

Blockchain Based on Network Data Interaction Helps the Construction of Digital Economy Cost Control System

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Abstract: Enterprises must take cost control actions to gain advantages in the fierce market competition. Therefore, if enterprises want to achieve sustained and stable development and make contributions to the steady and rapid development of the economy, they must make deeper adjustments to the cost control to improve the profit space. The economic environment on which the traditional cost control depends has begun to die out, and the deficiencies of its theories and methods have become increasingly prominent. The development of cost control is not only reflected in new technologies and methods, but also reflected in ideas. This paper attempted to integrate the blockchain based on network data interaction into the cost control of the digital economy, and established a cost control system that adapted to the development needs of the times. This paper adopted the Analytic Hierarchy Process (AHP) method. It took cost control as the center of evaluation, and worked according to the overall cost impact degree, so as to minimize the impact on the overall cost during project implementation. The experimental results showed that when the throughput was 100, the time spent by system A and system B was 13.6s and 6.1s respectively, and the average delay of system A and system B was 1.25s and 0.27s respectively. It could be seen that the operation efficiency of system B was higher.

1. Introduction

With the rapid improvement of productivity and the rapid development of science and technology, especially the extensive use of network technology, the industrial economy has become a digital economy. At the same time, the internal and external environment of enterprises are also constantly changing, and enterprises are gradually moving towards internationalization. In the worldwide competition, Chinese enterprises would face greater global competition pressure. Under such circumstances, if enterprises want to win and maintain their competitiveness in the future development, it has become an urgent problem to be solved. The changes in the social and economic environment have had a profound impact on enterprises. It has also promoted fundamental changes in the concept and methods of cost control of enterprises. Therefore, cost

control is a very important work.

With the booming development of Bitcoin, the blockchain technology adopted behind it has also been highly valued by many scholars. The blockchain has a strong transformation potential and would become a key driving factor for the construction of the digital economy, digital society and digital China, which is another major leap in human society. With the in-depth study of blockchain technology, especially the introduction of smart contract technology, blockchain technology has realized the processing of complex cost control. Therefore, it is widely used in cross-border payment, supply chain finance and other fields. Smart contracts have the characteristics of complete transparency to all participants and consistent contract provisions, so they can reduce the distrust between enterprises. Therefore, the use of blockchain smart contracts to achieve cost control management can change the status of cost control, so that the cost control information and data interaction of each enterprise can be realized.

2. Related Work

With the development and application of Internet technology, cost control is gradually entering a state of digital life. Dong Lingling found that cost control played a core role in enterprise management. Cost control was an important work of current enterprise financial management [1]. In view of the poor economic cost control and investment effect of small and medium-sized enterprises, Liu Zhichao elaborated the current situation of enterprise economic cost control. He analyzed the basic business process of economic cost control, and established an investment effect evaluation model. The experimental results showed that this method could accurately analyze the economic cost control and investment effect of small and medium-sized enterprises [2]. The purpose of Hwang Bon-Gang research was to investigate the effect of cost control in large projects and find out the key knowledge areas highly related to the cost control of large projects. Finally, it was found that the knowledge field was highly related to the cost control of large projects. It showed that compared with general projects, large projects were more relevant to cost control [3]. The above scholars pointed out that cost control played an important role in the competitiveness of enterprises.

After entering the 21st century, cost control is defined as a strategic idea. Sinambela Ella Anastasya pointed out that the furniture industry was a long-standing industry in Indonesia. The frequent problem was that it was difficult to control costs, which often led to overproduction or shortage as well as the losses for industry participants [4]. Oyegoke Adekunle Sabitu aimed to identify and analyze the factors that affected the selection of effective cost control technology in the construction industry, and evaluated its importance. His research relied on the hybrid method to qualitatively discuss the most effective cost control technology. As the most effective cost control technology, budget technology ranked first, followed by cost forecasting and cash flow monitoring [5]. The above scholars believed that with the development of modern network technology, it provided essential technical support for business division, cost control standards and other work of enterprises.

