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The use of blockchain to support sustainable supply chain strategy

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Abstract. This paper aims to identify, and analyze how the use of blockchains technology can support sustainable supply chain management strategies. This support is seen from environmental, economic, and social aspects. In addition, it explains the various advantages of using Blockchain technology to reduce the use of transportation and other resources that have the potential to damage the environment. From an economic aspect, this technology has the potential to increase the efficiency of cost and time. Blockchain technology also has the potential to provide social benefits for the companies involved because of the increasingly good reputation of the organization. Three examples of implementation of the blockchain in three different industries are also provided in this paper. This paper also points out the potential disadvantages of using this technology for supply chains that can threaten supply chain sustainability.

1. Introduction

In the 21st century, awareness of environmental care in organizations is a trend. Environmental awareness of organizations grows towards sustainability which is not only related to care for the environment but also economic and social sectors. The concept of sustainability has been introduced to many fields as a strategy to improve the operations of the organization. This strategy has also been implemented in the supply chain to support efforts to improve organizational performance in the supply chain. This strategy is called Sustainable Supply Chain Management (SSCM).

The process to achieve sustainability in the supply chain often does not run smoothly due to various factors including inaccurate data or lack of smooth flow of information between members in the supply chain, data asynchronous, and inefficiency in fulfilling supply and demand. These constraints occur mainly because the availability of data on each supply chain member is centralized and often kept secret for the benefit of the member concerned so that it often cannot be anticipated by other members. Related to this situation, another approach is needed to reduce the constraints in SSCM. The approach that has been tested in several industries is the use of blockchain technology.

Blockchain is a new technology for storing and moving data. All data are held in one place. The data is then atomized and spread over thousands of points throughout the network [1]. Distribution of data on the blockchain is based on the principle of decentralization, so intermediaries between members in the supply chain can be eliminated. Thus, the need for banks or other financial intermediaries can be eliminated. Transactions can be directly carried out between buyers and sellers. Payments can be done quickly and smart contracts are executed after all the underlying conditions or obligations are fulfilled [2].



2. Literature Review

This blockchain technology is believed to be able to overcome the lack of smooth flow of data and inefficiency in a sustainable supply chain.

2.1. Supply Chain Management and Sustainable Supply Chain Management

The term Supply Chain Management (SCM), according to the Council of Supply Chain Management (CCSCM), refers to the planning and management of all activities involved in procurement, conversion, and all logistics management activities. Importantly, this also includes coordination and collaboration with member's partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and throughout the company. SCM's main objective is to meet consumer demand with more efficient use of resources including labor, inventory, stock and distribution capacity. In this context, SCM aims to integrate key business functions and business processes within and throughout the company into cohesive and high-performance business models that can quickly react to dynamic market demand and rapidly changing features.

In each supply chain many members are involved in performing different tasks. As a result, the whole process becomes broad, long, slow, and inefficient. In this long process, the supply chain does not have an audit or centralized mechanism to ensure that contracts between supply chain actors are enforced according to the rules. Consumers do not have a way to know whether goods such as shoes that they have bought are fake, the drugs he bought were original, or whether the food he consumed was contaminated with bacteria or not. In this case, conventional supply chains have serious transparency and traceability issues.

Sustainability is known as an integral component of supply chain management, but no single definition of Sustainable Supply Chain (SSC) is universally accepted [3]. On the other hand, SSC is often explained as a green supply chain or triple bottom line supply chain. SSC is a growing movement to show the concern of SC members for the environment without forgetting economic or social factors as covered in the triple bottom line. SSC also define as a strategic step, with transparent integration, to achieve organizational, social, environmental, and economic goals in systemic coordination of business processes among key organizations to improve the long-term economic performance of each company and its supply chain [4].

Furthermore, the SSC is defined as "the management of material, information, and capital flows as well as cooperation between companies throughout the supply chain while taking the objectives of the three dimensions of sustainable development, namely, economic, environmental, and social, into accounts originating from needs of customers and stakeholders [5]. In a sustainable supply chain, environmental and social criteria must be met by members to remain in the supply chain, while it is expected that competitiveness will be maintained by meeting customer needs and related economic criteria.

In all the SSC definitions discussed above, it can be seen that the integration and objectives expected by SSCM are always emphasized so that the achievement of SSC objectives must be carried out with a strategy that integrates and considers the internal and external conditions of the organizations involved in SSC.

2.2. Blockchain and Cryptocurrency

Blockchain is a digital information recording method that can record data using the logbook approach and with certain characteristics. Operationally, Blockchain is known as a large decentralized and distributed ledger that keeps records of digital transactions in such a way that makes them accessible and visible to many members in a gated network [6].

