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FOOD SUPPLYCHAIN TRACEABILITY BASED ON BLOCKCHAIN

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Abstract- According to the World Health Organization (WHO), one out of 10 people get sick from eating contaminated food. Complex food production process and globalization make food supply chain more delicate. Many technologies have been investigated in recent years to address food insecurity and achieve efficiency in dealing with food recalls. One of the most promising technologies is Block chain, which has already been used successfully in financial aspects, such as bitcoin, and it is attracting interests from food supply chain organizations. As block chain has characteristics, such as decentralization, security, immutability, smart contract, it is therefore expected to improve sustainable food supply chain management and food traceability. This paper applies a content-analysis based literature review in block chain adoption within food supply chain. It is very important to track and trace the detailed event information within the whole food supply chain including food production, processing, warehousing, transportation, and retail. Establishing an accurate and effective food safety traceability system has become a key solution to the food safety issues. The existing traceability systems adopts either of the two architecture: centralized architecture and Distributed architecture Centralized traceability system is managed and maintained by an authoritative third party. It may suffer through single node attack and has higher risk of data tampering and information disclosure. Distributed traceability such as the EPCIS-based distributed traceability system, can facilitate the creation and sharing of visibility Event data concerning physical or digit objects both within and across enterprises.

Keywords— Block chain, Food supply chain management, Food safety traceability system

1.0 Introduction

Block chain's capability of tracking ownership records and tamper-resistance can be used to solve urgent issues such as food fraud, safety recalls, supply chain inefficiency and food traceability in the current food system. In this article, we are going to take a closer look to address these concerns and how block chain could make a positive impact on the food ecosystem. Food traceability has been at the center of recent food safety discussions, particularly with new Block chain's capability of tracking ownership records and tamper- resistance can be used to solve urgent issues such as food fraud, safety recalls, supply chain inefficiency and food traceability in the current food system. We are going to take a closer look to address these concerns and how block chain could make a positive impact on the food ecosystem. Food traceability has been at the center of recent food safety discussions advancements in blockchain applications. Due to the nature of perishable food, the food industry at whole is extremely vulnerable to making mistakes that would ultimately affect human lives. When foodborne diseases threaten public health, the first step to root-cause analysis is to track down the source of contamination and there is no tolerance for uncertainty.

Consequently, traceability is critical for the food supply chain. The current communication framework within the food ecosystem makes traceability a time- consuming task since some involved parties are still tracking information on paper. The structure of blockchain ensures that each player along the food value chain would generate and securely share data points to create an accountable and traceable system. Vast data points with labels that clarify ownership.

The use cases of blockchain in food go beyond ensuring food safety. It also adds value to the current market by establishing a ledger in the network and balancing market pricing. The traditional price mechanism for buying and selling relies on judgments of the involved players, rather than the information provided by the entire value chain. Giving access to data would create a holistic picture of the supply and demand. On one hand, the disclosure of data would provide accountability for trading transactions and farming practices, which supports claims like organic, freshness, and superior quality. On the other hand, detailed information might get scrutinized and cause a backlash.

2.0 LITERATURE SURVEY

2.2.1 A two-echelon supply chain coordination for deteriorating item with a multi- variable continuous demand function,Xian-Hao Xu,Ming-Yuan Chen Qian Luo (August 29,2014).

This paper considers a two-echelon supply chain system consisting of one manufacturer and one retailer for deteriorating items. Shortages are not allowed and the market demand is simultaneously influenced by multiple factors including promotional effort, selling price, on-hand inventory level and time. Demand information is symmetrically known to both the manufacturer and the retailer, hence, the promotional effort is assumed to be provided by both members. For the system where the manufacturer and the retailer share the investment cost of promotional effort equally, it is shown that revenue sharing contract and revenue and cost sharing contract can both lead to perfect coordination. Comparing these two contracts, it is also found that the latter contract is easier to be accepted by the system. Hence, revenue and cost sharing contract is applied to coordinate the general system, and the range of revenue sharing fraction leading to a win-win outcome is obtained. Two numerical examples are presented to illustrate the development of the model. Shortages are not allowed and the market demand is simultaneously influenced by multiple factors including promotional effort, selling price, on-hand inventory level and time. Demand information is symmetrically known to both the manufacturer and the retailer,