The traditional cost control system is mainly centralized, with different departments and lack of unified standards and interfaces, thus resulting in difficulties in cross-department flow of cost control [6-7]. Traditional cost control is basically to store user and property information through electronic databases, so there is a risk of being tampered with, resulting in user property losses. The blockchain has the characteristics of decentralization, trustworthiness, and non-tamper, which can well solve the above problems [8]. Therefore, it is of great practical significance to study the cost control system based on blockchain to realize the safe flow of cost control information across institutions.

3. Design of Cost Control System Based on Blockchain

Cost control refers to the strict calculation, adjustment and monitoring of various factors affecting the cost in the production and operation process of the enterprise, and the timely discovery of the difference between the actual cost and the predetermined standard cost. Through some methods, costs are continuously reduced and profits are increased [9-10].

The implementation of cost control has three important meanings: First is to clarify the purpose of cost control; second is to strengthen the process monitoring of cost control; third is to focus on the future. Any business of an enterprise would generate certain costs, so any cost, such as manufacturing cost, cannot be separated from cost control. Cost control is a work involving a wide range of aspects, and various enterprises have conducted research from different perspectives [11]. In production enterprises, in order to achieve the purpose of cost control and combine benefits, costs are usually classified. Various costs would be generated in all production links of the enterprise. Therefore, by allocating these costs, it becomes a kind of cost. In order to achieve the unity of power and responsibility, enterprises must decompose the cost composition into each cost department, that is, implement cost hierarchical management, so as to maximize the subjective initiative of each department in cost control [12-13].

3.1 Blockchain Technology

Blockchain technology itself is very valuable and promising. At the bottom of Bitcoin network, it can be a data structure to record data. This data structure has the characteristics of decentralization, data unchangeability and revocation. It is very suitable for building a highly safe and reliable system, and can even be fully constructed as a shared social infrastructure. The main functions of blockchain are shown in Figure 1:

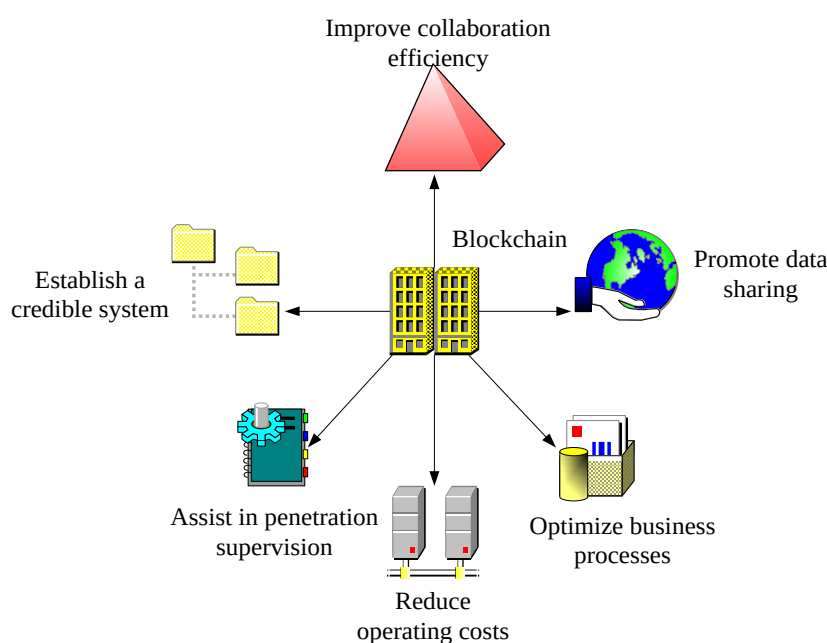


Figure 1. Main functions of blockchain

As shown in Figure 1, the main functions of blockchain are as follows: First is to improve the efficiency of cooperation; second is to promote data sharing; third is to optimize the business process; fourth is to reduce operating costs; fifth is to help to penetrate supervision; sixth is to

establish a credible system. At present, blockchain technology has received great attention from governments, enterprises and financial institutions, and it has been rapidly integrated with traditional industries, including medical field, transportation, data management and privacy protection, supply chain, financial credit, smart city, Internet of Things and other fields.

