Strengthening E-commerce Site in Supply Chain with Blockchain

İrem Ünsal[1] and Murat Çelik[2]

[1]b21946677o@cs.hacettepe.edu.tr, Department of Computer Science, University Hacettepe
[2]b21827263@cs.hacettepe.edu.tr, Department of Computer Science, University Hacettepe

Abstract

Supply Chain is the integrated management of material, data and cash flow that ensures that the proper product reaches the customer at the right time and at the cheapest price possible for the entire supply chain. And also sharing knowledge between manufacturers, suppliers and customers become vital in it. But sometimes individuals in the supply chain do not share this information correctly or do not want to share it. This paper proposes a blockchain based solution to information problems on supply chain management. It is thought that this solution will contribute to both the academic literature and related institutions and organizations.

Keywords— supply chain management, blockchain, logistics, e-commerce, smart contracts

1 Introduction

First of all, it is thought that the blockchain technology, which has found an application area in the field of finance, will lead to important solutions in many areas. There is no need for a third party in transactions made with this technology. As each transaction takes place, it is processed into the encrypted block by the supply chain member performing that transaction. Each block is linked to previous and next blocks and cannot be changed or deleted by a single chain member. With the blockchain, which is an autonomous technology, transactions can be carried out automatically by depending on conditions.

With the application of blockchain technology in the supply chain, every stage of a product, from manufacturing to sales, can be documented by creating a permanent product history. An autonomous structure is given to the supply chain and human errors are minimized. Thus, it is thought that a reliable, sustainable and less costly structure can be brought to the supply chain with blockchain technology.

Due to the developing and globalizing economy, manufacturers and sellers need to compete more with each other today. In addition, the number of members in the supply chain is increasing day by day, so the supply chain has become more complex day by day. The methods in the supply chain have started to be insufficient and cause problems in the face of the development in the world. Problems such as low communication, insufficient information and insecurity among supply chain members are among the main problems of the current supply chain. Thus each company with inside the supply chain units sets strategic and operational desires to maximize its very own income with the aid of using the usage of local information.

Due to this reasons information in supply chains is one of the most valuable resources to use for potential improvements at the supply chain operational strategies such as cost-saving. But it is important to focus most useful data by weeding out unnecessary data. Also to implement such strategies it is needed openness of specific information related to product orders and physical shipments, including transport and logistics activities. The openness of information makes reducing costs and improving operational performance by analyzing this information.

Based on this information, blockchain technology will play a very important role in solving problems in the supply chain area and in its efficiency. Based on this information, blockchain technology will play a very important role in solving problems in the supply chain area and in its efficiency. Based on this thesis, we created a model that can be used in an e-commerce company.

BBM443 Fall 2021 Group Project, Hacettepe University, Ankara, TURKEY.

2 Related Work

Accelerating with the article of Satoshi Nakamoto (1), blockchain technology also entered the supply chain field. Academic studies on this subject are new but continue to be carried out rapidly.

Prior researchers propose a blockchain based solution to address the problems of supply chain such as Double Marginalization and Information Asymmetry (2).

In Kshetri's article (3), he states that blockchain will grow rapidly in the fields of supply chain, energy, health and agri-food. It examines features such as cost, speed, dependability, risk reduction, sustainability and flexibility on the supply chain with 11 different scenarios. It states the advantages as well as the disadvantages.

5 researchers in their work have argued that the use of Blockchain technology in multiple industrial applications such as healthcare, finance, government and manufacturing industry is very important. And they proposed a healthcare industry application, Healthchain, developed on the foundation of Blockchain using IBM Blockchain initiative. (4).

In addition, prior researchers consider the convergence of supply chains and sustainability. While doing this, they argue the importance of focusing on environmental management and moving operations from local optimization of environmental factors (5).

Topçu and Iraq, who examined the articles on the application of blockchain technology in the supply chain, shared the cost analysis of this technology. They state that operational costs have decreased by 73% and risks by 57%. They say it increases revenue opportunities by 51% and reduces capital costs by 46%. It is said that the initial cost is high, but the subsequent expenses are falling rapidly (6).

