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Building a Government System Based on Blockchain Innovation Supply Chain System

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Abstract: Blockchain as a new technology is a public ledger constructed based on cryptography, distributed storage, data encryption and other technologies, which is a new production relationship in the digital era. This paper constructs a government procurement (GP) system based on the blockchain innovation supply chain system (SCS). This paper proposes an analysis framework of government system based on blockchain innovation supply chain (SC), and uses blockchain technology (BT) to converge the data scattered on each node to a public ledger, forming a public ledger to realize real-time sharing and traceability of data; using BT to realize the credit rating of the government for each participating subject in the SC, and to adjust and manage them dynamically, forming a dynamically changing and sustainable credit system. The credit system is dynamic and sustainable. By using BT to innovate the SCS, it can not only realize the optimization and integration of the SC, but also promote the sharing of data in the SC, realize the effective allocation of market information, and realize the optimal allocation of SC resources.

1. Introduction

The SCS is a new form of industrial organization constructed based on Internet technology, and in the context of economic globalization, the SCS has unique economic, political and social functions. The government adjusts and optimizes the government functions in the SCS by implementing SC policy measures, organizing and implementing and innovating SC management methods. Through the use of BT, data validation and data verification as well as the establishment of a credible credit rating system are carried out in the transaction link of the SC; the traceability of goods or services is carried out during the transaction process to achieve traceability and full record of the quality of goods or services; after the transaction is over, the product traceability system and the whole life cycle management system of products are established to finally achieve the traceability management of products or services and the whole process traceability.

Building and innovating SCS based on BT can not only improve government performance, promote information sharing and optimization of market competition pattern, but also promote sustainable and healthy development of digital economy. The SCS is a new form of industrial

organization with economic, political and social functions, and in the context of global economic integration, the SCS has become an important force to promote the development of the world economy [1]. From the perspective of government functions and status, from the macroscopic point of view it is the maker of national security strategy, industrial development strategy and market competition strategy; from the microscopic point of view it has certain government management functions, such as economic regulation and control, safety and security, environmental protection and public utility management; and it is also an important subject in the market economic system and market order [2].

This paper focuses on how to build a perfect, efficient and standardized SCS in the blockchain era in order to improve its competitiveness in international competition and cooperation. Based on this ideological background, this paper firstly analyzes the important role of BT for the construction and optimization of SCS; secondly, it analyzes the impact of blockchain on government management function and status from the perspective of international competitiveness; finally, after analyzing the impact brought by the combination of blockchain and traditional SCS, it puts forward the optimized countermeasures based on the combination of blockchain and new technology to build a perfect and effective operation, guarantee efficient and fair competition environment and government governance efficiency improvement are combined with the optimization countermeasures [3-4].

2. Blockchain Innovation SCS Research

2.1. Basic Characteristics of the SC

As an emerging form of industrial organization, SC is essentially a process of optimal allocation of resources. By using BT, the traditional SCS can be transformed into a new economic organization with distributed, digitalized and value transfer, which can not only reduce the operation cost but also reduce the information transfer cost and management cost, but also improve the efficiency level and market competition pattern. In the construction and innovation of SCS, the government needs to use BT to transfer and exchange the economic, political and social characteristics of the whole SCS through the digital platform, and it also needs to coordinate the interests of all parties to form a synergy [5]. In SC management, the government and enterprises should not focus only on the interests of enterprises and ignore the needs of consumers. If there is a large and complex SCS in the market, it will lead to information asymmetry, lack of information flow, and inconvenient transactions between consumers and suppliers [6].

The protocol used in blockchain is based on consistent negotiation among all nodes, and each node no longer trusts a designated organization or institution, but generates a trusted data source through arithmetic competition, which is not controlled by the subject and is not subject to human intervention, making it possible for nodes to exchange and transact data in this de-trusted environment. At the same time, the blockchain acts as a public ledger, and in addition to the encrypted data, any user can query any data stored in the blockchain and can use the data to develop their own applications, and the whole information system remains transparent [7-8]. In the blockchain, the stored data are connected first and last in the form of blocks, and the next block contains the hash of the previous block, and once the block is confirmed, it cannot be tampered with or deleted, otherwise it will lead to a discrepancy between its hash and the one stored in the next block, so the blockchain has good tamper-evidence. Currently, Bitcoin and Ether are two relatively mature and commonly used applications based on blockchain, as shown in Figure 1.

