Blockchain Technology on Supply Chain Collaboration in Lenovo

Subjects: Operations Research & Management Science

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Blockchain technology, as a revolutionary technology that has emerged, holds significant potential for application in supply chain operations.

blockchain supply chain collaboration smart contract

1. Introduction

Blockchain technology allows various participants in a supply chain to store, calculate, and monitor their information in the platform, which enables real-time information transmission and sharing among multiple actors involved in the supply chain. The platform checks and records operations and transactions and achieves intelligent data collection and contracting as well as fulfillment, thus improving the service capability of the supply chain. The present study examines Lenovo's use of blockchain technology to improve its supply-chain management capability and brings forward a conceptual model for blockchain-based information collaboration systems.

2. Background Information

Lenovo operates in 180 countries and regions and runs 35 factories worldwide. It cooperates with over 1000 suppliers and 2.8 million distributors and third-party agencies. It processes more than 5 million orders and produces more than 150 million units of smart devices on a yearly basis. Lenovo has established a complicated supply chain network. For example, LCFC (Hefei) Electronics Technology Co., Ltd., the company's largest personal computer (PC) factory in the world, processes 30,000 rolls of electronic materials through the fully automatic warehousing system per day and transfers more than 2000 kinds of raw materials every four hours, meaning that any potential problem in part production may disrupt the supply chain. The LCFC (Hefei) factory actively develops products of the fourth industrial revolution, such as intelligent production scheduling, joint production scheduling, supply chain collaboration based on blockchains, and other innovative applications, greatly improving production efficiency. At the beginning of 2023, the LCFC (Hefei) factory was successfully selected for the "lighthouse factory" list which represents the highest level of global intelligent manufacturing.

Previously, to ensure the stable operation of the entire supply chain, Lenovo, together with its suppliers and OEMs, had to assign a large number of workers to fulfill complicated, time-consuming tasks, including checking the accounts and keeping track of order statuses. Despite this, it failed to achieve efficient collaboration. Since 2017, Lenovo has applied blockchain technology to the supply chain by proposing a model integrating the supply chain

and blockchain (hereinafter referred to as the dual-chain integration model). It applies the model to the server business to integrate the flow of information, logistics, and flow of funds in its supply chain, thereby ensuring higher transparency in each manufacturing step. After five years of development, Lenovo has made great progress in the research and application of the combination of blockchains and supply chains (see **Table 1**).

Table 1. Lenovo's practical exploration of blockchain application.

Step in the Process	Main Achievement
Technical preparation	From 2016 to 2017, Lenovo began to conduct technical research on blockchaining, exploring the landing direction and application direction, mainly focusing on the application in the financial industry at the beginning
The "dual-chain integration" model is proposed	In 2017, a "dual-chain integration" model was proposed based on the similarity between supply chain structure and blockchain structure.
Small-scale application in the server business	In 2018, Lenovo began to carry out a small-scale application in the server business, using blockchain technology to establish a trusted sharing mechanism among Lenovo, foundries, and suppliers
Summarize experience and try to establish industry standards	Released "Lenovo Blockchain Technology White Paper" in 2018, "Lenovo blockchain white paper supply chain solution" in 2019, and "Blockchain supply chain Collaborative Application White Paper" in 2020

3. Case Study Deployment

Here employed a qualitative approach and collected data through semi-structured interviews. The interviews were conducted with the head of Lenovo's blockchain R&D department and two sales managers from the sales department. Each interviewee answered twelve questions, and the process lasted about two hours.

Following the 5W1H framework, the research method can be described as follows:

- Who: The interviewees included the head of the blockchain R&D department at the Lenovo Research Institute and two sales managers from Lenovo's sales department.
- What: The research involved conducting semi-structured interviews to explore Lenovo's blockchain solution, its impact on supply chain management, and the resolved business difficulties and efficiency improvements.
- Where: The interviews took place at Lenovo's premises or a mutually agreed location.
- When: The interviews were conducted within a specific timeframe, with each interview lasting approximately two hours.

- Why: The primary purpose was to understand the business challenges addressed by Lenovo's blockchain solution, assess its efficiency improvements in supply chain management, and propose a conceptual model of blockchain information collaboration systems based on associative cases.
- How: The research employed a well-designed interview questionnaire (**Table 2**) to guide the interviews and collected data through handwritten notes, as requested by the respondents.

Table 2. Details of the questions.

Main Concerns	High-Level Questions	Detailed Questions
Business problem	What are the biggest difficulties and challenges in Lenovo's supply chain management?	What problems does Lenovo's supply chain face in inventory management? What challenges does Lenovo's supply chain face in terms of timeliness of delivery? How coordinated are the supply chain parties?
Effect evaluation	What efficiency improvement does Lenovo's blockchain solution bring to supply chain management?	Manual verification cost saved? Process time saved? More accurate in delivery? Inventory turnover increase? Inventory cost reduced?
Technical solution	What elements does Lenovo's block chain integration technology program contain?	What technology platform is Lenovo's blockchain solution based on? What does Lenovo's blockchain solution accomplish? Can you briefly describe the business process of Lenovo's blockchain solution? What is the application prospect of blockchain technology in the direction of supply chain coordination?

