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Self-employment in the Construction Machinery Industry with Blockchain Technology in Mind

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Abstract: Although the product varieties of China's construction machinery industry are diversified, they lack the ability of independent innovation. The data among the blockchain can meet the requirements of investors and creditors and stakeholders for the reliability of financial information. Therefore, this paper takes into account the blockchain technology to explore and study the independent entrepreneurship of construction machinery industry. This paper discusses self-employment in three parts: the basic overview of self-employment in construction machinery, the construction of blockchain system and the analysis of self-employment results. Through the comparative analysis of inventory models, it is found that the information interaction system based on blockchain technology can make collective decisions based on real business information.

1. Introduction

Entrepreneurial enterprises are an important force in promoting technological innovation and high-quality industrial development in China [1]. In the era of open innovation, innovation in enterprises is no longer the task of a single organization, but the task of an innovation ecosystem that spans multiple organizations [2-3]. This is due to the fact that firms need not only internal resources and capabilities in the innovation process, but also complementary resources and capabilities provided by the entire innovation ecosystem outside the firm [4-5]. The whole society supports industrial integration, and blockchain technology has many application areas and a wide market space in the future [6]. Blockchain is an integrated technology and a form of governance. Blockchain technology creates conditions for the innovation of corporate governance mechanisms

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[7].

In recent years, many scholars have conducted in-depth research on blockchain technology and self-employment in the construction machinery industry, and have achieved good results. For example, researchers such as Kanevche J used a blockchain federation-backed fog layer and smart contracts to ensure privacy, using optimised smart contracts that reduce the monetary cost of vehicles and provide more location privacy protection; performance analysis showed that the solution provides optimal monetary cost management and secure, private, and fast block validation [8]. sitnik A A by consulting with participating food subsidy various stakeholders in the value chain, proposed a blockchain-based system using the principles of value-focused thinking (VFT), which was demonstrated through a prototype to provide a solution to the food problem [9]. Although many scholars have conducted in-depth research on blockchain technology, there has been relatively little exploration of self-employment in the construction machinery industry that takes into account blockchain technology.

Blockchain technology is beneficial to industrial innovation and corporate governance in the construction machinery industry, so this paper explores self-employment in the construction machinery industry based on blockchain technology. The content of this paper is mainly divided into three parts: the first part is a basic overview of self-employment in the industry, including two parts of the entrepreneurial environment and entrepreneurial information platform; the second part is about the blockchain system, which is mainly constructed from the effective interaction of information and real-time audit and supervision of the system; the third part is an analysis of self-employment, the third part is mainly an analysis of entrepreneurial orientation and inventory model, and finally The corresponding conclusions are drawn.

2. Basic Overview

2.1. Entrepreneurial Environment

In the process of self-employment in the construction machinery industry, entrepreneurs will encounter various risks and obstacles, and the main obstacles faced by most entrepreneurs are insufficient start-up capital, lack of management experience and no good projects [10]. As can be seen from Figure 1, 33% of the self-employed entrepreneurs think that the entrepreneurial environment in the construction machinery industry is general, indicating that the entrepreneurial environment in the construction machinery industry needs to be optimized. In the survey on the greatest advantages of entrepreneurship in the construction machinery industry, most entrepreneurs think that the market of the construction machinery industry is well developed, the entrepreneurial atmosphere is active, project resources are abundant, venture capital and DAB capital are sufficient, and talent resources are sufficient, and 15% of them do not know anything about the entrepreneurial environment of the construction machinery industry.