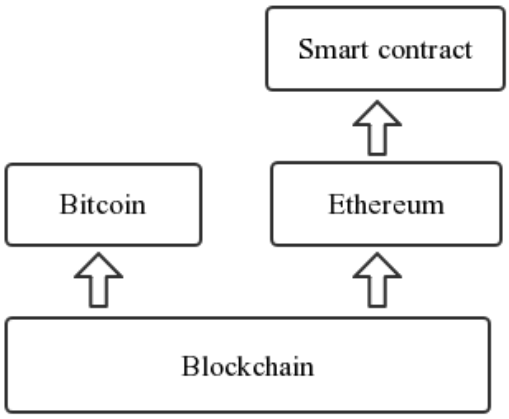

Figure 1: Blockchain application.

2.2. Characteristics of Blockchain

BT was born along with Bitcoin, and its decentralization and de-trustability provide great convenience to the implementation of secured transactions in this transaction system, while transparency and tamper-evident make the data source for counterfeit identification more credible. Since all nodes of the blockchain are peer-to-peer, they follow the same consensus mechanism to keep the data consistent, and there is no management node or subject to dominate or control the working behavior and operational mechanism of other nodes in the whole peer-to-peer network system, and all nodes remain independent, thus creating a decentralized working environment [9].

2.2.1. Timestamp

In blockchain, how to ensure that blocks are linked sequentially according to time is inseparable from timestamp. Timestamp brands each transaction with "time stamp", which effectively solves the problem of double payment and makes each transaction traceable to its source and has the characteristics of non-tampering and non-forging.

2.2.2. Security

The mechanism of blockchain operation makes it effective against malicious attacks[10]. First, the data is encrypted using asymmetric cryptography principles, and strong arithmetic power is created with the help of consensus algorithms such as proof-of-work to resist external attacks. Second, the blockchain is jointly managed by all nodes, so that the loss of control of one node will not lead to the paralysis of the whole network. In addition, the tampering of data information by a single node is ineffective. Finally, an attack can only be carried out if it holds more than 50% of the arithmetic power of the whole network [11-12].

3. GP SCS Construction

3.1. Overview of China's GP SC

Although some scholars in China have conducted some research on GP from the perspective of SC, so far, no unified and clear definition of GP SC has been found. In this paper, the SC of GP

should be summarized as follows: it refers to a procurement SC with the main body of GP as the core, involving the financial department, procurement agency, procurement unit, suppliers, evaluation experts and other subjects, covering the whole process of GP such as GP budget, procurement agency, procurement organization, procurement evaluation, contract signing, contract performance, performance acceptance, integrity evaluation, payment and performance assessment, etc. The chain can be divided into two parts: the main chain and the operation chain. The procurement process of traditional supply chain vendors is shown in Figure 2.

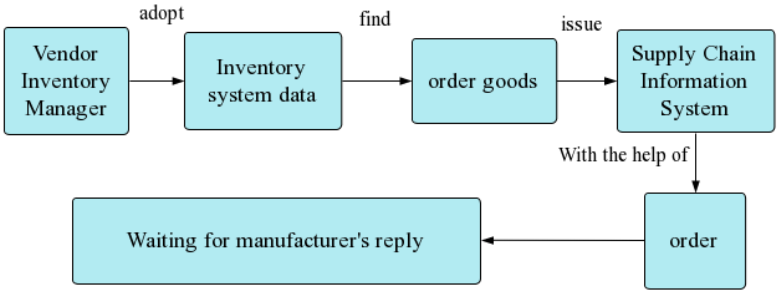

Figure 2: Traditional supply chain procurement process.

3.2. Ideas of Using SC Theory to Build a New Type of GP SC

The core idea of enterprise SC management is to maximize and share economic benefits as a common goal to achieve the purpose of SC bar reshaping and integration. However, the GP SC pays special attention to the purpose of enhancing the social and economic benefits of the GP SC on the basis of lawfulness and compliance, and through the transformation in line with the laws of market economy.

