The 19th International Conference on Mobile Systems and Pervasive Computing (MobiSPC)
August 9-11, 2022, Niagara Falls, Canada

Blockchain-based Real-time Information Management in Remicon Manufacturing Process

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Abstract

Blockchain is applied not only to the financial sector but also to various areas such as insurance, healthcare, asset management and public services, and various technologies are being developed accordingly. Basic information on purchase-production-sales payment for each raw material, part and product generated through the recovery process, up to the collection and management of all information, including manufacturer, supplier, date of manufacture, production and processing plant, and fund flow. It can be shared by the relevant departments at the same time. Unit monitoring and management can be strengthened by sharing manufacturing data generated from vast smart factories managed by region and sector through a block chain platform that cannot be modulated. Therefore, the use of proposed Supply Chain Management (SCM) data is used to design block chain data management programs. The design system measures the data collected from each data source and verifies the integrity of the data based on it.

Keywords: Blockchain; SCM; Ready Mixed Concrete; Integrity; Smart Factory

1. Introduction

In today's digital economy, the demand for speed, efficiency and the most important trusty is increasing. Establishing trust also resulted in other targeted costs such as transparency, faster transaction processing and faster

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problem resolution. Confidence, speed and accuracy problems increase exponentially, especially as more products, steps, geography and entities are added to the process in the supply chain world.

Production tracking management technology based on block chain technology or tracking technology for raw material movement path are not found despite being explicit and specific technology, but patents for source technologies and services needed to track raw materials or production processes or processes are introduced considerably by utilizing the transparency and objectivity of the block chain. In particular it is good to acquire specific knowledge based on the perspective of small and medium enterprises (SMEs) when securing and applying block chain-based source technology as new industries and tracking technology for products or raw materials is clear that it is a good technology for SMEs to apply to new industries [1].

To keep up with this trend of the times, the Ready-mixed concrete (Remicon) industry is also striving to change the way it works through automation technologies such as advanced construction machinery and smart factory. One might wonder if factory automation is necessary in the Remicon industry, which produces only cement, water, sand and gravel. However, the management of data produced in relation to production is becoming a necessity, not an option, as the Remicon industry also requires systematic and accurate management throughout the entire process from production to delivery, including acquisition management, process control, product management, inspection, manufacturing facility management, shipment management, and transportation management [2].

Turning the supply chain of the construction industry into a block chain system will lead to technological innovation in logistics creation. A distributed logistics system based on smart contracts, a transparent framework of interactions among all participants, ensures the complete security of the entire supply chain as well as the ability of all participants to secure measurable profits and a unique transparent environment.

This paper is configured as follows. In Section 2, we show the definition of Remicon manufacturing process, concept of blockchain and Supply Chain Management (SCM). Management of blockchain-based Remicon information is proposed in Section 3 and implement the model in Section 4. Finally, Section 5 provides a conclusion.

2. Related Work

2.1. Manufacturing process of Remicon

Remicon which is composed of raw materials, is manufactured by mixing materials according to the pre-designed mixing ratio at the factory [3]. Remicon is produced in a facility called Batcher Plant by accurately measuring and mixing cement, aggregate, and water, which are the components of concrete, according to the prescribed mix ratio. When cement and aggregate transported by the conveyor and elevator, and water are mixed by the mixer while passing through the quantifier, it is transported to the site by a mixer truck [4, 5]. The manufacturing process of Remicon is shown in Figure 1.
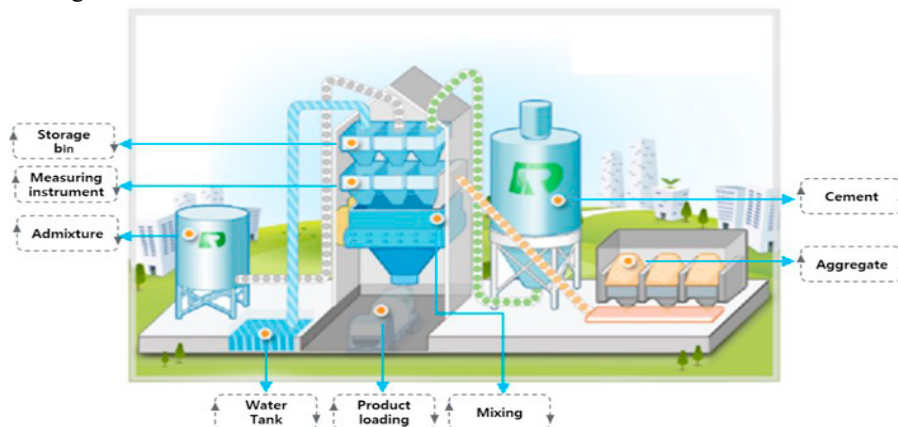

