesn't stop it from getting tampered. The truth still poses a question with the quality of the product being consumed by the end user. Adding another level of surety is only possible by ensuring that the data is not tampered with during the whole supply chain of the product. This is only possible by having a blockchain to moderate the whole process. This will not only make sure that the data regarding the product is true to its point but also make the auditing easy and fast in case of any discrepancy. Few western countries have already implemented blockchain for the products which require high quality throughout the supply chain. Since the type of supply chains vary and data privacy is required in some stages between different parties, private blockchains are preferred in such scenarios to create that balance between truth auditability and data privacy.

Keywords— *Blockchain, FMCG, Source truth auditability, Supply Chain Management*

1. INTRODUCTION

Supply chain management of a fast moving consumer good is a long chain of the product preparation starting from its raw materials to the final consumption by an end user that is the customer. It begins from the manufacturing of the raw materials, which then move towards the processing units, distributors and then finally sellers. The chain isn't really that simple as it seems to be. Majority of tasks are handled by paperwork in small to medium scaled supply chains. The large ones, though with the facility of digitalization for their internal workings, don't provide with the concrete source of truth to ensure the quality of the food being consumed by the customer. Having a quick look over the current supply chain and its working doesn't reveal much about their underperformance in real life. Though it seems a tedious work over a long chain, nothing much can be done over the operations and working involved in it. Though, the efficiency can be tuned by improving the time required to solve any discrepancy between the multiple parties involved in the whole chain by automating their asset transfer operations. But the actual benefit lies in the ability to trace to the original source and having the sense of reliability that the data isn't tampered with during the whole journey of product preparation. This will not only help the end user with a sense of satisfaction but will also force the intermediaries to focus on their quality control so that their contracts aren't affected.

The ability to have the above-mentioned functionalities without breaking the existing system is to have a continuous record of the transfer of assets taking place between the multiple parties along with the state of the raw materials and processed items. This is nothing but having a blockchain for the whole supply chain to make sure the data regarding the quality during the stages isn't tampered with. The smart contracts, that is. the contracts between the multiple parties get executed automatically on the transfer of assets, thus reducing the time it takes to do so via the traditional way. This blockchain ensures that there is proper accountability of the data being entered into it regarding the product at different stages.

But all this doesn't mean that the data can be made public regarding the whole chain. The contracts being executed are made after an agreement between the parties involved, that is. they have a proper channel of execution between them. Their data privacy is a point of concern for them and wouldn't want other parties to have a look into it. Therefore, to address this concern of the intermediaries, different types of blockchains are brought up called the private blockchains to address the enterprise level issues involved between parties with varied agreements and different level of privacies. These private blockchains, along with the advantages of public blockchains,

that is immutability and truth source, they provide execution channels between the parties so that their agreements, that is the contracts can be executed as and when the conditions are met. Private Blockchains have the ability to get moulded according to the enterprise level requirements as well as maintain the integrity required by the intermediaries without affecting the existing system in any manner. The customer can thus always verify whether the food being consumed by him/her has been fit for consumption during the whole chain or not.

2. RELATED WORK

Supply Chain Management has been well explored with the help of blockchain so as to improve upon the weak areas. This ranges from the simple proposals of having blockchain in a general supply chain to an actual use case with intermediaries involved with varied contractual agreements.

Si Chen, Rui Shi [3] and the fellow authors targeted the importance of quality management in the supply chain via blockchain. They aimed at solving the three major challenges identified by them, that is. the self-interests of the supply chain members, the information asymmetry in the production process and the cost of quality testing and technical limitations. This was done by proposing a Supply Chain Quality Management framework with 4 layers, namely, the IoT layer which senses the data, the Data layer which manages the data from different departments like logistics, transactions, etc., the Contract layer which deals with the privacy and agreement related operations between the parties and finally the Business layer which deals with the decisions on purchasing and manufacturing activities.

