Mechanism Construction of Human Resource Management based on Blockchain Technology

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Abstract  The traditional human resource management system is faced with such problems as the quality of staff recruitment cannot be guaranteed, the training performance is not consistent with the actual performance, the enterprise performance appraisal is unfair, and the salary distribution is unfair, which seriously affects the enthusiasm and loyalty of employees and threatens the survival and development of enterprises. In view of the current situation and problems of human resource management system, combined with the technical characteristics of blockchain, this paper proposes a human resource management mechanism based on blockchain technology, in order to achieve the company’s human resource management system accurate, efficient, open and transparent. It is found that there is a good coupling between blockchain technology and human resource management system. This paper constructs a human resource management mechanism based on blockchain, innovates the application scenarios of blockchain technology, and provides certain guiding significance for the establishment of human resource management system and process improvement in the future.

Keywords  blockchain; human resource management; mechanism construction

1 Introduction

In the process of human resource management (HRM), the following phenomena are common: False employee’s resume; the employee’s performance in the training process is inconsistent with the actual situation; unfair performance appraisal and salary distribution; unclear position promotion; and untimely employee’s evaluation feedback[1]. These phenomena reflect that most enterprises’ human resource management system is not systematic, which makes human resource management unable to achieve the goal of reasonable distribution of human resources, property and other resources, which has a serious adverse impact on the survival and development of enterprises. In most enterprises, the salary and promotion are decided directly by the collective leadership. The subjectivity of decision-making members becomes the root of unfairness. The blockchain technology shows the characteristics of decentralization, information traceability, tamper proof, openness and transparency, which points out a new direction
for the improvement of human resource management system. Since the concept of bitcoin was proposed by Nakamoto in 2008, the attention and application of blockchain technology have been increasing in recent ten years. In essence, blockchain is a decentralized database. Data blocks are interconnected to form a chain through cryptography technology. The public key and private key owned by users can ensure the openness of transaction records and the security of personal information. Each data block records the transaction information of all kinds of network users, so as to realize the traceability of transaction information. Then some transaction record information is merged into a block and recorded in the distributed public account book to save all transaction record information, which ensures the decentralized characteristics of blockchain technology. At present, blockchain technology has shown a very good internal mechanism, and its core technologies such as distributed accounting technology, asymmetric encryption technology, chain structure, consensus mechanism, smart contract and other core technologies are highly consistent with the commercial needs, which has aroused the attention of blockchain technology in various fields. As another new outlet for technological innovation and institutional upgrading, the field of human resource management participates in the research and application scenarios of blockchain technology with a positive attitude, and establishes credit system through efficient, convenient and legal technical means. The application of new technologies such as blockchain will have a significant impact on the traditional human resource industry. It can not only become a new and upgraded technical special tool for the industry, but also greatly enhance the logic of generating key business. It will promote the comprehensive transformation and development of the industry in recruitment, back adjustment, training, performance incentive, flexible employment, labor contract storage and other aspects, so as to create a human resource management bank trust ecology in the whole process of industry. Therefore, this paper proposes a human resource management mechanism based on blockchain technology. Firstly, the basic components of blockchain are analyzed. Then it describes an integrated human resource management mechanism of blockchain. Finally, an example is given to explain the function and construction process of this mechanism. The overall structure of the paper is as follows. The second section introduces the related work of blockchain. The third section explains in detail the framework of human resource management system based on blockchain technology, and gives an example to explain how the proposed framework is applied to institutional construction. The fourth section summarizes the connotation of human resource management mechanism of blockchain. Finally, the fifth section summarizes the full text.