3 Analysis (Current Limitations/Problems)

There are many benefits of using blockchain technology to improve supply chain technology and make it more effective, as well as many difficulties that may arise during this implementation. We can list a few of them as follows:

- Organizations that want to make a successful implementation in this field must become familiar with this field. Because working with blockchain requires a lot of experience and knowledge to be successful. Also Percy Venegas thinks that it is necessary to consider all financial risks of handling a large portfolio of suppliers and increase legal department expertise (Venegas, 2016, 42). According to his opinions, a company should know more about blockchain literacy before going into the network.
- Organizations need skilled and prepared employees. Hiring these talented and experienced employees on the blockchain network will also be costly. Also they need collaboration of all participants in chain. But some of the participants may not want to share their informations. Pat Bakey thinks that blockchain implementation can have many benefits, but it cannot fix problematic relationships between participants in supply chain. End-to-end processes are too complicated to be solved by technology. (Earls, 2016).
- To provide security every participant must be able to access all the transactions data but this requires a lot of technical knowledge and needs. Therefore, it is inevitable that these facilities will be expensive to provide.
- Since existing systems are built on private networks this will reduce security in a large supply chain network. Because in a system created in private networks, it is easier to reach an agreement to change a block. This should be fixed in future systems and some data should be protected in additional systems that are not accessible to everyone but most of them should be open to public.
- Existing blockchain systems are on private networks to provide security, which limits their interaction with other technologies. In future systems, this problem should be eliminated and blockchain should be made more interactive.
- This system needs to be implemented by many participants in order to fully see the effect of the use of blockchain in the supply chain and to define its benefits and shortcomings. That's why there is a need for dedicated participants in this field, but it will be difficult to find dedicated participants in this new field as there are already well-established systems in the current order.
- Theoretically, it seems that blockchain technology will have many contributions to the field of supply chain, but it will not be as easy as it is thought to change the already existing supply chains and add a new technology to them. Many integration problems will arise and complicate the process.
- Blockchain solutions process transactions more slowly than traditional systems because the transactions must be validated on many different computers or servers. This can reduce efficiency in terms of speed in the supply chain.

- Due to the logic of the blockchain, it does not check the accuracy of the information entered into the system, instead it allows the users in the system to confirm that the information entered has not changed since a certain time. Therefore, incorrect entry of data into the system due to human error and deliberate abuse can create a problem. New approaches should be implemented to prevent this in future systems.

4 Proposed Model

With the necessities of the age, new developing technologies and innovative thinking, the need to raise the current systems to a level arose. Now is the time to develop new approaches to the supply chain system today.

Our aim is to support the e-commerce-site project with blockchain. Our aim is to prepare a distributed system where each development can be seen by everyone. In this system, our main goal will be to protect the privacy of the consumer and to ensure security at every stage of the system. We plan to achieve this goal with the timestamp and immutability in the system.

We will include everything from the producer to the consumer, from the logistics map to the product. The basic features of each account and each product will be defined in the system. Technologies such as RFID, GPS and IOT will be supported to ensure product traceability. Location, temperature, history information of all products will be visible to everyone on the system.

We want our system to work lively and efficiently. We will use smart contracts that serve this purpose at every point of our model. We have divided our smart contracts into 4 groups as audit, recycling, efficiency and production. We embrace principles such as more integrated work, customer trust, control mechanism, and environmental awareness.

Audit

- We have defined some smart contracts in order to ensure mutual trust, to have data in case of problems that may arise, to prevent unfair profits and to protect workers' rights.
- We have defined color codes for our account records. Red is blocked account, yellow is suspended account, green is trusted account, blue is unverified account. We will use these color codes to create a dynamic between the seller and the consumer. We plan to announce developments transparently across the entire chain by changing the color codes of accounts in any judicial situation.
- Voting systems will be set up in many parts of the system. These systems will allow the system to be controlled by accounts on the network. In particular, there will be voting that can include these color codes. The consumer will be able to vote for the seller, and this vote will aim to follow a customer-friendly approach of the seller. The seller who can switch to different color codes according to the results of the voting. For a fairer voting, information such as the seller's protection of employee rights and the reliability of the products will be presented to the voters.
- By placing votes in the system for cargo companies and cargo employees, the consumer will conduct the inspection in the system. This will show that the system belongs to those who are included in the system.
- In the system, the wages of the employees will be paid automatically when the time comes, and it will be tried to prevent situations such as delaying the wages of the company.
- Each product label will have its own unique code. With these inspections, the consumer will observe whether the product is fake or not. The consumer who wants the system to be audited will actually be the controller of the system.