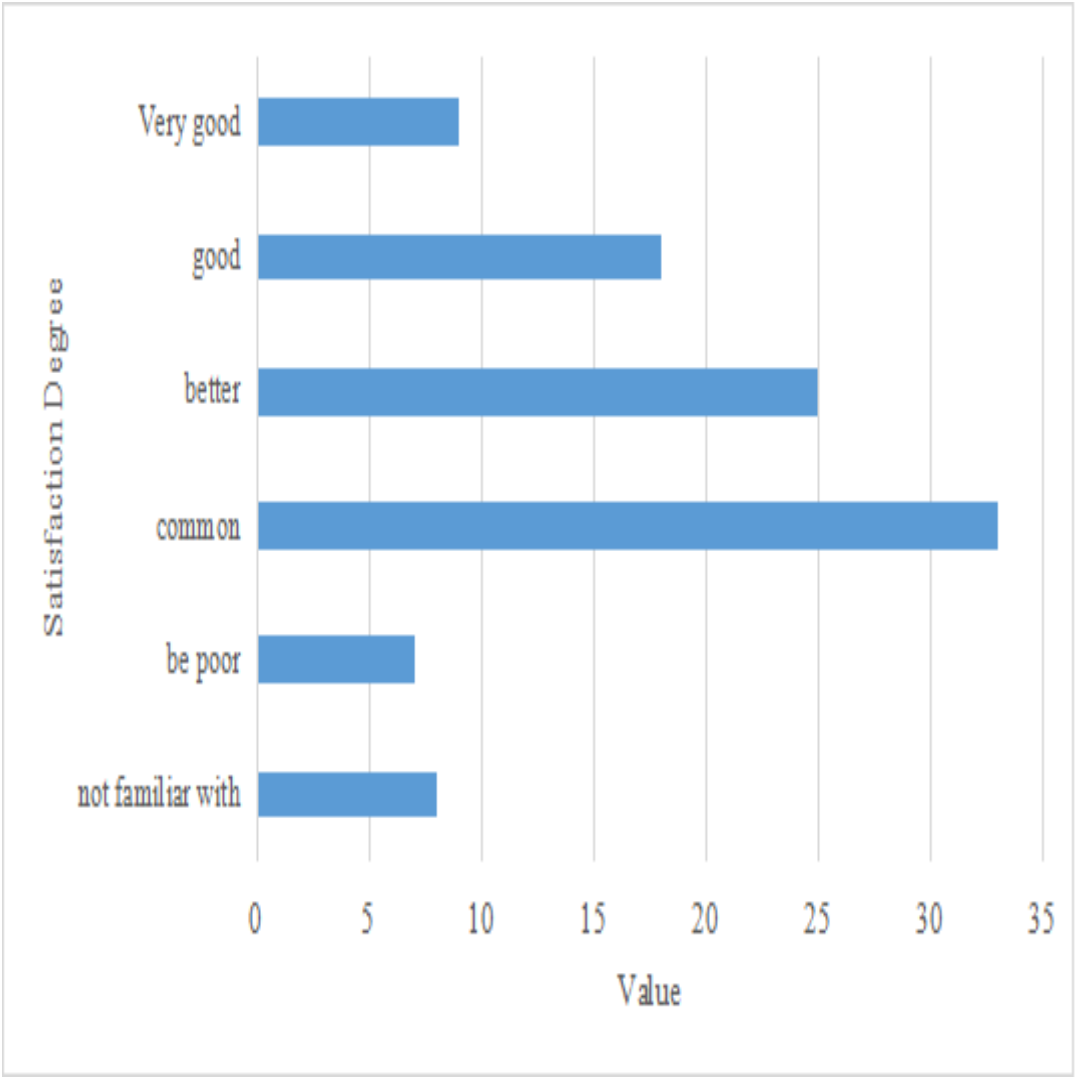

Figure 1. Entrepreneurial environment survey results

2.2. Startup Information Platform

The startup information platform uses the consensus mechanism of PBFT for consistency voting to obtain the bookkeeping rights of a new block [11]. When a user logs into the platform and wants to upload startup information, he or she first uploads the startup information to the platform, which broadcasts and distributes this startup information to users across the network according to the settings of the smart contract [12-13]. The users of the whole network will review and vote on the received startup information. Once more than 2/3 of the users have approved it, this user gets the right to bookmark the new block, i.e. the user can successfully add this startup information to the platform [14]. The platform will automatically execute the corresponding smart contract to package and encrypt this startup information and store it in the new block, which will then be connected to the blockchain [15]. The workflow of the startup information platform is shown in Figure 2.