2.2.2 Analysis of the access system of photovoltaic power station based on photovoltaic power/agricultural planting hybrid. Light Eng Xueru Bi Y, Wang C (2016)

This study conducts a feasibility analysis on the photovoltaic power generation project based on the agriculture-photovoltaic hybrid approach in Anlu City, Hubei Province. The article considers policy orientation, implementation model, technology, resource conditions, and economic benefits. This paper mainly reports the characteristics of the sites and the superiority of adopting the agriculture photovoltaic hybrid approach, equipment selection, as well as regional demand for electricity and solar energy resources, which are important factors that affect the implementation of the project. Finally, results of electric power balance in Anlu after the implementation of the project are discussed based on the actual conditions of the project.

2.2.3 Information technology and supply chain management coordination. Int J EServ Mob Appl (IJESMA) Carrus PP, Pinna R (2013)

The philosophy of supply chain management extends the concept of partnerships into a multifirm effort to manage the total flow of goods from the supplier to the ultimate customer to achieve greater benefits. A supply chain management involves three distinct interrelated flows: product/service, information and financial flow. Successful supply chain management requires planning, managing and controlling these three flows through the integration of key processes, from original suppliers through manufacturers, retailers to the end-users, which produce values to the ultimate consumers Encompassed within this definition, Mentzer et al. (2001) identifies three degrees of supply chain complexity: a “direct supply chain,” an “extended supply chain,” and an “ultimate supply chain.” A direct supply chain consists of a company, a supplier, and a customer involved in the upstream and/or downstream flows of products,

services, finances, and/or information. An extended supply chain includes suppliers of the immediate supplier and customers of the immediate customer, all involved in the upstream and/or downstream flows of products, services, finances, and/or information.

2.2.4 Coordination mechanism of SaaS service Supply chain: Based on compensation contracts Guo, YanliChen, JianbinGuo, HailingLu, XinmanYear of Publication: 2013

Compared with traditional manufacturing supply chain and general service supply chain, the new IT service supply chain which based on SaaS has characteristics of both service and IT. And SaaS is completely different from traditional software package model. Therefore the classic contracts, which be widely used in traditional manufacturing supply chain, can't be directly applied in SaaS service supply chain. The necessary way of IT services developing is to study the SaaS service supply chain combining with characteristics of SaaS. Therefore, It focuses on the coordination of SaaS service supply chain. Design/methodology/approach: It tries to answer the following question: how do the ISV motivate SaaS operators to improve the service level through effective contracts mechanism under conditions of asymmetric information. In order to answer these questions, this paper does some researches including: Under the conditions of information asymmetry, supposing the service level (is related to the degree of effort) of SaaS operator was private information, we construct model of compensation contract, i.e., to motivate SaaS operator to improve service level through transfer payments of compensation price. Findings and Originality/value

2.2.5 The joint bargaining coordination in a photovoltaic supply chain. J Renew Sustain Energy Chen Z, Su SII (2016)

The photovoltaic (PV) industry encounters a serious oversupply problem, which has caused a fierce competition among the crystalline silicon module suppliers to get the business from the PV system assemblers. This paper has developed a mechanism to coordinate a c-Si module supplier and a PV system assembler considering the government subsidy. A centralized, a decentralized, and a joint bargaining coordination decision models in a PV supply chain are formulated and analyzed. Using the world PV industry data, the numerical and sensitivity analyses are conducted to assess the impact of key parameters on the decision models. The research result has shown that a joint bargaining coordination mechanism is optimal for the studied PV supply chain. Both a PV system assembler and a c-Si module supplier gain more profit from the joint bargaining coordination model than that from either the centralized or the decentralized decision model.