2 Related Work

2.1 Application of Blockchain Technology

In the research of foreign scholars, our team has tried to search for various keywords that combine blockchain technology with human resource management, but unfortunately, foreign scholars seem not interested in the combination of the two. Foreign scholars’ research on the application of blockchain technology focuses on the integration with financial industry, supply chain management, medical treatment, logistics industry, etc., such as the integration of blockchain technology and financial industry, Chang first described the impact and revolution
of financial technology and blockchain technology on the financial industry, then interviewed 16 experts with qualitative method, discussed the development of blockchain in the financial field, and described the real motivation of banks to use blockchain technology. In terms of the integration of blockchain technology and agricultural supply chain, Ahluwalia and others focused on the traceability of agricultural food supply chain. In agriculture, we need to establish a traceability system based on blockchain technology to ensure the quality of agricultural food. In terms of integration with the medical industry, Tandon and other research results show that blockchain can improve the general standards of processing, sharing and processing medical data and personal health records by improving efficiency, access control, technological progress, privacy protection and security of data management process. In terms of integration with logistics industry, Bagloee and others studied the potential application of blockchain in transportation, logistics and supply chain industries, and formulated the concept of tradable mobile license (TMP). Based on the deployment of TMP scheme of blockchain platform, the specific scenarios such as dynamic pricing, emergency vehicle priority, heavy truck scheduling and networked vehicles are set and arranged. The above-mentioned articles only show a general situation of foreign scholars in blockchain technology research, only to illustrate the difference between the research focus and domestic scholars, and are not representative.

2.2 Application of Blockchain Technology in Human Resource Management

From the perspective of human resource management, domestic scholars have tried to combine blockchain technology with human resource management, and in recent years, there are more and more researches in this field. Hang thought that blockchain will bring changes in recruitment, training and performance evaluation of human resource management; Zheng and others believed that blockchain technology will bring more efficient social network and lower trust cost to enterprise recruitment, and put forward chronobank and CTE based on blockchain technology Chain is a representative model of two recruitment modes; Zhang took colleges and universities as the research object of human resource management, combines human resource training and development of colleges and universities in the new period with blockchain technology, and puts forward a university training system based on blockchain technology; Shen and Zhu applied blockchain technology, especially the intelligent contract technology, to the enterprise human resource management system. And a human resource system based on blockchain technology is designed. Zhang and Xing proposed to use “blockchain” technology to solve the problems such as low recruitment efficiency in the recruitment market, time-consuming and laborious resume screening, and false academic information. The “blockchain” technology is integrated into the recruitment market, in order to solve the problem of trust cost in the recruitment process, improve the efficiency of recruitment, and save financial and material resources; He and Feng took platform enterprises as the research objects, and provide an effective implementation way for the new platform enterprises and traditional enterprises with platform transformation and upgrading to build a new human resource management system. In order to solve the problems of casual recruitment and labor relations in platform enterprises, Feng used blockchain technology to solve the problems of difficult back adjustment, high cost and long time-consuming in the process of human resource management, which is expected to improve the efficiency of enterprise recruitment by using blockchain technology. Chen, et al.
first introduced recruitment, training and performance in the process of human resource management. Pay and employment issues, and use the characteristics of blockchain technology to improve each part of the theoretical level. Liu, blockchain researcher of the Ministry of industry and information technology of China, said that the combination of blockchain technology and human resources industry will solve the problems of authenticity and trust of personal information and enterprise information, build a trust bridge between individuals and enterprises, and promote credit the development of related industries. To sum up, it can be seen that blockchain technology can be applied in all aspects of human resource management. From recruitment to training, to performance pay, blockchain technology can be optimized to a certain extent.

3 Mechanism Construction

3.1 Blockchain and Consensus Mechanism

The basic structure of the blockchain is shown in Figure 1. The information of records or transactions will be stored by the blockchain in batches in data blocks containing time stamps, so as to achieve the order of transaction time. The information of the data block can hardly be tampered with. Only when the malicious nodes with fifty-one percent of the computing power of the whole network attack, can it be tampered with. A transaction is often recorded in a block in the form of a smart contract. When a new transaction or record is generated, the recorder uses its own public key to identify the transaction information, and connects it with the public key of the previous record data block, and then the private key of the previous transaction recorder is used to verify the authenticity of the transaction information. After the private key is verified, the transaction is executed automatically to realize the transaction without the third party and improve the efficiency of the transaction. Transaction information is broadcast to the whole network to ensure the credibility of transaction records. The public key and private key is based on the hash algorithm in cryptography technology, which transforms the input of any length into the output of fixed length through the algorithm, which makes the input and output present unidirectional. Merkle tree is based on hash algorithm. Through continuous merging and calculation, a root hash is finally obtained. In this way, the structure of Merkle tree can be used to verify whether the transaction data is damaged or tampered. Therefore, based on the inherent algorithmic logic between public key and private key, the recorder outside the transaction can not know the personal information of both sides of the transaction, so as to realize the transparency of transaction information and the security of personal information. It is this strict information recording structure that makes the transaction information traceable, tamper proof, open and transparent, fast and effective transactions, and personal information security and confidentiality.