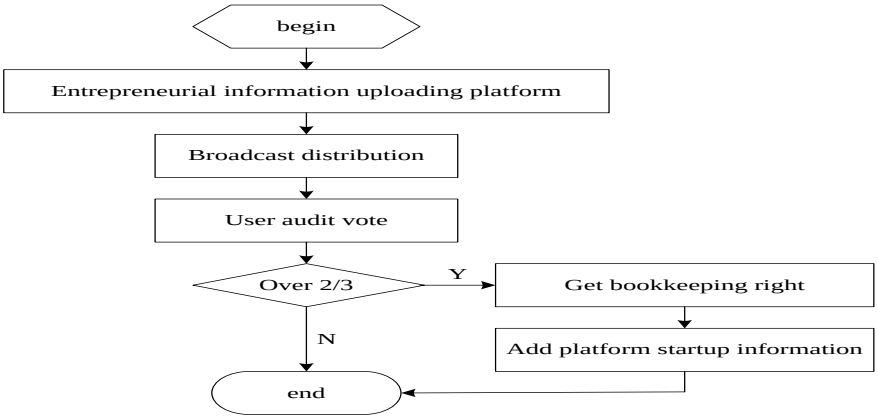

Figure 2. Workflow diagram of the entrepreneurship information platform

3. Blockchain System

3.1. Effective Information Interaction

Different models are needed for the bullwhip effect and the effective information interaction problem. In calculating the bullwhip effect and the effective information interaction, we can derive the corresponding demand forecasting model. Thus, the demand expression for autonomous enterprise i at time period t+1 is :

$$Q_{i,t+1} = N_{i,t} + r_{i,t} \tag{1}$$

$$(x)^+ = \max\{0, x\} \tag{2}$$

ri denotes the random value of supply chain enterprise i facing demand Qi,t+1 with variance s2. Based on this, the analysis of the bullwhip effect and the effective interaction of information between upstream and downstream enterprises in the supply chain requires the assumption that the manufacturer in the upstream of the supply chain can only truly obtain Qi,t in the case of effective interaction of information among the demand enterprises in the supply chain, i.e. in the time period of t, the real demand data of the enterprise terminal The supply chain can only obtain the real demand data in period t.

When upstream and downstream supply chain firms adopt a conservative strategy, the values of inventory levels and safety stocks fluctuate, however, the safety factor is not related to the time period and the part influenced by the conservative attitude is offset when calculating the order quantity, so that the order quantity fluctuation does not change compared to the risk neutral case. The bullwhip effect can be reflected by the ratio of the variance of upstream demand to the variance of terminal demand. The bullwhip effect in the case of a conservative strategy is expressed as follows.

$$\frac{W_{a,t}^I}{Q_{a,t+1}} = \frac{Var\left[Q_{a,t+1} \middle| P_{j,t}\right]}{Var\left(Q_{j,t+1}\right)} = (1+\lambda)^2 + \lambda^2 \tag{3}$$

$$\frac{W_{a,t}^U}{Q_{a,t+1}} = \frac{Var\left[Q_{a,t+1} \middle| Q_{j,t}\right]}{Var\left(Q_{j,t+1}\right)} = (1+\lambda)^2 \tag{4}$$

3.2. Real-time Audit Supervision

The difference is that firstly, business processes and financial processes are endorsed by the organization members who are granted approval and form a non-tamperable event record written into the distributed ledger; secondly, business data and financial data of major businesses can be formed in the form of adding new smart contracts to form a self-audit, and when the data and logic of financial processes and business processes do not match, the system can automatically determine that the data is not legal and issue an early warning to organization members. When the financial process does not match the data and logic of the business process, the system can automatically determine that the data is not legitimate and issue an early warning to the members of the organisation.

Each update of data in the blockchain requires confirmation from other nodes in the organisation and an endorsement signature from a node that conforms to the rules. The flow of all business transactions in the channel is hashed and encrypted and time-stamped. The hash value in the chain in the blockchain is closely linked to the hash value in the previous block chain, the data entered in this block is based on the data entered in the previous block, if the data on a node in a block is modified, the hash value of all the records related to this data in the blockchain will change, and the other nodes in the chain quickly identify it through hash verification, so malicious tampering of the financial data in the chain is not actionable.

The blockchain system is based on a superledger platform that is well scalable and allows for flexible configuration of the endorsement strategy corresponding to the rules of corporate governance and membership when changes occur. The system can therefore continue to expand to establish new channels and permissions with external regulators, new investors, creditors and companies upstream and downstream of the business chain, meeting a wider range of requirements for the right to know, inspection and data reliability.

4. Analysis of Self-Employment

4.1. Analysis of Entrepreneurial Orientation

Table 1 examines the relationship between entrepreneurial orientation on the four dimensions of strategic entrepreneurship through multiple regressions. All model 1 has only control variables, and all model 2 adds the mediating variable entrepreneurial orientation to the corresponding model 1.