2.2.6 Coordination of supply chains with a flexible ordering policy under yield and demand uncertainty. Hu F, Lim CC, Lu Z (2013)

This paper studies a flexible ordering policy among a manufacturer and a supplier with random yield and demand uncertainty, where the order quantity lies between the minimum and the maximum quantity. We first determine the optimal flexible ordering policy and the corresponding raw material production quantity that maximize expected profit of the centralized supply chain, and find that our flexible ordering policy can significantly enhance the supply chain's expected profit compared to an invariable ordering policy. Then we analyze the decentralized scenario and propose a revenue sharing policy with an order penalty and rebate (OPR) contract to fully coordinate the supply chain. Finally, numerical examples are given to illustrate the results.

2.2.7 Strategic interplay between store brand introduction and online direct channel introduction. Hai L, Kaijun L, Qiankai Q, Stuart XZ (2018)

This paper investigates the strategic interplay between a national brand manufacturer and a retailer in introducing an online direct channel and a store brand by constructing a game-theoretic model that incorporates the firms' channel and brand strategies. We show that at equilibrium, the store brand is introduced but the online direct channel may or may not be introduced. Interestingly, the firms may be trapped in a prisoner's dilemma when they choose to introduce the online direct channel and store brand. The online direct channel may be introduced if the store brand has been introduced; otherwise it may not be introduced.

2.2.8 Analysis of coordination mechanism of supply chain management information system from the perspective of block chain,Huigqun yuan,Houngbin,ya bi,Sheng- Hung Chang& Anthony Lam information technology e-business management (June 7,2019)

Block chain technology can save a lot of intermediary cost by means of decentralized distributed structure, and can solve the problem of data tracking and information security by means of unauthorized timestamp. The security trust mechanism can solve the core defects of the current Internet of Things technology. The flexible programmable characteristics can standardize the existing market order, help to enhance and create trust, and change the mode of cooperation and business cooperation between people. By setting up scenario application mode based on block chain, such as block chain credit financing, block chain procurement financing, etc., we can achieve the goal of shortening the time of supply chain management, improving the quality and meeting the demand. In this paper, the process of supply chain management information system and the key technology of block chain are analyzed, and the collaborative mechanism of supply chain management information system from the perspective of block chain is proposed, including the process and consensus collaborative management mechanism, which optimizes the transaction process supply chain management information system platform architecture under the collaborative mechanism is designed, which provides a reference path for the performance improvement and platform architecture design of data transaction system based on block chain.

3.0 EXISTING SYSTEM

This paper explores ways of improving transportation and supply chain management within the food processing industry (sugar industry). It involves the concept of lean tools, transportation model and supply chain management in the food processing industry. Consistent supply of quality raw material (sugar cane) for processing industry is missing with improper handling and transportation systems with chances in loss of productivity. In today's competitive market, it is extremely difficult to successfully produce high quality, low cost products without any other extra cost of suppliers.

i. DISADVANTAGES OF EXISTING SYSTEM

1. This paper only explains about the number of methods were involved in supply chain management SPM
2. There is no details about security enhancement

4.0 PROPOSED SYSTEM

As blockchain has characteristics, such as decentralization, security, immutability, smart contract. This paper applies a content-analysis based literature review in blockchain adoption within food supply chain in our proposed method we are going to apply Blockchain food supply chain. We have three individual

modules, ingredient modules, storage details of the product, and usage details (expiry date and manufacturing dates). We apply consensus algorithm to generate blocks for above details which makes our data more reliable and secure

i. ADVANTAGES

1. More flexible
2. More reliable
3. Decentralize the supply chain data

ii. APPLICATIONS

Currently the supply chain must allow multiple parties to update and share data, it must verify that such information can be trusted and it may have to interact with national and international verification systems, transport systems and regulatory bodies. The model overcomes the strong objective factors that in the traditional DEA model and not support fuzzy input and output. It is conducive to improve the efficiency of the developer, which is very important for decision of makers. Fuzzy logic is a technique suitable for dealing with uncertainty and subjectivity, which becomes an interesting auxiliary approach to manage performance of supply chains. A descriptive quantitative approach was adopted as research method, based on the prediction model. Statistical analysis of the prediction model results confirmed the relevance of the causal relationships embedded in the model. The findings reinforce the proposition that the adoption of a prediction model based on fuzzy logic and on metrics of the SCOR model seems to be a feasible technique to help managers in the decision making process of managing performance of supply chains. A descriptive quantitative approach was adopted as research method, based on the prediction model. The model overcomes the strong objective factors that in the traditional DEA model and not support fuzzy input and output.

