Research on Blockchain based Supply Chain Management Mode

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Abstract: In recent years, the wide application of cloud computing, Internet of things, artificial intelligence and big data in our societies and life has spurred the development of blockchain. The crucial factor that determines the management efficiency is the information validity, which is also the core issue that is in urgency to be addressed. Nevertheless, since supply chain itself is a system with dynamics and self-awareness, information of different sections are independent of each other in current supply chain system; each business entity of different sections fail to communicate and supervise each other, resulting in the deficiency of coordinating operation as a whole. Furthermore, because of the openness of supply chain, business entities of each section are imposed substantial information asymmetry based on information security and privacy protection, which is going to cause the "bullwhip effect" to the supply chain. The efficiency of supply chain management can be improved through information sharing, which has been approved by a huge amount of domestic and international researches. However, there research results fail to come up with effective operation mechanism and management mode, as they were conducted based on algorithmic modeling and extensive assumptions. These results have little significance to implement in real world. Blockchain is a distributed ledger technology with de-centralization, which has harvested widespread attentions from governments, academic communities and industries. Blockchain technology verifies the authenticity of the information for business operation, improving the transparency and tractability. Another capacity that blockchain offers is providing business entities with an integrated network for information sharing to achieve equality, autonomy, and common management of business operations. The researching process adopts game model construction, algorithm design and analysis, analysis on system dynamic model simulation and multivariate statistics etc. This essay also conducts research on the theory of supply chain management in terms of supply chain content management, credit management, performance evaluation, putting forward supply chain management mode based on blockchain and detailed mode and approach for blockchain application in supply chain management, as well as flourishing the theory system of supply chain management. Based on the analysis and improvement of classical blockchain technology, the research results promote the application of blockchain in supply chain management, as well as the development of blockchain application research in other fields, with certain prospective and positive social values.

1. Background

The term"supply chain"is not an original concept, yet it has never faded away from the field of management science. Some Research studies conducted on supply chain are by nations, while others are by enterprises. "Supply chain" still remains its significance in management science even when the market environment is ever changing. Although information sharing is an elemental research subject in supply chain management, domestic and international research results about it reveals deficiencies on applied researches in this field including imperfection on information infrastructure of the supply chain, differences between business entities processing information, as well as information asymmetry. In order to construct a network system with sustainability, stability, coordinating, effectiveness and vigilance, one of the most substantial issues required to be addressed is the improvement of information sharing and management efficiency.

Blockchain is a decentralized, distributed ledger technology as well as a distributed database. It

utilizes dynamic real-time P2P transmission of network information, encryption technology, hashing algorithms, digital signature technology, and consensus authentication mechanisms, which solves the problem of undeniable proof in blockchain-based business activities. Furthermore, the blockchain actualizes information sharing and the dynamic instantaneity of transmission; and de-centralizes the dynamic supervision of business activities, accelerating the group decision making in business content management.

Due to the feature of the blockchain, the application of blockchain in supply chain management improves the quality of supply chain decision makings, which effectively addresses the classic bullwhip effect in traditional supply chain management.

2. Current Status

In recent years, information technology has been developed drastically. Innovative information technologies including artificial intelligence, Internet of things, could compute and big data has been widely applied in our society and life, which tremendously reformed our life. Among all technologies, supply chain underwent a great transformation from physical form to operation mechanism. In the modern management system, since supply chains are resting on the Internet, transaction activities between business entities from the traditional business model transform to the network-based e-commerce transaction process, as well as the corresponding control and management of information flow, logistics, and capital flow.

3. Research Significance

3.1 Major Theoretical Significance

The blockchain technology is applied in supply chain management, enriching the theory of supply chain management. The supply chain management mode is constructed based on blockchain, which achieves intelligent group decision making of business entities under the consensus mechanism of blockchain and addresses bullwhip effect caused by information asymmetry. The essay also analyzes the deficiencies in the specific applications of classic bitcoin blockchain and ethereum blockchain; refines and develops the principles of classic blockchain, which stimulates the development and application of the theory of the blockchain technology.

3.2 Major Actual Significance

The research provides a solution to the issue of information sharing in supply chain management. With the target of classic issue that applying blockchain to supply chain management, this essay conducts research on the melioration on the aspects of blockchain linking structure, block structure and block record. It also guides further researches in blockchain technology in other fields, stimulating the development and application of blockchain technology itself.

3.3 Innovation

Information sharing among all parties of the supply chain is going to be actualized based on blockchain. In addition, a supply chain management mode is going to be depicted, formulating a set of supply chain business system based on blockchain.

4. Methodology

Methodologies include game model construction, algorithm design and analysis, analysis on system dynamic model simulation and multivariate statistics etc.

(1) Game model construction. It constructs a game theory model for each section of the supply chain under the background of supply chain technology and multisource data analysis.

(2) On the base of information economics and capital allocation theory, the economic value of blockchain application in supply chain management is analyzed through constructing an algorithm model.

(3) Analysis on system dynamic model simulation. The game theory model and the algorithm analysis model are simulated through system dynamic model to elaborate the value actualization principle of “blockchain –based supply chain management mode” and the business operation principle.

(4) Multivariate statistical analysis. To analyze the impact of block in the performance of the supply chain management, questionnaires were distributed with the factor analysis and structural functions.

5. Conclusion

With the popularization of Internet applications, supply chain management has also developed rapidly. The supply chain has become a management system combining e-commerce, cloud computing, Internet of Things and big data technology and other emerging information technologies, and the integration of emerging information technologies has promoted the transformation of the supply chain from business-centered management to information-centered management, which fundamentally improves the efficiency of supply chain management. Blockchain is a decentralized distributed ledger technology and a data storage system at the same time. Blockchain uses cryptography, P2P information dissemination technology, hash algorithm, consensus authentication mechanism, digital signature, etc. to realize the traceability, automated operation and indestructibility of information storage in blockchain-based information system. Applying blockchain technology to supply chain management can realize the full sharing of information of each link of the supply chain, realize the group decision of business content management of each link of the supply chain, promote the business coordination of supply chain management, eliminate the "bullwhip effect" of purchase orders and inventory in supply chain business operation, and realize the group supervision of business subjects in supply chain operation process. Blockchain distributed data storage system combined with information access control mechanism can effectively realize the security management of supply chain information and prevent the leakage of important information.

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