(1) Decentralization

Decision-making institutions and account books of the blockchain are distributed on each node of the network. Each fully functional node has a copy of the account book and is jointly maintained by the nodes of the entire network. All nodes have the same rights and assume the same responsibilities to determine which blocks can be added without intermediate permissions.

(2) Openness

The blockchain system is highly open. The data stored in it is open to all participants. Everyone can participate in the transaction, and get transaction confirmation, so as to participate in consensus and decision-making.

(3) Data cannot be tampered with.

All transaction data are verified by all nodes of the whole network, and would be permanently saved in a blockchain after confirmation.

At present, the access control of many systems is based on the centralized management mode. If the blockchain technology is used to update it, the traditional access control mode would have the characteristics of blockchain decentralization and high reliability. Based on this way, a kind of access control for most systems with wide application prospect and with little customization can be developed.

3.2 System Design

(1) Overall system architecture

In the traditional cost control system, due to the single and static cost control indicators, it is difficult to consider the needs, work skills and self-worth of different employees in the work, thus resulting in contradictions between individuals and enterprises [14]. Employees are not willing to overload in work. Therefore, when determining the cost control objectives, managers should understand the real ability of employees to control costs. Only by relying on an effective cost control mechanism can employees' own cost control ability be explored and finally the cost control results reflecting their actual ability can be output in the enterprise cost control system [15].

The cost control of an enterprise refers to a series of prevention and adjustment measures taken by the cost control subject to various factors and conditions affecting the cost within its scope of authority in accordance with the predetermined cost control objectives in a specific period of time to ensure that the cost control objectives can be achieved [16].

The cost control system consists of basic subsystem, execution subsystem and support subsystem. The execution subsystem is composed of four parts: quantum counting subsystem, analysis subsystem, improvement subsystem and evaluation subsystem. These four subsystems are the core content and key elements of the entire cost control system, as shown in Figure 2:

As shown in Figure 2: measurement subsystem: The measurement subsystem is the basis of the entire implementation subsystem. The cost control process of its analysis, improvement and evaluation is inseparable from the cost measurement, which uses activity-based costing.

Analysis subsystem: The analysis subsystem is an important part of the execution subsystem. The analysis here is the analysis at the strategic level rather than the analysis at the operational level. It includes strategic positioning analysis and strategic cost driver analysis.

Improve subsystem: The improvement subsystem should achieve the optimal cost control and provide elimination measures for ineffective operation and improvement measures for inefficient

operation according to the concept of improving operation management. No matter how to eliminate or improve, different methods should be adopted according to the cost reasons of inefficiency.

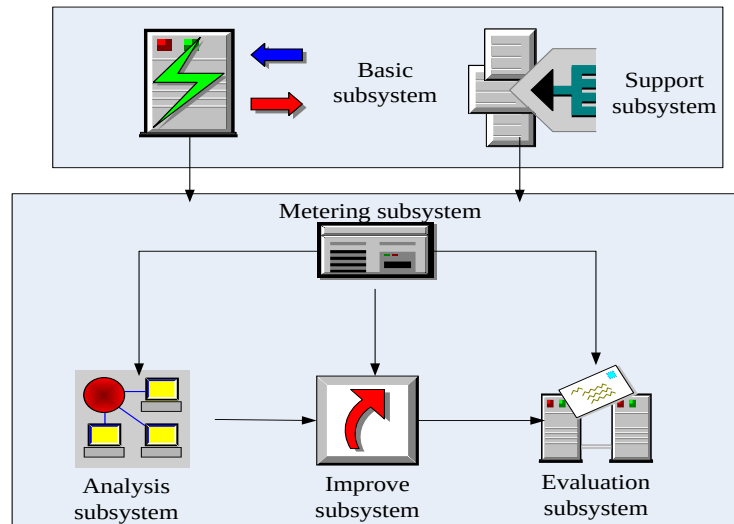


Figure 2. Overall system architecture

Evaluation subsystem: Cost performance evaluation is conducted under the guidance of the financial department and the cooperation of other departments. In terms of the benchmark of performance evaluation, the diversified performance evaluation indicators that combine the financial and non-financial benchmarks can be used. The financial benchmark is based on cost, while the non-financial benchmark includes customer satisfaction, internal process efficiency, innovation ability and other contents.

