

Human Resource Information Management Model based on Blockchain Technology

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Abstract

The authenticity of human resource information has become an important factor that affects the cost and efficiency of human resource management. With the rapid development of mobile devices and Internet technology, various human resource risks caused by information asymmetry constantly bring economic loss, and even a fatal blow, to enterprises. Based on Blockchain(BC), this paper aims to combine traditional encryption technology with Internet-distributed technology, to establish a human resource information management model that reduces the risk of authenticity of human resource information. This model aims to solve the lack of discrimination of the authenticity of human resource information, and to provide authentic and effective decision support information to the human resource management of an organization. The operation method, such as Bitcoin, is used to certify the human resource documentations, as well as to bind the information and the documentation. Furthermore, human resource information is recorded in an accounting book based on BC technology; thus, modifying and validating may be difficult in the entire network. Consensus mechanism, smart contract, accounting, and payment functions of BC can provide the basic support for human resource information management. Moreover, decentralization of the protection mechanism can be achieved to achieve low cost and high efficiency of information transfer, and to ensure a high-performance work system in the human resource management of enterprises.

Keywords: Blockchain; Human resources; Information management

1. Introduction

With the rapid development of society and the accelerating process of economic globalization, enterprises face unprecedented pressures and challenges. Human resources, as an important carrier of knowledge, technology, and service, is the core element of enterprise management practice. The strategic value and significance of human resources for the development of organization cannot be replaced. The increasing update of information technology has become a powerful driving force for the rapid development of all sectors of society. Human resource is the primary productive force. Only retaining talent can promote the development of the organization. Accordingly, modern human resource management should combine information technology with an advanced human resource management concept, optimize management method and mode, as well as improve human resource management efficiency and effect to guarantee the attainment of the core competitive power in the dynamic environment of an enterprise.

The authenticity of human resource information directly affects the cost and efficiency of human resource management. Some surveys show that over 70% of job seekers show relatively hidden and fraudulent information during the recruitment process. Some job applicants submit fake résumés, diplomas, and certificates of

qualification, and others deliberately exaggerate their abilities. To enhance the quality of service, the process of improving identification and management of human resource information authenticity has become an urgent issue that requires solutions from the human resource and social security department. This paper aims to establish a human resource-oriented management mode by introducing BC technology to reduce the risk faced by human resource information authenticity, thereby providing authentic and effective decision support information for the human resource management of an organization.

2. Analysis of risk management needs of human resource information

Information is the key issue in human resource management. For a long time, the authenticity of human resource information has been in a relatively ineffective regulatory state. In the practice of human resource management, we constantly face the following risks:

(1) Employment risk

In the labor market, the labor age value that job seekers are willing to accept, as well as the ability, educational background, and experience of job seekers are the private information of applicants. Furthermore, enterprises spend significant costs to obtain the information, as well as to conduct interviews and psychological tests. In most cases, enterprises do not know if the types of job seekers comply with the needs of organizations. Reality shows that a relative number of job seekers are not honest, and many enterprises do not easily believe in the message of job seekers. Job seekers intentionally deceive enterprises, and enterprises cannot completely identify the types of job seekers that they have to deal with. Thus, the application process may have poor results. This practice is simply a form of adverse selection in information economics. Adverse selection results in increased costs. Therefore, a high uncertainty exists in the labor service trade, there by resulting in human resource risks of enterprises.

(2) Risk of moral degeneration

In the process of implementing labor contracts, enterprises frequently address the following problems: employees are lazy and they cut corners. Alternately, employees sell products at lower prices to relatives and friends, or they claim back expenses for tickets unrelated to their work. In the process of implementing labor contracts, the efforts of employees cannot be generally observed. Employees know their own efforts, but managers do not. Thus, employees may behave in an indolent manner, such as contributing to non-labor.

The information is asymmetric between enterprises and job seekers (or employees). Job seekers have private information regarding their types. Uncertainty occurs whether or not they

truthfully inform the enterprises about their types. After labor contracts are assigned, uncertainty still exists whether the employees are lazy or diligent at work. This uncertainty poses risks to human resources. Thus, information asymmetry is the important reason for human resource risk.