Adrian E. Coronado, Christian E. Coronado and Etienne S Coronado [4] targeted the use of blockchain in the supply chain of composite materials/carbon fibre, in particular, the manufacturing of structures and components relying on semi-finished materials such as prepregs which require temperature-controlled transportation and storage conditions. In composite materials distributed ledger/blockchain technology can be used for the purpose of tamper-proof history of product manufacturing, provenance, transportation, handling and storage. This was made possible with the help of IoT sensors and RFID tags to monitor the state of the materials during their transit, thus ensuring the quality during their final deployment.

Thomas Bocek, Bruno B. Rodrigues, Tim Strasser and Burkhard Stiller [5] proposed how blockchain can disrupt the supply chain in pharma. They focused on using IoT sensor devices leveraging blockchain technology to assert data immutability and public accessibility of temperature records while reducing the operational costs in the pharmaceutical supply chain. The medical industry has many complex and strict environmental control process to ensure quality control and regulatory compliance over the transport of medical products. The sensor devices monitor the temperature of each parcel during the shipment to fully ensure GDP (Good Distribution Practice) regulations.

Kamanashis Biswas, V. Muthukkumarasamy and Wee Lum Tan [6] focused on wine supply chain traceability system due to an increase in counterfeiting, adulteration and use of excessive preservatives and hazardous chemicals. The current systems are RFID and web-based and thus it is possible to counterfeit stored information as required and provides no integrity. Thus, they came up with a blockchain to incorporate the parties involved in the whole supply chain, namely, grape growers, wine producers, bulk distributors, transit cellar, filler/packer, finished goods distributors, wholesaler, retailer and other entities.

3. PRIVATE BLOCKCHAIN

Private Blockchain, as the name says, is a private type of blockchain with the functionalities being not as open and public as the regular blockchains. The regular blockchains, or to be precise, the public blockchains were built for a use case which required complete transparency. No permission is required to access and push transactions on to the blockchain. This complete transparency comes with the cost of making sure that no one can easily modify the data being held by the blockchain. That is where the term immutability comes from. Immutability doesn't mean the data can't be changed, but it means that even if someone tries to tamper with the existing data, it would take near to the infinite amount of time to synchronize it with the existing blocks being generated. This proves out to be near to impossible, thus, the word immutability.

Private Blockchains are more aligned towards permission access and are useful for the enterprise level use cases rather than public level. Since the nodes involved in a particular enterprise level use case would be way less than the public blockchains, they are somewhat faster in executing the transaction like operations on the blockchain. Private Blockchains give you the ability to have varied consensus algorithms which are less power hungry as compared to the public blockchains. This is useful since the nodes involved in the private blockchains are already verified and have permission access, thus removing the need to incorporate heavy consensus algorithms like PoW. Private Blockchains provide you with the ability to have channels between the verified nodes involved in the system. A channel allows the two parties to make sure that their transactions and related information remain between them. Giving them the much-needed privacy, but also the sense of surety that the data is not tampered with.

One such private blockchain that we are going to focus on in this paper is Hyper ledger Fabric. Hyper ledger was started by Linux Foundation and is supported by IBM, SAP and Intel. Hyper ledger Fabric is a permission blockchain infrastructure which provides a modular architecture with a proper definition of roles between the nodes in the infrastructure, execution of smart contracts, that is. chain code and configurable consensus and membership services. It comprises of "Peer Nodes" and "Orderer Nodes". The former executes the chain code, accesses ledger data, endorses transactions and interfaces with applications. The latter ensures the consistency of the blockchain and delivers the endorsed transactions to the peers of the network.

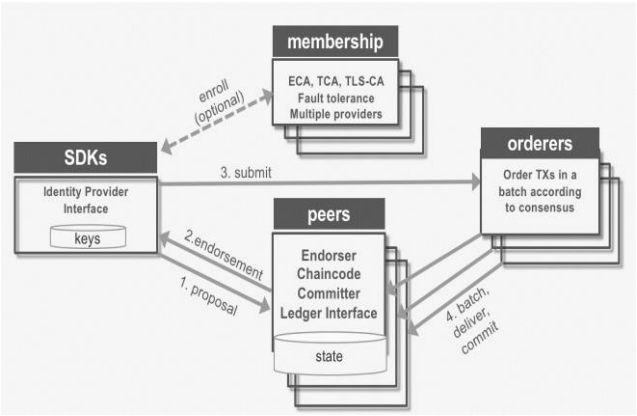

Fig. 1: Private Blockchain

4. PROBLEM DEFINITION

Problem definition is, "How can Blockchain technology influence the role of trust and solve the challenges in tracking and tracing fast moving consumer goods throughout its supply chain?"