(2) Blockchain subsystem design

The main function of blockchain subsystem is to provide users with blockchain-related services. Its specific implementation is a blockchain subsystem. The blockchain subsystem receives the transaction request sent by the subsystem and calls the smart contract through the interface to pre-execute the transaction. It packages the transaction into data, and writes it into the blockchain ledger after reaching a consensus. The blockchain subsystem is shown in Figure 3:

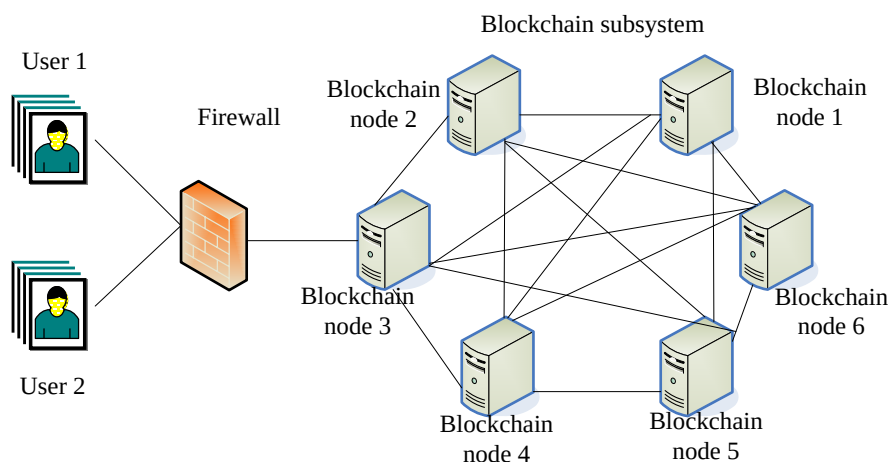


Figure 3. Blockchain subsystem system

As shown in Figure 3, the system runs blockchain nodes through firewalls to complete user tasks. The advantage of this system is that each node is connected by the blockchain subsystem. If a node's background network service fails, it would not affect the system. That is to say, it would not interfere with other tasks, thus ensuring the overall operation safety of the system. Scalability is a common problem for the application of blockchain technology, but the subsystem and blockchain subsystem in the system can be operated, so that the system can be graded according to the importance of cost control, thus enhancing the scalability of the system.

3.3 Evaluation Based on AHP

The function of evaluation subsystem is to establish evaluation criteria, and obtain evaluation information, so as to make value judgments and get evaluation results. It is an important task of enterprise cost control to implement evaluation management inside the enterprise, and financial performance is the comprehensive reflection of enterprise operation performance. Therefore, financial indicators should be selected in the evaluation subsystem to reflect the final effect of cost control. The evaluation of cost control can measure the effect of system operation, and judge whether it has achieved the desired goal, so as to evaluate and reward the implementers at all levels.

AHP method has been widely used in the field of economic management. AHP is a multi-attribute decision-making analysis method. It divides various factors related to decision-making into different levels, and combines quantitative and qualitative methods. It can rank the risks that cannot be quantified according to the weight of the impact and distinguish them from each other. It has the characteristics of flexibility and simplicity. The judgment matrix A is defined with the judgment scale as the matrix array:

$$A = (a_{ij})_{n \times m} \quad (1)$$

a_{ij} is the weight value and the most important judgment data when the AHP is applied to decision analysis in specific projects. The eigenvector W_i of the judgment matrix A is calculated:

$$W_i = \frac{1}{N} \sum_{j=1}^n \frac{a_{ij}}{\sum_{k=1}^n a_{kj}} \quad (2)$$

The judgment scale of each element N is obtained from expert judgment and experience of previous projects, so it is difficult to accurately determine the specific ratio W_i , which can only be roughly estimated. Therefore, error analysis and consistency judgment must be carried out for the final results. In each pairwise comparison matrix, the maximum eigenvalues and eigenvectors are calculated, and consistency tests are performed using consistency ratios and random consistency indicators:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (3)$$