4. Facts

4.1. The Complex Problems and Challenges Confronting Lenovo's Supply Chain Management

Lenovo uses original equipment manufacturers (OEMs) for production. The raw materials used by the OEMs for production are purchased by Lenovo from certified raw-material suppliers. After the OEMs assemble the finished products, Lenovo conducts a unified quality inspection and stores them in the warehouse. The complex problems and challenges confronting Lenovo's supply chain management in the process of procurement and sales are listed as follows:

First, ledger records may be inconsistent with the actual inventory. The company deals with a wealth of information regarding plans, procurement, prices, and payments, as well as logistics engaging in multilateral transfer and collaboration with one another. Supposing that mismatches, delays, or human errors occur in the course of exchange and collaboration, problems, such as discrepancies in product inventories, postponed deliveries, extended payment cycles, and unknown order statuses, may arise.

Second, information fragmentation poses a challenge. As the OEMs need to purchase raw materials through Lenovo to produce devices for the company, they cannot find out when the suppliers will accept their orders, and the logistics statuses of shipments will update. This lack of information means they cannot make an accurate production schedule for the next step.

Third, the supply chain cannot respond to information on time. Suppliers, who provide raw materials, have to send the goods directly to the OEMs after receiving orders from Lenovo. So, it is hard for Lenovo to keep track of the accurate times at which the OEMs receive the goods, thus prolonging the entire payment cycle. In the case of defective raw materials, Lenovo, the buyer, is unable to acquire first-hand information, so it cannot respond to the problem promptly and handle it as soon as possible.

4.2. The Blockchain-Based Solution of Lenovo and Efficiency Improvement in Its Supply Chain

Under the dual-chain integration model, Lenovo, its suppliers, and OEMs achieve real-time data synchronization. Every piece of information is documented clearly and shared in real time, simplifying the procedures of repeated confirmation among them.

First, in line with the demand schedule, the OEMs upload the purchase orders to the blockchain system through the enterprise resource planning (ERP) system, which in turn simultaneously shares the information with Lenovo and its suppliers. The data shared will automatically trigger the generation of POs, and the suppliers will prepare raw materials in advance, thus effectively shortening the supplier delivery cycle and Lenovo’s payment cycle.

Second, the suppliers upload the information about advanced shipping to the blockchain system after it finishes manufacturing. The OEMs can arrange production schedules following the shipping information shared by the suppliers through the blockchain system without receiving any physical goods.

Lastly, the OEMs need to upload the receipt information of physical goods and the usage information of raw materials to the blockchain system to ensure the consistency of the inventory information of multiple parties and allow them to respond to quality issues, if there are any, promptly.

Dual-chain integration enables Lenovo’s sourcing and sales process to be more cost-effective and faster in a shorter period, making it a key step in quality and efficiency improvement for the enterprise. To be more specific, blockchain technology saves more than 15 percent of the cost of human cross-checking in the process of sourcing and sales. Reliable data sharing saves up to 15 percent of the time spent on the procedures of overall estimation

and materials preparation. Real-time order tracking allows all parties to gain information about orders seven days earlier than before and increases the delivery accuracy of production schedules by 10 percent. The number of goods in stock becomes more accurate, and the turnover rate rises by over 10 percent. Under the impacts of the COVID-19, Lenovo's supply chain has demonstrated strong resilience. When faced with unexpected production and work suspension due to pandemic control, decision makers in the supply chain were able to draw up plans to switch production schedules rapidly with the help of blockchain technology in less than two hours, which took at least several days previously, and the success rate of the switch was 80% higher than before.

4.3. Technical Solution of Lenovo's Dual-Chain Integration

Lenovo has developed a consortium chain network based on Hyperledger Fabric and other mainstream consortium chain technologies and formulated a technical solution to the dual-chain integration to fulfill the following functions: the visualization of the full order delivery cycle of part orders across the enterprises; the achievement of real-time online tracing of manufacturers' inventories of parts and components; triggering of automated cross-enterprise procedures by the production schedules in the case of understocking; performance of the transfer of property rights of goods according to international trade terms; the affixing of digital signatures and the encryption and decryption of electronic invoices in line with security rules; and the tracking of the shipping and arrival of parts and components.

The business procedure of Lenovo comprises the following steps.

First, an OEM creates a transaction request and uploads the information on the PO to the blockchain-based platform. The enterprise and its suppliers then simultaneously receive the sourcing information shared by the OEM in the supply chain. Based on shared data, the PO generation of the enterprise is triggered automatically, allowing the suppliers to start estimation and materials preparation in advance and shortening the operation time of the entire procedure. The OEM and suppliers will stay informed of the latest statuses of documents in a real-time manner when the enterprise uploads the PO to the blockchain. Next, when the suppliers complete the production of raw materials, they upload the information on advanced shipping to the blockchain network and send the physical goods directly to the OEM. In line with the information shared, such as the shipment and the estimated time of arrival, the OEM revises and improves the production schedule in advance, and the enterprise launches a settlement with the suppliers based on the information shared in the supply chain. Lastly, the OEM needs to upload the receipt information of the physical goods and the production information to the blockchain for the automatic calculation and reconciliation of the inventory information from multiple parties.