In bitcoin blockchain, each record node obtains the right to record public account books through proof of work pow (proof of work). As a token, bitcoin rewards the computing power leader in workload proof. However, the workload as the basis of bitcoin consensus mechanism proves that although decentralization is realized, it can only carry out 2~3 operations per second, so it is difficult to shorten the block confirmation time. Although POS (proof of stake) improves the computing power to more than 1000 times per second, it is still a way to obtain accounting rights based on hash operation competition, so it has weak supervision. On the basis
of the proof mechanism of DPOS, it will be based on the proof mechanism of DPOS. DPOS first takes the rights and interests of each node as a vote, and obtains the top multiple recorders with the largest interests through election, and then verifies and records the transaction information in turn among these recorders. The premise is that ninety percent of the bookkeepers need to be online. If there is “Absence” behavior, the recording node will be banned and replaced by a new node. This consensus mechanism greatly reduces the number of nodes participating in verification and bookkeeping in the proof of workload mechanism, and increases the speed of block output. The speed of consistency verification can reach the level of seconds. At the same time, it avoids the high cost of POW and the weak supervision degree of POS. According to the working principle of DPOS, the recorder is selected by election, and then verified and recorded by the recorder in turn, which is very suitable for the scenario of enterprise human resource management data management. According to different classifications, blockchain will have different application directions. Generally, according to different service objects and audience subjects, different forms are adopted, which are generally divided into public blockchain, consortium blockchain and private blockchain. Compared with the public chain, the scope of the audience subject of the alliance chain is reduced, and the degree of openness is slightly reduced. It is only open to the organization members within a certain range. The data on the chain can be viewed externally. However, the authority to generate and record the data on the chain is defined by the manager of the alliance chain. Considering the scope characteristics of the three types of blockchain, this paper proposes a human resource management mechanism based on alliance chain.

![Basic structure of blockchain](image)

Figure 1 Basic structure of blockchain

### 3.2 Construction of HRM Mechanism Based on Alliance Chain

The basic structure of human resource management mechanism based on alliance chain is shown in Figure 2. The content shown in the middle box of Figure 2 mainly covers the operation logic of the data layer and consensus layer of the mechanism. The information block chain formed below is stored on the devices of nodes at all levels. For users or enterprises, what needs to be operated is an App based on such bottom layer data structure. The main function of the app is to complete the interaction and storage of various information data and
analysis. According to the current development of human resources industry, a company from interviewing a candidate to the final appointment will often go through the following steps: Recruitment, back transfer, training, employment, and finally rely on the performance pay system to keep excellent talents in the company. Human resource research is to determine the effectiveness of past and present human resource practices through data analysis\textsuperscript{[15]}. The process of human resource management can be simplified as an interactive process of data information. From the perspective of the enterprise, that is, the employee information is screened out by the enterprise, and the employee is hired through the confirmation of the application information and the performance of the on-site interview; from the perspective of the employee, through the interview and training, we can see whether the enterprise image and the specific work process are consistent with the external publicity, which is the first interaction of information; during the period of working for the enterprise, the traditional enterprise managers pay performance bonus according to the employee’s performance, and the employee will judge his own performance and income as well as others’ performance and income, and decide the next effort. This is the second interaction of information. Therefore, the human resource management mechanism based on blockchain technology is a process of information and data interaction from the operational level.