5. SYSTEM DESIGN

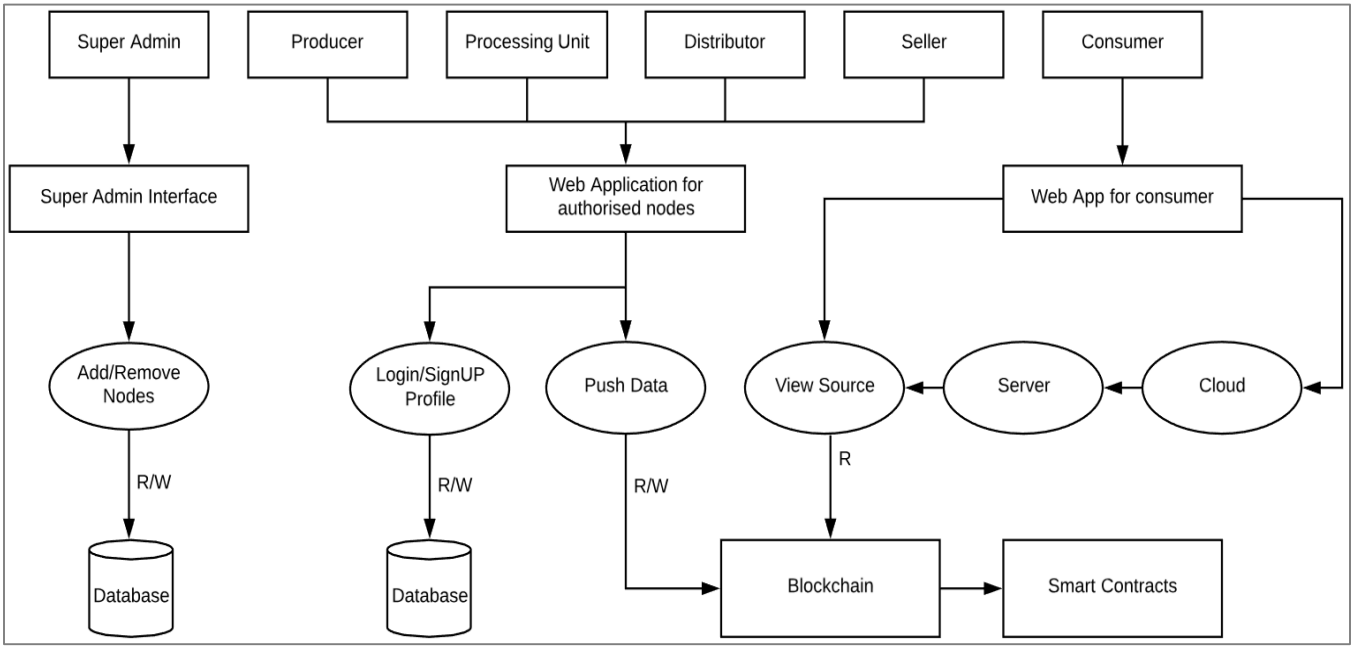

Fig. 2: System architecture

The unique constraints and requirements of modern tracking fast moving consumer goods system faces some major challenges to achieve a reliable, auditable and transparent supply chain management process. These challenges are faced just because of the diverseness of involved stakeholders, actors, and business models, the lack of interoperability among the involved systems, and their different level of confidentiality. Involved stakeholders are briefly introduced as the following:

5.1 Super admin

These stakeholders regulate the transactions happening on a private blockchain. These people need to expertise of being able to monitor the blockchain in case of any discrepancy. They are not allowed to push any data into the blockchain but are allowed to add/remove the nodes.