After obtaining the weight vector of each layer element to the upper layer element, Formula 4 is used:

$$W_j = \sum_{i=1}^n a_n \times b_n \quad (4)$$

After determining the node of cost control, the cost deviation of all the work in progress (including completed and unfinished) before the node is calculated, and the arithmetic sum is WP_i . The cost deviation added to the weight of the overall cost impact degree is the sum of the weight vector of each activity multiplied by the cost deviation CV_w :

$$CV_w = \sum_{i=1}^n w_i (BCWP_i - ACWP_i) \quad (5)$$

The evaluation subsystem is the process of evaluating the implementation effect of strategic cost control, and dynamically measuring the completion of cost control objectives and process implementation, as well as providing feedback information to users. As the final link of the strategic cost control system, the evaluation subsystem is the end of the old cycle and the beginning of the new cycle. It can not only evaluate the previous performance, but also provide a basis for decision-making for the improvement of the future cost control system. To achieve this goal, it is necessary to introduce non-financial indicators closely related to the internal operation of the enterprise.

4. Current Situation and System Effect of Traditional Cost Control System

4.1 Challenges Faced by Traditional Cost Control System

The business environment of enterprises is constantly changing, and the cost control of enterprises is also constantly changing. With the continuous innovation of technology, the continuous diversification of product demand and the continuous automation of production environment, enterprises have problems using traditional cost control, so cost control must be adjusted. In the case of continuous technological innovation, cost control has been unable to match the current reality, thus exposing many defects. This paper investigated 40 enterprises in a city.

(1) Unable to meet the requirements of enterprise strategy

The traditional cost control method isolates the internal situation of the enterprise and ignores the information from the outside and from the competitors, thus separating itself from the increasingly fierce market competition and making the information provided by it less and less relevant to the cost control. First of all, in the traditional cost control, the profit of the enterprise comes from the internal benefit of the enterprise, but the competitiveness of the enterprise also depends on the external environment of the enterprise. The competition between enterprises produces profits. Only enterprises with competitive advantages can obtain long-term benefits. Therefore, enterprises should formulate appropriate competitive strategies. The adaptability of traditional cost control methods to enterprise strategy is shown in Table 1:

Table 1. Adaptability of traditional cost control methods to enterprise strategy

Adaptation	Enterprises	percentage
Very maladaptive	14	35%
Relatively maladaptive	12	30%
Generally maladaptive	8	20%
adaptable	4	10%
Very adaptable	2	5%

As shown in Table 1, 14 enterprises indicated that the traditional cost control method was not suitable for the strategic requirements of enterprises, accounting for 35%. There were 12 enterprises

that showed that the traditional cost control method was relatively suitable for the strategic requirements of enterprises, accounting for 30%. Eight enterprises indicated that the traditional cost control methods was generally suitable for the strategic requirements of enterprises, accounting for 20%. Four enterprises indicated that the traditional cost control method was suitable for the strategic requirements of enterprises, accounting for 10%. Two enterprises showed that the traditional cost control method was very suitable for the strategic requirements of enterprises, accounting for 5%.

The role of traditional cost control is very limited, because many costs have been confirmed before the product, and the strategic positioning, development goals and long-term plans of the enterprise are ignored, which often leads to the transitory management actions of the enterprise and the lack of sustained impetus for the development of the enterprise. The management of modern enterprises has changed from simply pursuing the maximization of short-term product benefits to seeking competitive advantages that can support the long-term sustainable development of enterprises, and cost control should also serve this strategic goal. Only by adopting different cost control principles according to different competitive strategies can the enterprise's cost control play a maximum role.

(2) Low efficiency and high cost of manual control

The traditional cost control, whether it is data collection, data processing or data transmission, is mainly manual, and focuses on the post-analysis and control of data. When setting standards, calculating costs and comparing deviations, they are all done manually. In this case, the cost control efficiency is not high. The efficiency and cost of manual control.