The human resource risk information that affects the operational efficiency of enterprises are as below includes the following:

- demographic information of human resources, including age, marital status, work experience as measured by number of years, and so on;
- education and training of human resources, including education and various training experiences;
- ability of quality information of human resources, including technical title, technical grade, certificate, and so on;
- pay-for-performance information of human resources, including assessment result, salary incentive, promotion, and so on;
- incentive information of human resources, including various certificates of honor, as well as reward and punishment information.

The risks of human resources caused by information asymmetry constantly bring economic loss to enterprises, even causing a fatal blow. Therefore, developing a new human resource management mode is imperative to effectively solve employment risk and the risk of moral degeneration in human resource management.

3. Blockchain Technology model

3.1 Introduction to Blockchain technology

The concept of a BC was initially presented by Satoshi Nakamoto in a paper titled "Bitcoin: A Peer-to-Peer Electronic Cash System," which was published in 2008. A BC is a type of new decentralization data framework. It is commonly owned, managed, and supervised by all nodes in the network, without accepting a single control. This technology is the core of Bitcoin and other new digital encryption currencies. Many well-known banks and insurance companies, as well as brokers and future companies worldwide have made technical development in the field of BCs. They used blockchain-based Bitcoin and other electric currencies in related commercial systems or application services.

Blockchain technology is a type of technical program to save, validate, transfer, and communicate network data through its own distributed node without depending on a third party. Based on agreed regulations and agreements (similar to hash algorithm and various mathematical algorithms adopted by Bitcoin), all nodes can automatically and safely validate and exchange data in the system without any human intervention. A BC is a series of data blocks generated from the association with the cryptography method. Each block contains all network trade

information in the last 10minutes, which is used to verify the validity of the information (anti-fake mechanism) and to form a next block. A BC has the following main features:

(1) Decentralized structure. Blockchain technology does not rely on third management organizations or hardware facilities; without central control, all nodes realize information self-validation, transmission, and management. Decentralization is the most prominent and essential feature of BC.

(2) Trustlessness. Data exchange in the system does not require nodes to trust one another. The operation regulations of the entire system and all data contents are open and transparent. Therefore, nodes are unable to deceive each other in terms of rule scope and time range designated by the system.

(3) Collective maintenance. Data blocks in the system are commonly maintained by all nodes with maintenance function in the entire system. Furthermore, these nodes with maintenance function can be involved by anyone.

(4) Reliability and security. When 51% of all data nodes cannot be grasped, network data cannot be controlled and modified without restraint. Thus, the BC itself becomes relatively safe and is able to avoid subjective and artificial data modification. Therefore, if a greater number of nodes with strong calculation ability are involved in the system, then the data in this system have higher security.

(5) Open source. Blockchain technology is based

on the open-source concept. Except for the encrypted private information of trading parties, BC data are accessible to all people. Anyone can search the BC data through the public interface, as well as develop related applications. Thus, the entire system is highly transparent.

(6) Anonymity. Nodes do not need to trust one another except when a legal requirement exists. Technically, the identity information of all nodes in the block does not need to be open or verified, and transfer can be anonymous.

3.2 Comparison of Blockchain and existing technologies

At present, human resource information management systems are based on the B/S or C/S framework. Several safety factors exist in this management mode. As a new development mode, Blockchain technology adopts consistency verification, Byzantine Agreement, public key and private key encryption mechanism, including a hash test and a series of security algorithms and protocols to ensure security in management, storage, tampering, and other aspects. With the development of Blockchain technology, security is guaranteed whether to the human resource department or system users. The credibility of this technology has been further strengthened.

Table 1 shows a comparison of three technologies in terms of consistency verification, storage equipment, real time, encryption mechanism, tamper resistance, and other security aspects.