The GP SC should absorb the essence of the enterprise SC theory, including the idea of integration, integration, and the combination of open and closed, and reconstruct the GP SC by closely combining its own characteristics, and at the same time, deeply understand the applicable conditions and market environment of various types of mature e-commerce platforms, select the practices that are similar to the conditions and environment of GP and are effective in the operation of e-commerce platforms, and combine them with the characteristics of GP, such as fairness, public welfare, authority, and legality. At the same time, the company will also understand the conditions of application and market environment of various types of mature e-commerce platforms, select the practices that are similar to the conditions and environment of GP and have worked well in the operation of e-commerce platforms, combine the characteristics of GP such as fairness, public welfare, authority and legality, and conduct targeted research and absorption, and improve the strengths and avoid the weaknesses, so as to finally form an operation chain that meets the actual GP.

3.3. Model and Assumptions of GP System Construction

In this paper, we consider a game between a manufacturer and a retailer to analyze the green innovation decisions of SC member firms in a noncooperative dynamic game and a cooperative game. Consider a two-level SC structure consisting of a manufacturer and a retailer, as shown in Figure 3, and assume that the manufacturer and the retailer are long-term partners, the manufacturer commits to wholesale to the retailer in the long run and at a constant price w. The manufacturer's level of green innovation (including green technology development, green raw material

procurement, green manufacturing, etc.) is em, and the retailer's level of green innovation is er, and the retailer sells at price p sold to consumers.

Figure 3: Structure Chart of Green Innovation SC.

To facilitate the computational analysis, we make the following assumptions about the model.

(1) The market potential θ is sufficiently large, much larger than the other parameters in the model.

(2) The manufacturer's unit production cost is c. The manufacturer's greenness of the product increases through innovation in green production technology by em, and the consumer's sensitivity coefficient to green production innovation is αm, then the increased market demand is αr em.

(3) The retailer increases awareness and establishes a green brand through green marketing innovation, the increased value of product greenness is er, the consumer sensitivity coefficient to green marketing innovation is αr then the increased market demand is αr em.

Assuming that demand information, green innovation input level information are symmetric, that there is a negative correlation between market demand and retail price and a positive correlation with the green innovation input level of manufacturers and retailers, and that market demand is a linear function of retail price and greening effort level, then the demand function is obtained as:

$$d = \theta - p + \alpha_m e_m + \alpha_r e_r \tag{1}$$

Let the manufacturer's green innovation cost coefficient be βm, and the green innovation cost be $\frac{1}{2}\beta_m e_m^2$, the manufacturer's profit function can be found as follows.

$$\prod_m = (w-c)(\theta - p + \alpha_m e_m + \alpha_r e_r) - \frac{\beta_m}{2} e_m^2 \tag{2}$$

Let the retailer's green innovation cost coefficient be βr, and the green innovation cost be $\frac{1}{2}\beta_r e_r^2$, the profit function of the retailer can be found as follows.

$$\prod_r = (w-c)(\theta - p + \alpha_m e_m + \alpha_r e_r) - \frac{\beta_r}{2} e_r^2 \tag{3}$$

The total profit function of the SC is given by:

$$\prod = \prod_m + \prod_r = (w-c)(\theta - p + \alpha_m e_m + \alpha_r e_r) - \frac{\beta_r}{2} e_r^2 - \frac{\beta_m}{2} e_m^2 \tag{4}$$

Table 1 shows the discrimination of system variables of supply chain collaborative innovation dynamics.

Table 1: Analysis of System Variables of Supply Chain Collaborative Innovation Dynamics.