![Figure 2 Basic structure of HRM mechanism based on alliance chain](image)

From the data layer logic of the mechanism, as shown in Figure 2, the mechanism divides the enterprise Human Resource Management Alliance into two levels, namely, the enterprise first level node alliance and the enterprise second level node alliance, and uses the DPOS consensus mechanism together. In order to ensure that the task data uploaded by employees is credible and has not been tampered with, the hash value of the task data summary, the public key of the data upload employee and the upload time stamp are collectively called an information aggregation info. The hash value of the info is calculated and stored in the leaf node of the Merkle tree. The information of the leaf node is combined in pairs and the hash value is calculated and put into the root node (info Root). This can not only ensure the authenticity of
data uploaded by employees, but also improve the verification efficiency of data authenticity by secondary nodes. As shown in Figure 3, the leaf node is composed of multiple info blocks, and then the hash value is calculated down to the tree root level of the Merkle tree. Figure 3 the blockchain structure of human resource management data is based on the alliance chain, so the DPOS consensus mechanism can stably generate a block within a certain period of time, and freeze the data once during this period. The on duty node in the enterprise level node alliance submits the generated info root root root to the blockchain, so as to achieve the purpose of tamper proof. Firstly, the DPOS consensus mechanism allows members to quickly reach an agreement and then share data to improve efficiency; secondly, it uses proxy re encryption to store task data in distributed database to improve security.

From the operational level of the human resource management mechanism, there are three different services: Information storage service, information query service and information upload service. 1) Information storage service: After the newly recruited employees enter the enterprise, the enterprise applies to the first level node to store the data information about the education background and internship related to the employee’s resume, which is only stored in the database as the basis, and is not disclosed to the public. In addition, the tasks that employees have completed can apply for storage to the first level node through the superior leader, and take this as the basis for salary payment. 2) Information query service: From the perspective of enterprises, enterprises can apply to the first level node to query whether the education and internship information of newly recruited employees is true through cross chain. From the perspective of employees, the first level node alliance of an enterprise provides query services to internal employees, which can query their own position information, basic information of related colleagues (such as name, position, entry date, achievements, etc.), completed task information and salary situation, as well as personnel information such as task quantity and salary of related colleagues. In addition, it can query the published task information, which should include the public key of the department members and the public key of the superior leader. The employees can obtain the task information after decrypting with their own private key. After the arrival number is online, the task can not be inquired and received; the audit situation after submitting the task can also be queried. When the employee completes the task

![A Branch of Merkle Tree](image-url)
Mechanism Construction of Human Resource Management based on Blockchain Technology

3.3 Case Verification

This section will take Nanjing Branch of R insurance company of China as an example to explain how the proposed framework should be applied to institutional construction. R insurance company is the group company with the largest asset scale and the highest premium income in China’s insurance industry, involving insurance business, securities investment business, etc. In this case, the human resource management mechanism of its marketing business is mainly studied. At present, the company’s human resource management system is as follows: Relying on school recruitment or social recruitment to find new employees, but the recruitment threshold of marketing posts is often relatively low, which often leads to the confusion of new employees and difficulty in reciting; and the positions promised in the enterprise interview often start from sales insurance, which is inconsistent with the psychological expectations of new employees; KPI test under target management has been relatively perfect, which can play a good role in motivating employees. However, the company only shares the experience of successful employees on a regular basis, which makes most employees have psychological gap. The closed and transparent salary performance system makes employees unable to recognize their own position and position prospects, resulting in a large number of employee turnover. Therefore, it is necessary to recruit and train again and consume the resources of the enterprise, which is not conducive to the long-term survival and development of the enterprise. The human resource management mechanism based on alliance chain proposed in this paper will act as the underlying technology system in the whole enterprise’s human resource system. R company has developed its own data processing and analysis system, which appears in the form of APP on the mobile phones of supervisors, employees and customers at all levels. Customers can query their own insurance policies, employees can query their sales performance and expected salary, and supervisors can query their own range of employees and the performance of different employees. This system of R company focuses on the statistical analysis of business and salary performance, that is, it lacks the perspective of human resource management, such as the lack of recruitment, back tracking, training process, and can not achieve the goal of traceability of transaction information, tamper proof and confidentiality of customer information. The salary is calculated separately according to the company’s published standards, which can not be open and transparent. Therefore, we should use blockchain technology to improve all layers of R company’s system: The underlying data layer uses time stamp, hash function and Merkle tree pair to change data storage and encryption methods, network layer still uses P2P network, consensus layer uses DPOS consensus mechanism to change data storage node logic, and finally establishes a two-level Alliance node human resource management mechanism, which is still in the form of APP The expression exists in the mobile devices of users, employees and supervisors at all levels. Take the new employees as an example, they “trade” the information such as academic internship and other information with HR before entering the job, and HR will “trade” together with other departments in the alliance, they can use the query service to get your own historical data. 3) Information upload service: The enterprise staff requests to encrypt and upload the task data when the task is completed. The uploaded information should include the public key of each task member and the public key of the superior leader. After the approval, the superior leader can apply to the first level node to upload the task.
the information such as the promised position and the expected salary to the candidates. Since these transactions are stored in the alliance chain node through the consensus mechanism, they can be traced and cannot be tampered with. If the information of one party is found to be untrue, the untrue behavior of employees or enterprises can be carried out in the next block of the broadcast all over the network. After taking the post, each transaction information of the employee is verified by the employee and the customer, and the salary that can be obtained from the transaction is put on the chain after the confirmation of the supervisor and the employee, so as to ensure the openness and transparency of the transaction and salary payment. After handling the resignation procedures, the employee also needs to verify with the supervisor, and update the employment information of this stage in his/her system, so as to facilitate entry into other companies.