5.0. SYSTEM ARCHITECTURE

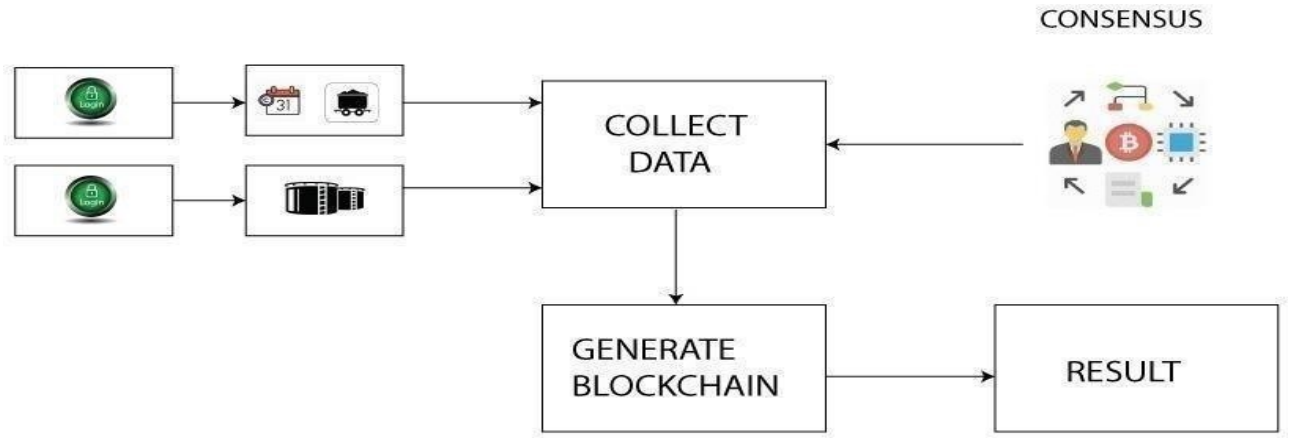

Figure 5.1: System Architecture

6.0 Working

We have three individual modules, ingredient modules, storage details of the product, and usage details (expiry date and manufacturing dates). We apply consensus algorithm to generate blocks for above details which makes our data more reliable and secure. A consensus algorithm is a procedure through which all the peers of the Block chain network reach a common agreement about the present state of the distributed

ledger. In this way, consensus algorithms achieve reliability in the Block chain network and establish trust between unknown peers in a distributed computing environment. Essentially, the consensus protocol makes sure that every new block that is added to the Block chain is the one and only version of the truth that is agreed upon by all the nodes in the Block chain. The purpose of a consensus mechanism is to bring all the nodes in agreement, that is, trust one another, in an environment where the nodes don't trust each other. Bitcoin's Proof-of-Work system: Bitcoin uses the Hash cash Proof of Work system as the mining basis. The 'hard mathematical problem' can be written in an abstract way like below :Given data A, find a number x such as that the hash of x appended to A results is a number less than A miner continues testing different unique values (known as nonce(s)) until a suitable one is produced. The miner who manages to solve the problem gets the bitcoin reward and adds the block into the block chain by broadcasting that the block has been mined.

7.0 Results

Figure 7.1: Options of the Mobile Application

Figure:7.2 Output of the product

Block chain's capability of tracking ownership records and tamper-resistance can be used to solve urgent issues such as food fraud, safety recalls, supply chain inefficiency and food traceability in the current food system. In this article, we are going to take a closer look to address these concerns and how block chain could make a positive impact on the food ecosystem.

Figure.7.3 Result of the product Match

The customers can the scan the detail of the product which they are buying after scanning the barcode it shows the result of the history of the product like ingredients used, price of the product and the manufacture number that matches the original data of the product.