Table 1 Analysis of different design model

	Consistency verification	Storage equipment	Encryption mechanism	Internal operation	Real time	Tamper resistance
C/S framework	None	Host	Common password encryption	Yes	Poor	Can be modified inside
B/S framework	None	Network server	Common password encryption	Yes	General	Can be modified inside
Blockchain technology	Yes	Each node of block chain	Public and private key encryption	Public	Strong	Cannot be modified

Table 1 shows that, compared with the existing technologies, the management system adopting Blockchain technology is significantly improved in security. Meanwhile, permission to the management system becomes more open, and it can effectively avoid malicious tampering of system information from the internal staff. Therefore, further enhancement is expected in the efficiency of the management system. It is different with the

traditional software engineering by using C/S architecture or B/S architecture, BC architecture more need to consider distributed, non center, multi-copy communication, consistency, concurrent, conflict control problem. It is similar to C/MS (Client /Multiple Server Client)

4. Human resource information management mode based on Blockchain technology

4.1 Contents of human resource information management

Based on the analysis of human resource risk information, the contents of human resource information management include the following:

- (1) Basic information management of human resources

Inclusion: employee information, contract information, archival information, as well as organizational and personal information. The main information of employees should be managed, recorded, and searched. The system sets different permissions for people to read through the relative contents. The staff in the human resource department can read through assigned contract information, new information, modified information, and canceled information.

- (2) Post-appointment and title information management

Post-appointment and title information management is one of the crucial personal system components in China, and one of the basic functions of personnel departments at all levels. Professional title management is directly related to the vital interests of many professional and technical staff. With greater prominence in the aspects of policy and correlation, professional title management further relates to the enthusiasm of professional and technical personnel; thus, these professionals can be mobilized or protected.

- (3) Training and deployment information management

Based on the training experience and results of human resources as well as the previous post-deployment information, competency, job promotion, and some post moves can be realized. Training and post-move information of human resources are recorded in a computer information system that is promptly updated to ensure human resource-related competency, and to promote efficient use of human resources through efficient allocation.

- (4) Performance appraisal and salary information management

The performance appraisal and salary information management is the core of human resource management. Its results, reflecting human resource input and output, directly affect the possibility of the promotion. The relevant information is entered in the computer system to obtain the corresponding performance appraisal and salary information. Then, the relevant sheets are output through these software information systems to predict the investment value of human resources.

4.2 Design of human resource management framework based on Blockchain

Human resource information management based on BC is based on the establishment of a private BC. The owners of the BC are firms or

enterprises. The BC is open to the internal staff and is not limited to the management. Thus, the BC can improve the transparency of the management system, particularly in terms of training, allocation, performance, salary, and sensitive information. It is highly significant to be fair, impartial, open, and improves the credibility of enterprises to establish a good and positive atmosphere in the enterprise.

The design of a human resource information management system is shown in Fig. 1. The system is divided into four layers, namely, online distributed database, basic layer of block chain, application interface, and human resource management system. All layers are independent, with a certain coupling, thereby facilitating software development and operation maintenance.

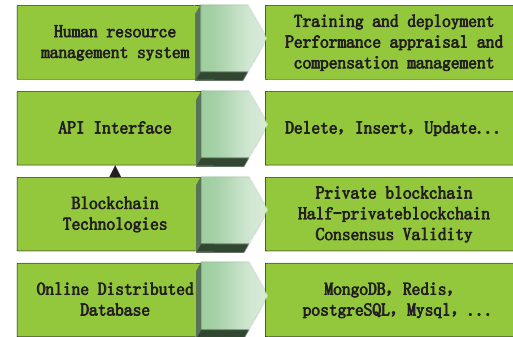


Fig.1 Design of a human resource management system framework based on Blockchain

4.3 Smart contract model of human resource information management

Information asymmetry in human resource management brings risk to enterprises. We can design a series of contract arrangements to stimulate and restrain the behavior of people. This model is a contract conceived by human resource management. It is based on the following idea: all actions taken by individuals are for their own interests; and the relevant information is asymmetric between enterprises and employees. Generally, employees grasp additional information regarding jobs.