Recyling

- We want to increase efficiency within the system and protect nature. We want to make the information of the products accessible in the system and show them to the consumer. It is aimed for the products to be nature-friendly, not to go to waste, not to spoil, and to re-evaluate the damaged products within the system.
- Thanks to the IOT technology, the storage conditions of the products will be added to the system instantly. (Temperature, Humidity) For products that do not comply with the standards, the system will automatically make decisions that will prevent the consumer from buying it.
- The seller will evaluate the products that he cannot put up for sale in terms of recycling with a separate system. For this reason, it will win additional rewards.

Efficiency

- Contracts whose main purpose is efficiency will be integrated. Production decisions will be made by both government and consumer decisions. Work will be done on macro and micro data.

- In addition, awards will be distributed for the development of the system. These awards can be given for each recommendation made by people who do not work for companies. These suggestions can be logistics planning, product packaging systems.

Production

- Strategy decisions on production and planning can be made more dynamically and quickly with system traceability. While making these decisions, reward and punishment systems are important to keep the system alive and secure.
- A reward will be given to the producer for each product that reaches the consumer.
- Additional discounts will be provided for consumers who prefer returned and replaced products.
- Different strategies will be followed for products that are close to their expiration date.
- Penalty for each product that does not reach the consumer.
- Reward for each product that reached the user a few days ago.

Various smart contracts make the system controllable by system individuals, giving them system ownership. The aim of the model is to establish a self-operating structure. It makes trust essential and prevents a few people from managing the system.

5 Discussion and Conclusions

Blockchain technology is rapidly entering our lives.In these circumstances, integrating blockchain technology into an e-commerce system is important to aim for the future.

We analyzed the benefits of blockchain, possible problems and possible solutions. We created a model. We know that this technology will create a more ethical, productive, environmentally-friendly, reliable, and cost-effective system. However, at this point, problems such as the transparency of the companies that will be included in the system, the compatibility of real-life data with the in-system data, and international law rules are still human problems.

We observe that blockchain technology is developing rapidly and will be a definite part of our lives in the future. We think that the use of this technology and what it will bring are important study subjects in this field.

References

[1] Bitcoin: A Peer-to-Peer Electronic Cash System; Satoshi Nakamoto; 2008; bitcoin.org

[2] Information Sharing for Supply Chain Management Based on Block Chain Technology; Nakasumi, Mitsuaki;2017; 2017 IEEE 19th Conference on Business Informatics (CBI)

[3] Blockchain's roles in meeting key supply chain management objectives; Nir Kshetri; 2018 ; International Journal of Information Management

[4] Blockchain technology innovations; Ahram, Tareq and Sargolzaei, Arman and Sargolzaei, Saman and Daniels, Jeff and Amaba, Ben;2017; 2017 IEEE Technology Engineering Management Conference (TEMSCON)

[5] Sustainable supply chains: An introduction; Jonathan D. Linton and Robert Klassen and Vaidyanathan Jayaraman; 2007; Journal of Operations Management

[6] Tedarik Zincirinde Blokzinciri Teknolojisinin Uygulanmasının Maliyetler Üzerindeki Etkisi; İRAK,Gülay and TOPCU,Yunus Emre ; 2020; Int. Journal of Management Economics and Business

[7] How blockchain improves the supply chain: case study alimentary supply chain; Casado-Varaa, Prietoa, Prietaa, Corchadoa; 2018; International Workshop on IoT Approaches: for Distributed Computing, Communications and New Applications (IoTAs 2018)

[8] How Bitcoin's Technoogy Could Make Supply Chains More Transparent; Williams, R. ; 2015; Available at: http://www.coindesk.com/how-bitcoins-technology-could-make- supply-chains-more-transparent/

[9] Building a Transparent Supply Chain; Vishal Gaur, Abhinav Gaiha; 2020; Available at: http://hbr.org/2020/05/building-a-transparent-supply-chain

[10] An agency theory perspective on supply chain quality management; Xingxing Zu, Hale Kaynak; 2012; International Journal of Operations and Production Management

[11] Endüstri 4.0 İle Bütünleştirilmiş Dijital Tedarik Zinciri; Yıldız Aytaç; 2018; An International Journal of Business and Management Studies