(1) Testing the relationship between entrepreneurial orientation and network reconfiguration

As can be seen from the table, model 2 has a significant change in R2 and a significant regression coefficient for entrepreneurial orientation (β=0.364, $p<0.001$) after adding entrepreneurial orientation to model 1, indicating that entrepreneurial orientation has a significant effect on network reconstruction of the focal firm.

(2) Test of the relationship between entrepreneurial orientation and resource integration

As can be seen from the table, model 2 has a significant change in R2 after adding entrepreneurial orientation to model 1 and the regression coefficient of entrepreneurial orientation is significant (β=0.532, $p<0.001$), indicating that entrepreneurial orientation has a significant impact on the resource integration behaviour of focal firms. (3) Test of the relationship between entrepreneurial orientation and R&D heterogeneity

As can be seen from the table, model 2 has a significant change in R2 after adding entrepreneurial orientation to model 1 and the regression coefficient of entrepreneurial orientation is significant (β=0.416, $p<0.001$), indicating that entrepreneurial orientation has a significant impact

on the R&D off-site activities of focal firms.

(4) Test of the relationship between entrepreneurial orientation and industrial innovation

As can be seen from the table, model 2 has a significant change in R2 after adding entrepreneurial orientation to model 1 and the regression coefficient of entrepreneurial orientation is significant (β=0.635, $p<0.001$), indicating that entrepreneurial orientation has a significant impact on the industrial innovation behaviour of the focal firms.

Table 1. Regression analysis of mediating variables on the dependent variable

	Network reconfiguration		Resource integration		R&D in different places		Industrial innovation	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Entrepreneurial orientation		0.364		0.532		0.416		0.635
R^2	0.214	0.645	0.223	0.514	0.265	0.478	0.275	0.589
F test	4.535	63.457	4.631	55.335	4.639	68.134	4.789	77.463

In summary, entrepreneurial orientation has a significant positive effect on network reconfiguration, resource integration, R&D relocalisation and industrial innovation, i.e. the forward-looking, risk-taking and innovative nature of entrepreneurial orientation is a positive driver and essential for strategic entrepreneurial activities. Network reconfiguration, resource integration, R&D relocation and industrial innovation all require the focal company to have a unique vision, to be innovative and to make risky decisions to seize entrepreneurial opportunities based on rational decision-making. In short, entrepreneurial orientation is an attitude and willingness that can lead to a series of exploratory and development activities in the focal company. Entrepreneurial orientation is embedded in strategic entrepreneurship and is an indispensable driver of strategic entrepreneurship.

4.2. Comparative Analysis of Inventory Models

Inventory management is the market response of sellers to respond flexibly to market demand and unstable market demand [16]. Taking the business information interaction between suppliers and manufacturers as an example, by deploying actual business-based procurement smart contracts and dynamic inventory process management in the blockchain system, the management efficiency of the entire supply chain will be improved and upgraded from manual paper to fully automated deployment and execution, but the specific implementation process of actual operational business outside the blockchain network still needs to be completed by specific business subjects based on the decision results of smart contracts. In the traditional supply chain core data system, there is poor compatibility of database systems with each other, and there is a lag in information transmission and interaction, relying on manual and paper-based [17-18]. The traditional inventory management process is shown in Figure 3, and the blockchain-based information interaction system is shown in Figure 4.

According to Figure 4, the introduction of blockchain technology into the supply chain system enables procurement information and supply information to flow and interact freely in the blockchain network, and allows collective decision-making based on real business information. It has successfully achieved an accurate grasp of the interaction of each actual business information of

traditional upstream and downstream enterprises in the supply chain, which has a significant mitigating effect on the cascading bullwhip effect. The seller can make inventory plans and obtain all the information about the manufacturer in real time through the blockchain system, and this information is highly reliable and real, and is open and transparent and fully recognised. Taking the inventory link as an example here, the actual business-based procurement smart contracts and dynamic inventory process management are deployed in the blockchain system, and the entire supply chain management process is optimised accordingly, from manual paper to fully automated deployment and execution, but the actual operational business implementation process outside the blockchain network still needs to be completed by specific business entities based on the decision results of the smart contracts.