Fig. 1. Remicon Manufacturing Process

2.2. Blockchain

Blockchain is a form of distributed database designed to be impossible to arbitrarily manipulate by the operator of each distributed node on the network and is an agreement and convergence algorithm that ensures that data stored distributed on each node is always up to date among large nodes.

It is a kind of transaction book that can be shared by everyone connected through a P2P network, which can be defined as a managed database by a P2P network, and can be recorded and managed as a distributed network based on a P2P network rather than centrally managed, and above all, it is a database that is almost impossible to hack, and it is a way to replace not only people but also objects that require authentication due to the advent of the Internet [6].

Due to the nature of the block chain, all transactions are packaged in one or several blocks. When a new block is identified and recorded in the main chain, all nodes update their books by default. That is, every node has the same account book that records all transactions [7].

Blockchain is a distributed database that ensures tester integrity and reliability among network participants. This can be seen as almost impossible because malicious nodes must simultaneously manipulate more than 50 percent of the participants that make up the network to forge and change the database, and this feature increases the security of the block chain technology [8].

Thus, modifying the block chain requires a lot of cost and time. Blockchain can keep information safe without manipulation.

2.3. Supply Chain Management

An activity that manages the flow of goods and data and funds related to products or services from raw material procurement to the point of delivery to the final destination. In addition to handling materials, the latest digital-based SCM systems include software for multiple parties involved in the production, fulfillment of orders and tracking of information, including suppliers, manufacturers, wholesalers, transportation/loggers, and retailers [9].

It is a strategy that all companies involved in the process of delivering a single product to consumers work together to reduce time and cost. Broadly, it includes all stakeholders involved in the entire process of consumption activities, from the raw material supplier of the product, the raw material supplier of the product, to the raw material supplier of the raw material supplier to the consumer and consumer. The biggest goal of the SCM is to manage greater value (downstream) from raw material suppliers (upstream) to customer delivery, which is the starting point for product supply, at a minimum cost [10].

The supply chain had existed since ancient times, when the first goods or services were made and sold. With industrialization, SCM has become more sophisticated, enabling companies to produce and deliver goods and services more efficiently. For example, Henry Ford's standardization of auto parts changed the landscape of the industry, paving the way for a mass production chain in line with growing customer demand. As time passed and gradual changes (such as the invention of the computer) occurred, the SCM system became more sophisticated. But even after generations, SCM remains essentially a linear, disconnected function managed by a supply chain expert group [11].

The block chain can be sent to the Remicon producer material information store through category, quantity, quality, origin, etc. The main chain is like a distributed book with copies on all nodes. All transactions recorded in the block chain are transparent and open and everyone can search and view them as encrypted transaction topics. Meanwhile, all nodes can track material origin information as to where the raw material moved or where it came from, and help all agencies improve traceability management of the raw material source [12].

3. Remicon Information Management Based on Blockchain Technology

In many cases, the government and large corporations apply the block chain technology to the efficiency of SCM. SCM refers to a system in which a company manages the entire process of producing and distributing products in a single "network." Supply and demand of raw materials, primary production, secondary and tertiary production, and consumption in different regions are more important than SCM.

A well-made SCM is useful for companies to look ahead. This is because the data accumulated in the production and distribution process is used as a key basis for corporate decision making. It is similar to a student who did a good job in making a wrong answer note in school. Based on historical data collected by the SCM, companies can not only manage inventory but also create new production, distribution, and marketing strategies for the future [13].