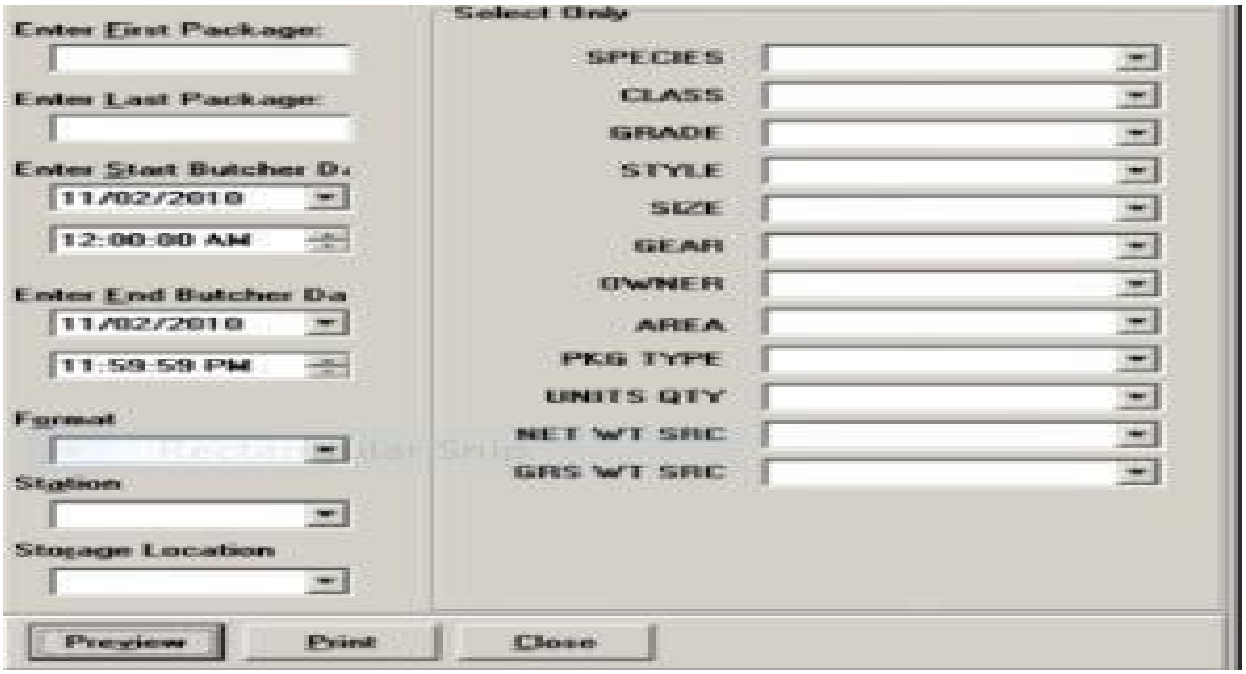

Figure 7.4: Input storage location of product

The Block chain consists of individual behavior specifications, a large set of rules that are programmed into it. Those specifications are called protocols. The implementation of specific protocols essentially made Block chain what it is a distributed, peer-to-peer and secured information database. The Block chain protocols ensure that the network runs the way it was intended to by its creators, even though it's completely autonomous and isn't controller.

8.0 CONCLUSION

Block chain is still within an innovative phase, being tested and developed in pilot programs. However, with success being seen across other industries and regulations requiring greater connectivity and oversight for the food supply, it may not be long until Block chain becomes a fundamental part of the supply chain

9.0 FUTURE WORK

In the coming future, we review the application of the block chain. It also enhances the professional's capability to upgrade themselves. With the help of Block chain technology, it is possible to transform the whole world into a much smaller place. The transactional activities can be performed much faster and efficiently using Block chain. Block chain technology is going to be used in many more sectors in the future such as in government systems as these systems are slow, dense, and likely to corruption.

A consensus algorithm is a procedure through which all the peers of the Block chain network reach a common agreement about the present state of the distributed ledger. In this way, consensus algorithms achieve reliability in the Block chain network and establish trust between unknown peers in a distributed computing.

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