Once the authenticity of human resource information is involved in the model, it is recorded and embodied as a digital contract to be saved in the accounting book. The generation of a smart contract is an automatic behavior without artificial intervention. Each smart contract has a unique digital ID, which can be encrypted and embedded in the text or on other digital carriers that record the content of the contract. Therefore, a contract management system can be used to ensure effective identification and maintenance.

In this model, the BC is created and maintained by an engineering team. The trust relationship throughout the stem is automatically established in the block chain, and does not need to be grasped by a certain organization. This new human resource

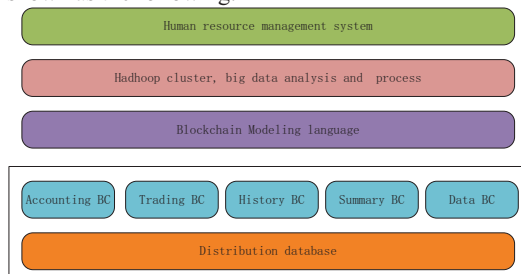
information management model successfully achieves decentralization. Therefore, a larger number of cross verification and supervision channels exist.

4.4 Language design

To better realize the function, we propose a BC modeling language to specify, design, develop, and test blockchain-based applications. It needs to support system customization and extension. BML will be a new modeling language as existing modeling languages do not model BCs.

In the BML framework, the detail needs should be specified. Firstly, the personal and parties information that involved will be shared; furthermore, we must consider the frequency of sharing. In addition, the security and privacy mechanisms are also important in the model. So there is a lot of Encryption algorithm application in the process. Taking into account the convenience of management, there will have the locking mechanisms in it.

Application modeling concludes the process modeling and architecture modeling. It is can be shown as the following:



BML is a common visual modeling language, which is used to describe the business process and data flow in the process of block chain development. BML is in the UML (United Modeling Language) on the basis of introducing the time stamp, encryption mechanism, chain structure modeling method. BML applies to all kinds of blockchain software development methods, block chain software life cycle of various stages, a variety of application areas and a variety of development tools. BML includes the concept of semantics, representation and description, which provides a static, dynamic, system environment and organizational structure of the model.

4.5 Testing Blockchain Applications

Testing consistency of BC nodes will be relatively simple as each block has been voted to be consistent before they can be stored, and each block is encrypted with the hash of the previous hash to ensure that these blocks cannot be changed without detection (at least theoretically). Testing a new block is a part of the BC protocol.

Thus, regression testing is relatively simple as contents in any nodes can be randomly selected for testing, and the results should be consistent. Testing multiple BCs is a research topic such as ABC, TBC, SBC, HBC and DBC.

A TBC(trading blockchain) will store only information necessary to carry out trades and

settlements only, and it will not store all the account information for all the participating administrative departments.

An ABC(Account blockchain) stores account information within a management institution or a family of institutions. For example, an ABC can store all kinds of information about the Department staff.

A HBC(History blockchain) can record the history of the transaction information. When you need to check the transaction history, it will greatly improve the efficiency of retrieval.

A DBC(Data blockchain) can will store the big data of the detail application. In the specific application, there may be a lot of audio, video and other large amount of data storage, then you can use DBC. This can reduce the amount of communication and improve the processing efficiency of BC.

A SBC(Summary blockchain) can store comprehensive records of transactions, accounts and other information, it runs on other BC.

There is also a lot of interconnection in various BCs. For example, TBCs and ABCs interoperate with each other in banking applications. The traditional software to consider the deployment and upgrade of the server and the client, such as B/S architecture only on the server deployment and upgrade; C/S architecture need to be upgraded at the same time in the server and the client. Application of block chain based on the need to synchronize all the nodes, and C/MS architecture, and to all the server nodes and synchronization upgrade deploymen

5. Conclusion

This study aims to solve the information risk of human resource management by introducing BC technology. Establishing a human resource information management model based on this technology can provides are and effective supporting information for human-resource decision making. This model can realize the valid application of human resource information at an extremely low operation cost without any third party. The human resource information management model based on BC is established to reduce the risk of authenticity of human resource information, to solve the problem of the lack of discrimination of the human resource information authenticity, and promote the use efficiency and effect of human resource management information.

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