5.2 Producer

They are the producers of raw materials.

5.3 Processing unit

They perform operations ranging from extracting the required material from the raw material to complex operations involving the conversion of one material into another via various methods such as chemical reactions, synthesis, fermentation, heat, etc.

5.4 Distributor

They are responsible for distributing the output of the processing units (example, the products) from the processor's site to sellers. They have the privilege to push data into the blockchain whenever they receive the goods from the processing units and when they distribute it further.

5.5 Seller

They are responsible for selling the products directly to the consumer. They have the privilege to push data into the blockchain whenever they receive the goods from the distributors and when they sell it further.

5.6 Consumer

They are the final element of the chain who are going to be the buyers of product for the consumption. They only have the privilege to view the chain information of the product to be assured of the quality whether it's for consumption or not.

6. USER INTERFACE

The user interface, built using the React.js v16.5+ framework, will consist of services written for interacting with the server deployed on the main node.

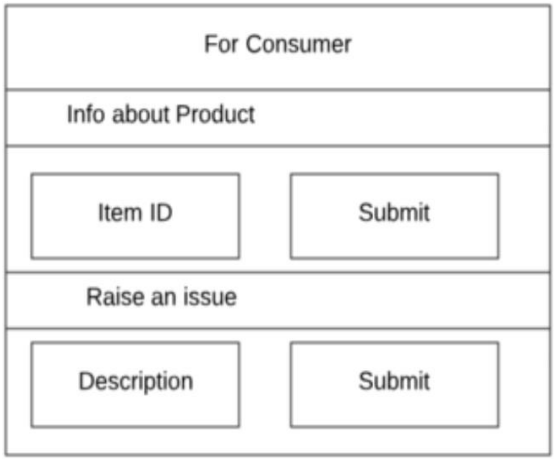

Fig. 3: Consumer user interface

Figure 3 shows a web app where the user has the option to enter item ID and click to submit button to see the product details and user have also option to raise an issue if he finds any discrepancy in the chain.

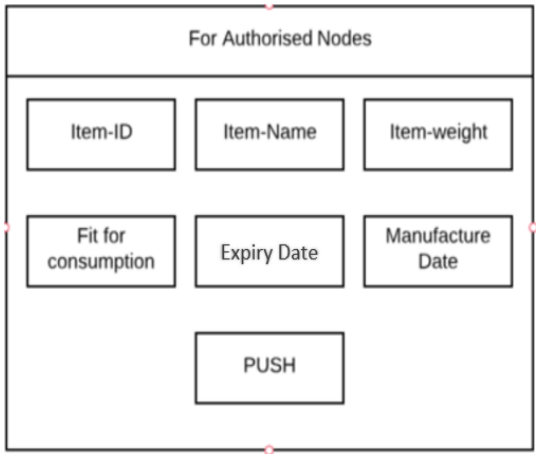

Fig. 4: Authorized nodes interface

Figure 4 shows a web app where the authorized nodes have the option to enter the data into the blockchainvia the input form.

7. CONCLUSION AND FUTURE SCOPE

Blockchain has introduced its potential to bring out positive changes in many industries and business till date including the supply chain industry. In fact, the supply chain management is one of the most obvious and useful applications of blockchain technology, therefore we can expect it to grow at a very fast rate in the near future. The source of the successful operation of a supply chain management is to keep a robust, transparent and end-to-end communication. Corporations are exploring ways to filter the way their supply chains currently work and adopt the change that the blockchain technology has to offer. Once business sees the bigger picture, they will eventually go through the hassle of applying newer systems embedded with blockchain in order to reap bigger benefits in the future. Dumping the paperwork and centralized databases will bring effective change in terms of higher rewards and increased performance among the supply chain teams.

This can be achieved if and only if the supply chain teams in place take notice of the latest technology trends in the blockchain space and find feasible ways to adopt the technology in their existing systems. The use of blockchain in supply chain management will work as a game changer by eliminating the vulnerabilities and inefficiencies of the current system.

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