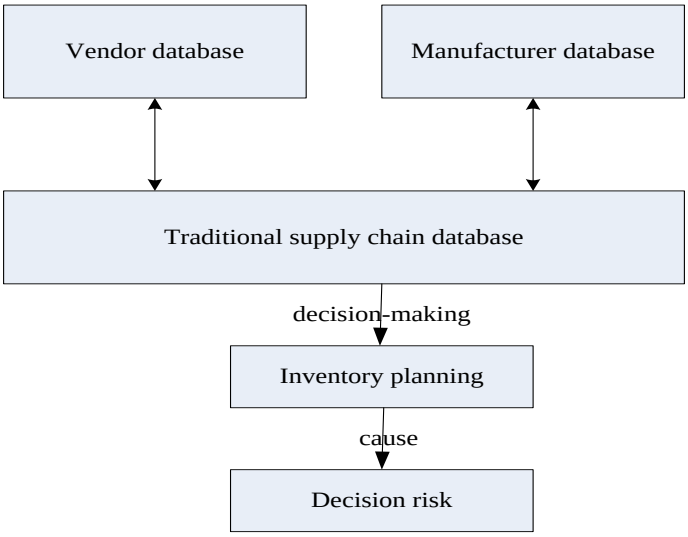

Figure 3. Traditional inventory management flow chart

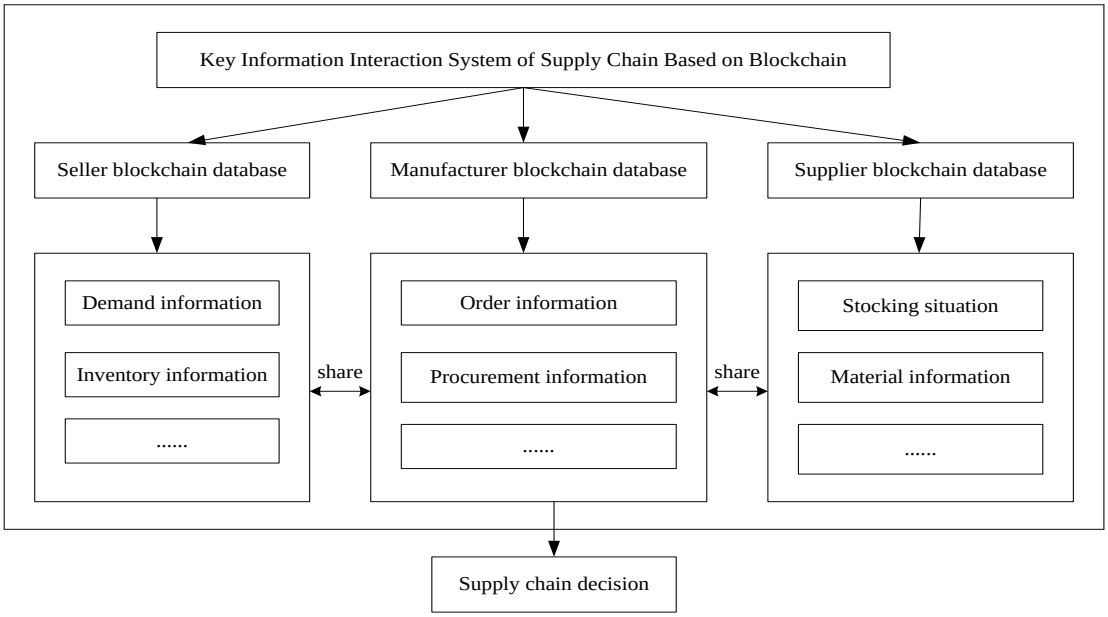

Figure 4. Blockchain-based information interaction system

5. Conclusion

As blockchain technology has the characteristics of distributed, trusted database, open source programmable, collective witness, etc., the independent entrepreneurship in construction machinery industry taking into account blockchain technology can facilitate the information interaction of upstream and downstream enterprises, and the low-cost adoption of blockchain technology can effectively improve the operation efficiency of the whole enterprise, which is a technical upgrade on the basis of the existing supply chain network system. Entrepreneurial orientation has a catalytic role in network reconfiguration, resource integration, R&D offshoring and industrial innovation, and should be embedded in strategic entrepreneurship. Whether blockchain technology can bring universal innovation in the field of corporate governance in the future, the following aspects still need to be studied: firstly, the supervision and governance of blockchain technology itself, and secondly, the boundary of blockchain technology to replace traditional governance.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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