Blockchain consists of cryptographically connected data blockchains. Blocks are chained in sequence using cryptographic hashes. A hash is a fixed-length number that originates from the message or document provided. Cryptography is the study of mathematical techniques related to

aspects of information security, such as data confidentiality, data validity, data integrity, and data authentication. Cryptocurrency is a digital currency created using the concept of cryptography. Cryptography was developed for online information and financial exchange activities. Thus, cryptocurrency becomes a currency that cannot be falsified because the security code is quite sophisticated. One type of cryptocurrency that is most widely known and in demand right now is Bitcoin. This currency was developed by Satoshi Nakamoto [7].

3. How does Blockchain technology support SSCM strategy?

To answer the question above, let's take a case example. If we buy drugs at the pharmacy, then, of course, we want to get a guarantee from the pharmacist, that the drug is safe, has not expired, is accurate, and is genuine. But the problem is that pharmacists cannot convince us that the drug is exactly what we expect it to be, so to ensure that there is a need for technology that can help us. Suppose we tag the microchip as an internet implementation for a drug package. Then, we trace the journey of the drug through each stage of the supply chain sequence.

The process to track the origin of raw materials, production locations, product carriers, storage and retailers to buy products can be done easily using the Internet of things (IoT) combined with blockchain technology. The buyer only needs to scan the package using his cellphone to retrace the supply chain route that the product goes through before it reaches us. The conditions described above indicate that consumers can now reject a product if the source or ingredients are suspicious or if the trip from the supplier to the retail store changes the quality of the product.

We know that the conventional supply chain management system is a centralized SCM system. This system cannot present data in real-time. The data sent will take time to process and present it, so the use of blockchain technology allows all members in any SC to access the network safely and quickly. Because blockchain is a decentralized database, no one controls or owns it and after the data is uploaded to the blockchain, the data cannot be changed so that the data cannot be corrupted or faked. Blockchain technology provides an opportunity to improve supply chain operations in a transformable manner.

The great potential of blockchain technology has moved various industries to conduct trials and even implement this technology in their companies. But a common question that often arises for researchers is how is blockchain step used in SSCM?

Blockchain is a simple, clever and quick way to convey transaction information between two parties automatically. If one party buys books from one supplier, then the supplier starts the process by making a book block and this block is verified by a group of computers connected to the Internet. Next the verified book block is added to the chain, which is distributed in a special book network (blockchain). On the verified block, a unique note will be written in the form of a secret code (cryptography) and can only be opened by buyers who pay using cryptocurrency (for example bitcoin), see figure 1 for the steps.

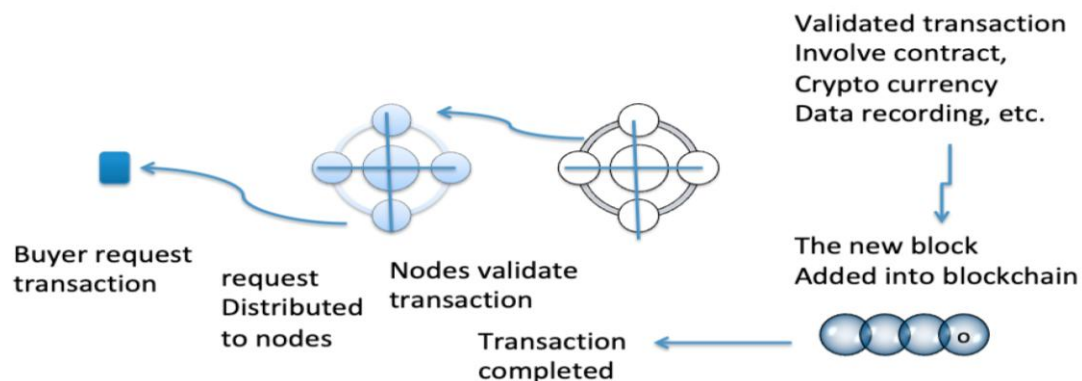


Figure 1. Blockchain steps in a supplier-buyer transaction (adapted from World Economic Forum)

From various literatures, it is found that several large international organizations have tested and implemented it for various purposes. Blockchain has been applied for tracking and tracing the origin of the product as was done in the Abu Dhabi National Oil Company (ADNOC) in collaboration with IBM. The idea was to track oil delivery from well to customers, while simultaneously automating transactions along the way. ADNOC, which produces oil about 3 million barrels per day, will benefit from tracking all the oil produced and reducing the time and costs associated with shipping if blockchain technology is fully implemented [8].