4 Mechanism Connotation

4.1 The Whole Process Information Can Be Traced

Based on the chain structure shown in Figure 3, it can realize the traceability of information in the whole process of human resource management, including employee personal information, enterprise department task information, salary payment, personnel promotion and other information. When the employees practice in other enterprises, the internship experience will be saved in the database of this enterprise. Therefore, when the enterprise recruits the employee, it can apply to the first level node of the alliance chain to query the authenticity of the internship information, which ensures the basic ability of the recruiter; the task information of the Department is released by the department leader, including its own public key, which means that the employee can verify the authenticity of the published task, and can still query the storage of the task through the traceability after completing the task. After the task is completed and approved, the leader uploads the task information, and other members can see the completion of the task (including the quality and efficiency of task completion). When paying salary, the enterprise can apply to the node to query the employee’s tasks in this month, this quarter and even this year, so as to ensure the reliability of salary payment basis.

4.2 The Whole Process Management Is Open and Transparent

The mechanism proposed in this paper relies on the distributed storage of two-level nodes in the alliance chain and DPOS consensus mechanism, which can ensure the transparency and tamper proof of task information, salary information and promotion information. The superior leader’s task release contains the employee’s public key, which indicates that the corresponding employee can apply for the task, while the employee without the public key cannot apply for the task. The task is recorded by each node of the alliance chain when the task is released, so as to eliminate the phenomenon that the leader only distributes “good errands” to the employees with good relationship, thus ensuring the openness of the task; when paying the salary, it is disclosed on the basis of the corresponding basic salary as a powerful basis, different employees get rewards according to different tasks, so as to achieve the transparency of salary payment; personnel promotion can trace the information of candidate employees, understand their contribution to the enterprise and the completion of previous tasks, and compare different candidate employees.
DPOS mechanism ensures the tamper proof of historical block information. Therefore, it can be used as a reliable basis for promotion, reduce the occurrence of nepotism, and ensure the fairness and justice of promotion.

4.3 The Whole Process Feedback Is Safe and Effective

Human resource management mechanism based on alliance chain stores task data in distributed database by proxy re encryption to improve the security of the whole process information record. The public key and time stamp contained in the information collection info have already encrypted the information in the process of human resource management. The combination of multiple infos until the generation of info root ensures the security of information again. Based on the information on the chain, all kinds of human resource management business is carried out, and the safety and effectiveness of various feedback are realized.

5 Conclusion and Prospect

This paper proposes a human resource management mechanism based on blockchain technology, which has a two-level node alliance chain. It innovates the application scenario of blockchain technology, overcomes the shortcomings of traditional human resource management in employee personal information verification, task information evaluation, task feedback efficiency, salary incentive fairness, and can realize fairness, justice and openness in the process of human resource management. Transparent, provide quick information update and feedback. Because there is no obvious third-party interference in the human resource management scenario, the smart contract technology has not been applied to the mechanism proposed in this paper. In addition, it will be a good research direction to solve the token problem of DPOS consensus mechanism in human resource management scenario.

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