The interface between SCM and Blockchain technology is excellent in that data must be connected without forgery or alteration from raw material supply and demand to final distribution stage. If production and distribution history can be tracked transparently by using smart contracts without third-party intervention, reliability of distribution information between producers, suppliers and consumers can be secured at low cost.

Figure 2 shows that the smart contract of the blockchain of Remicon, one of the building materials, connects the data to one platform, allowing data to be operated from the raw material delivery stage to the manufacturing and consumer delivery stage.
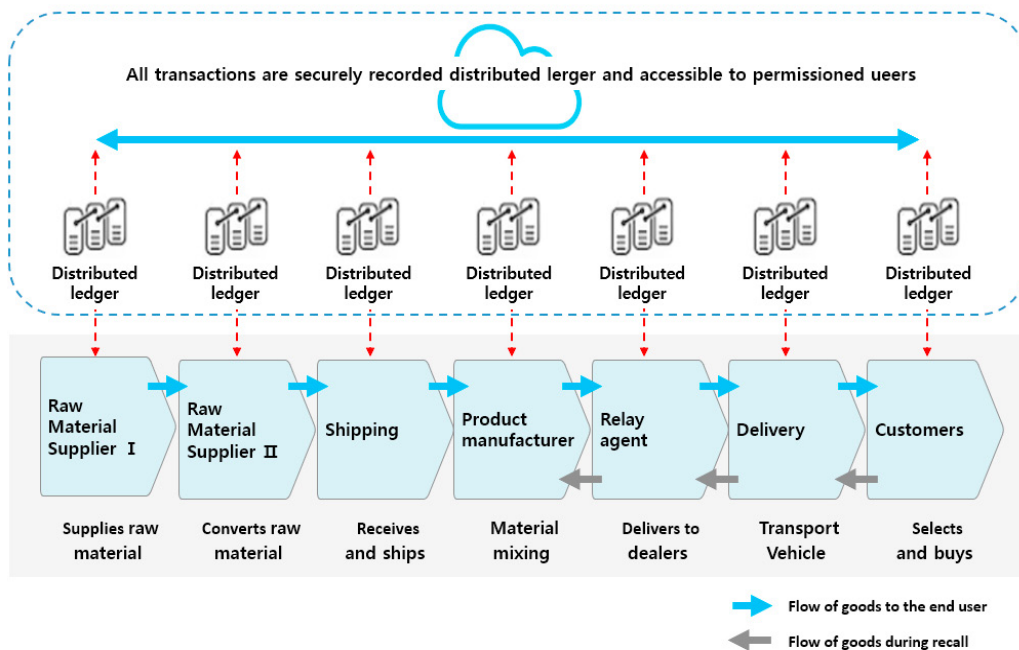

Fig. 2. Blockchain Application Model in Remicon Manufacturing Process

4. Implementation

4.1. System Configuration

In this study, the platform is designed through the management of encrypted data in the block chain from raw material production, the integrity verification data provided by the employee of the owner contractor through the combination of data through distributed ledger, etc. It is implemented as a hybrid web base and operates in a web and app environment using computers and tablets so that construction site managers can conveniently input and search in real time at the workplace. Figure 3 shows the format of data collected in real time from the pre-manufacturing stage, the raw material production stage, and the manufacturing stage.
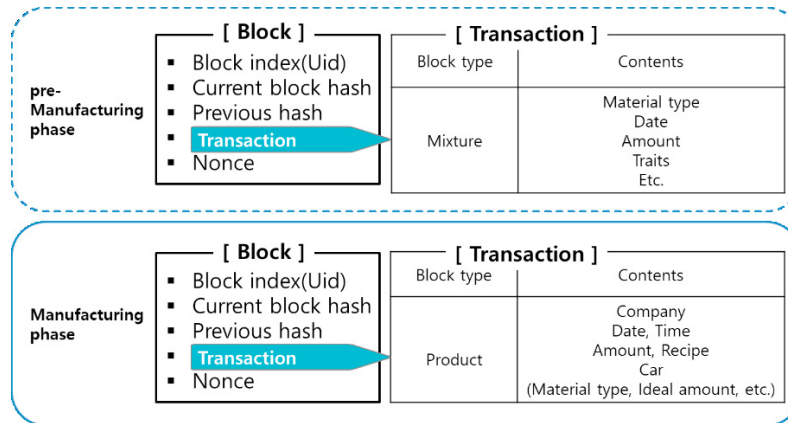
Fig. 3. Transaction History Structure by Block-type