Manual control is used, so there would be some lag from acquisition, input to report, and the transmission of information would not have the advantage of time. The management decision of the enterprise would be inaccurate, and the actual operation of the enterprise would become meaningless. Every operation link of the enterprise is undergoing earth-shaking changes, and the cost of the enterprise is becoming more complex. Therefore, it would be more difficult to use traditional cost accounting and control. Although informatization has been advocated, many enterprises, especially small and medium-sized enterprises, still use manual control in order to save costs, which leads to increasingly difficult cost control for enterprises.

(3) Traditional cost control standard is single.

The traditional cost control method can not effectively solve the incentive and supervision problems of the cost control standard, because it only focuses on the cost control of the product itself and uses a static standard for the allocation of manufacturing costs. The use of the standard is only based on a certain amount. If the standard is set too high, it would affect the enthusiasm of employees. If the standard is set too low, it would not play an incentive effect. The single degree of traditional cost control standards is shown in Table 2:

Table 2. Singularity of traditional cost control standards

Single degree	Enterprises	percentage
Very simple	13	32.5%
Relatively simple	10	25%
Generally single	11	27.5%
rich	3	7.5%
Very rich	3	7.5%

As shown in Table 2, there were 13 enterprises that believed that the traditional cost control standard was very simple, accounting for 32.5%. There were 10 enterprises that believed that the cost control standard was relatively simple, accounting for 25%. There were 11 enterprises that

believed that the cost control standard was generally single, accounting for 27.5%. There were 3 enterprises that thought the cost control standard was rich, accounting for 7.5%.

With the constant change of market and customer demand, the production and operation environment of enterprises is also changing. Therefore, enterprises cannot ignore the change of demand. They can't rely on unilateral high production to reduce costs, and they can't create some illusion of cost control by beautifying the financial report. This would not only hinder the enterprise's management personnel from making correct decisions, but also adversely affect the enterprise's business activities.

4.2 System Test

(1) Throughput time and average delay of different systems

The digital economy cost control system is controlled with mobile terminals as the core. The scale of terminal users is large, so it is possible to have multiple users trading together. Therefore, the overall performance must be tested. The performance is mainly reflected in the throughput time and average delay. Therefore, this paper selected two test indicators, transaction throughput and average transaction delay, to test the transaction performance of the system. This paper compared the traditional cost control system (system A) with the blockchain-based digital economy cost control system (system B), and selected 100 throughput.

(2) Enterprise use effect

In all the production and operation processes of the enterprise, the enterprise should be responsible for the corresponding costs at any time. The costs consumed by the enterprise are not only in the production process of materials. In order to implement cost control, a cost control system has been designed using blockchain to create good conditions. The degree of satisfaction and effectiveness of enterprises with the system designed in this paper.

The digital economy cost control system based on blockchain introduced in this paper could solve the problems of insufficient effective incentives caused by the single standard of traditional cost control, the contradiction between the objectives of employees and the objectives of enterprises, and the failure of supervision and incentives at the same time. This promoted the coordination between the interests of employees and the overall interests of the enterprise, thus achieving the best cost control of the enterprise. This could not only save the cost of the enterprise to the maximum extent, but also stimulate the potential of employees. In addition, blockchain could also solve problems such as distortion of product cost information and lack of correlation between cost targets caused by traditional cost calculation methods. It could provide more accurate cost information for the cost control of enterprises.

5. Conclusions

The development and application of modern information technology has laid the foundation for achieving diversified production cost control standards and accounting. This paper combined network data interaction with blockchain to establish a cost control system that could comprehensively realize cost control in enterprises. The advanced information system provided convenience for the communication between the responsible departments and between the upper and lower managers. Therefore, enterprises must transform backward data processing and collection methods, and apply advanced information technology to provide an unimpeded system for enterprise cost control. The system was tested in the experiment. The experimental results showed that the system designed in this paper could achieve the automatic cost control function required by enterprises. In the process of social development, the research on cost control would be further developed, and more updated content would be incorporated into the system, so that it could better

control the cost and provide more services for enterprises.

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