	Variable	Data availability
Supply chain core integrator	Integrators' willingness to collaborate on innovation	Quantifiable
	Integrators' collaborative innovation investment in spare parts	Easy to get
	Crowdsourcing platform construction investment	Easy to get
	Construction level of crowdsourcing platform	Quantifiable
	Integrator revenue	Easy to get
	Competitive pressure	Quantifiable
	Product innovation cycle	Available
	Integrator market share	Easy to get
Supply chain parts suppliers	Integrator procurement	Easy to get
	Suppliers' willingness to innovate cooperatively	Quantifiable
	Supplier collaborative innovation input	Easy to get
	Innovation cycle of spare parts	Available
	Technical level of spare parts	Quantifiable
	Spare parts cost	Available
Crowdsourcing participants	Enthusiasm of crowdsourcing participants	Quantifiable
	Input of crowdsourcing participants	Quantifiable
	Crowdsourcing Participant Rewards	Easy to get

4. Government System Construction based on Blockchain Innovation SCS

4.1. Optimization of Collaborative Management of Sc Procurement Information Based on Blockchain

In this paper, we realize the intelligence of this process by adding smart contracts to the information collaboration system, as shown in Figure 4.

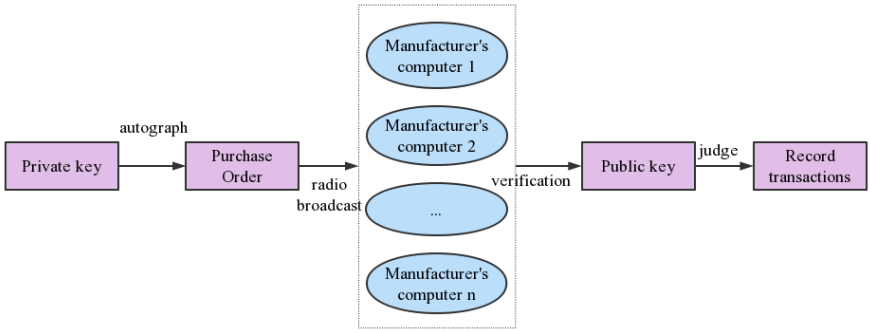

Figure 4: Transaction validation process.

The SC database implanted with smart contracts realizes the intelligence of the information collaboration process, increases the transparency of the information processing process, reduces human factor interference, saves transaction time, makes each transaction, each process and each task have a digital record and signature that can be identified, verified, saved and shared, and can be traced back to the source, effectively optimizing the SC information collaboration process.

The blockchain information collaboration system effectively integrates the databases of different enterprises, significantly compresses linking costs, releases new economic values, plays the role of a bridge and link, ensures the unimpeded information transmission process, enables SC enterprises to effectively respond to market demand and make timely decisions, improves the level of SC information collaboration, and provides a guarantee for the realization of synergy benefits.

The transaction authentication mechanism greatly improves the accuracy of information, reduces the risks and hazards arising from tampering and complicity in violations, improves the quality of data transmission, and facilitates the optimization of the SC information collaboration process.

4.2. The Operation Points of E-Commerce and Informatization of GP

The road of e-commerce and informatization of GP should be: on the premise of conforming to the spirit of the GP Law and the objective laws of market economy, sorting out the whole process of GP, taking the separation of "procurement right, use right and supervision and management right" as the core structure, clarifying the rights and responsibilities of each participating body according to the principle of consistency of rights and responsibilities, and standardizing all aspects of GP, improving the evaluation system of consistency of rights and responsibilities and objectivity and fairness. It also standardizes all aspects of GP, controls GP requirements in a scientific and effective manner according to the law, improves the evaluation system with consistent authority and responsibility and objectivity and fairness, and finally uses information technology and SC management theories such as the Internet to create a centralized and decentralized GP SC with efficient and closed-loop operation in which information flow, logistics, capital flow and business flow are truly integrated.

5. Conclusions

The application of BT can change not only the government operation mode, but also the market operation mode to a large extent. In the current business environment, the relationship between the government and enterprises is getting closer, information is transmitted faster, and decisions are made faster, so the traditional administrative management model is largely constrained. BT can improve government performance through the reform of four aspects: data identification, data sharing, credible credit rating and credit management. BT can also be used to achieve reforms in three areas: "SC management", "industrial policy" and "market regulation". The application of BT will also change the information transmission mode and reduce the cost of intermediate links. BT will play an increasingly important value in the future, and it will become a key technical tool and infrastructure for building a global industrial chain ecosystem. Therefore, when reforming government agencies in the SCS, BT can be considered as the basis for establishing a new system; for commercial companies, BT can be used to improve operational processes; for consumers, blockchain has the characteristics of traceability and high transparency to promote the consumer experience.

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