4.2. Use Case

The Service support of server data allows you to check the product's production results while also checking which vendors and when the product produced the raw materials. The system was first implemented to test practicability and applicability in the actual manufacturing process. The product production performance in the manufacturing phase is supported by data that constructs the block chain by batch, and the raw materials used to make the batch-specific product can also be combined into the corresponding batch in real time to be displayed on the screen as shown in the left screen of Figure 4. An error message is displayed when a pre-step replication of information occurs in the final checklist. When searching for a selected batch, the right-hand screen in Figure 4 shows the raw material information of the distributed source for that batch at the bottom of the screen, and the resultant values of the production measured within the tolerance range of each raw material for each approved batch are shown in the lower right-hand corner of the screen.
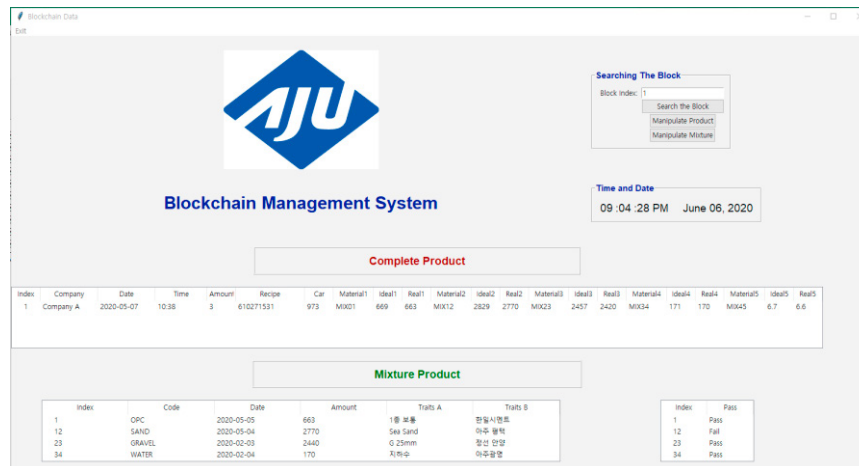

Fig. 4. Blockchain-based Remicon SCM Information Management System

As such, the production information of Remicon delivered to the construction site can be checked in real time, and the raw material information can be checked at the bottom of the center of the screen by selecting the layout for the product. Information on each raw material can be checked at any time, such as input quantity and country of origin information. In addition, it was intended to increase customer satisfaction by adding a comparative

verification function for tolerances stipulated in Korean Standard F 4009 (KS F 4009) so that customers who ordered products can determine the adequacy of production.

5. Conclusion

In this study, we proposed a Remicon SCM information management system through manufacturing data management of reliable smart factory using a block chain that can ensure both integrity and reliability of raw materials and production data in the manufacture of Remicon. In the delivery of production management records and supply chain information to consumers, real-time and accuracy were obtained through information sharing using the web through paperless in paper-based sharing. This results in remarkably reducing the probability of failure of incorrect construction through real-time quality control of the Remicon and shows efficiency in providing the information by clarifying that the reliability of the measured data can be verified. As seen in the case of Wal-Mart's SCM Blockchain Consortium, which is leading large companies independently, breaking away from the government-led centralized method, it may be a good example to verify how efficient, transparent and stable the tracking of such information can be operated on a block chain basis. The demands of the times are sufficient for development in terms of quality management of construction companies as consumers and production information and logistics management of Remicon companies as suppliers. The initial investment for faultless integrated management of information for each category that occurs in real time will be relatively weak, although it will cost some initial investment compared to the utility of the system.

In the future, we will study the establishment of IoT ecosystem for Remicon production information by creating an integrated system construction environment through application of the current system to all manufacturers in the region.

Acknowledgements

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