A research conducted by Walmart in collaboration with JD.com, IBM, and Tsinghua University found *Escherichia coli* bacteria that contaminate the food sold. It took a long time to find where the food was contaminated so the research was trying to increase food transparency and shipment efficiency with blockchain technology. The efforts were divided into two sections: Walmart and JD.com handled production and shipment of produce, while IBM and Tsinghua University handled the research and maintaining the blockchain. This project was completed in 2017 and Walmart announced that it would require suppliers of its domain and other leafy greens to upload their data to the blockchain by September 2019 [9].

As food safety is the main concern of every individual, and then the blockchain technology is expected to be used by every supply chain food corporation that guarantees the delivery of quality products to the public. Guaranteeing healthy and safe food and high quality directly or indirectly enhances the company's reputation in the eyes of consumers. Unilever, Kroger, Nestle, and Tyson Foods all plan to collaborate as the project advances, with more food corporations to join along the way. Furthermore, a software company Provenance is collaborating with designer Martine Jarlgaard to support the efforts of more transparency in the fashion industry [10]. Their first-ever garment tracked with blockchain was presented at the Danish Fashion Show in 2017. The goal is to track every aspect of a garment's life through all the development phases. With more transparency, consumers will always know the clothing they purchase is legitimate and that it is produced in factories providing acceptable working conditions. This example shows that blockchain applications directly support sustainability of supply chain management in terms of social aspects.

In order to understand how blockchain technology is used in the supply chain, please see figure 2, which is the adoption of the Applicature consultant below (applicature.com).

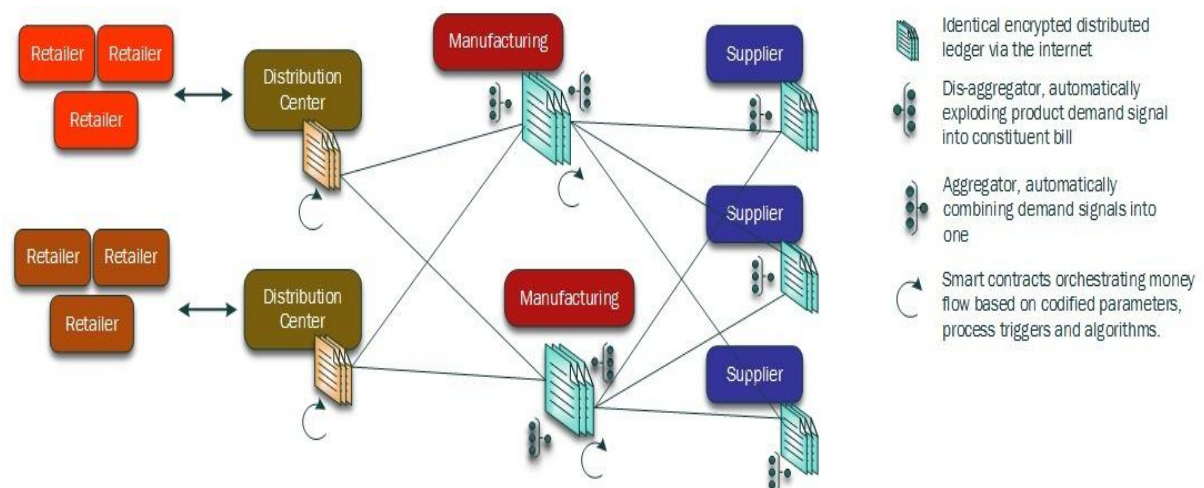


Figure 2. Blockchain in Supply Chain (adapted from Applicature consultant)

In addition to the various benefits of using blockchain in SCM, there are potential losses that can also be identified. Various disadvantages that SC members may face, that is, SC is difficult to achieve its full potential because it is blocked from areas that might be more beneficial individually for one SC member [11]. Another obstacle, namely too much SC transparency, can endanger data privacy issues.

Another thing is the companies can no longer maintain a kind of information asymmetry to maintain an organization's competitive advantage and to further reduce the risk of information leakage.

4. Conclusion

The use of blockchain can support the SSCM strategy to reduce environmental impacts while still providing economic benefits and providing social benefits for all stakeholders in the supply chain. Environmental benefits include pollution reduction due to the use of transportation in more appropriate shipping. It provides economic benefits for members because it can reduce costs by adopting more efficient production and transportation methods. On other hand, this kind of businesses can increase revenue by reducing delays. While, the social impact is the customers feel safe, comfortable in using the product because they can transparently trace the product flow while increasing reputation for all members in the supply chain.

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