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Big Data Surveys and Blockchain for Digital Transformation of Business Management

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ABSTRACT
Big data is an important foundation in social economy, science and technology, life and other fields, which also becomes a strategic emerging industry and has a crucial impact on the development of enterprises. As a new business model, its development is greatly limited due to the huge amount of data and difficult management. At present, there are many problems in power trading enterprises, such as backward management and low efficiency. The development of big data and blockchain technology would provide new management models for power trading enterprises and eliminate data inconsistency. It can improve data quality and help improve work efficiency, so as to reduce operating costs. Therefore, this paper introduced big data and blockchain based on fuzzy algorithm into the research of digital transformation of enterprise management. Blockchain technology provided technical support for enterprise data management. By starting from the concept of big data and blockchain, this paper would study and analyze how to promote the digital transformation of enterprise management. The research results showed that big data and blockchain based on fuzzy algorithm could promote the digital transformation of power enterprise management and improve the digital transformation process of power enterprises. This was about 11% higher than the digitalization process of traditional enterprises, and the satisfaction score was about 14.7% higher. Through data governance, the speed of digital transformation of power enterprise management was improved.

Keywords: Digital Transformation of Business Management, Blockchain Technology, Fuzzy Algorithms, International Electrical Energy Systems

1. Introduction

Nowadays, the development of enterprises not only depends on the product quality, distribution efficiency and service level, but also depends on the management level of enterprises more often. If

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an enterprise management level is high, then the enterprise can develop for a long time, otherwise it is destined to be eliminated by the market [1-3]. However, there are still many problems in traditional enterprise management that need to be solved, due to the negligence of the management, resulting in more and more passive enterprises, such as data forgery, information asymmetry, and unclear division of responsibility and other problems occur from time to time, seriously infringing on the interests of the enterprise [4-6]. Although some enterprises have taken corresponding measures to remedy the situation, they still treat the symptoms but not the root cause. Blockchain, as a new generation of information technology, is considered to be one of the most disruptive technologies, which can effectively solve many problems in enterprise management, provide enterprises with a more efficient, secure and transparent management mode, and help enterprises in digital economic transformation and upgrading [7-10].

Accompanied by the deepening and application of digital technology and artificial intelligence technology, enterprise digital transformation has become the focus and key to optimize enterprise management, innovate business models, enhance enterprise core competitiveness, and grow the digital economy industry [11-12]. Blockchain technology, as an organic combination of various existing technologies, with its many technical advantages, perfectly fits the development trend of the digital economy, promotes the development of enterprise digital transformation, and forces enterprises to adhere to the norms and integrity of business. But at the same time, we should see that the application of blockchain in the development of enterprise digital transformation faces a series of challenges [13-16].

Although blockchain technology can help the development of enterprise digital transformation based on its own decentralization, confidentiality and low-cost characteristics, but given that it is still in the initial stage of research, the maturity is relatively low, and in practice, it also faces four major risks of monetary sovereignty, information security, financial security and technical security [17-18]. Taking information security risk as an example, in order to meet the needs of users and data privacy protection, blockchain usually adopts a variety of cryptographic components such as public key encryption, digital signature, etc., and the security of the above cryptographic components directly determines the security of the blockchain data and information [19-20]. Even if in the short term, the existing theories do not pose a threat to cryptographic algorithms, with the rise of quantum computing, the security of the existing cryptographic algorithms will be difficult to guarantee, the confidentiality of blockchain will be questioned, and the digital transformation of enterprises based on blockchain will also be affected [21-22]. Therefore, it is necessary to scientifically grasp the development of enterprise digital transformation based on blockchain, start from the current situation of the application of blockchain technology in the development of enterprise digital transformation and constraints, and put forward countermeasures to accelerate the development of blockchain-driven enterprise digital transformation, in order to promote the rapid development of China's digital economy [23-24].

Literature [25] conceptualized an enterprise project management structure and related conceptual descriptions based on big data background, aiming to facilitate the digital management transformation of enterprises. Literature [26] illustrates that the digitalization of enterprise production management promotes the improvement of organizational structure, functions, methods, and information management efficiency, and discusses it in detail with specific cases. Literature [27] suggests that the focus of digital transformation of enterprise management in the context of an epidemic should be on continuous survival, self-learning, and unmediated cooperation.

Literature [28] used quantitative analysis to explore the current status of blockchain technology practice in listed technology enterprises, pointing out that the application of blockchain technology promotes the expansion of enterprise asset scale, and at the same time, blockchain technology also improves enterprise asset turnover and reduces the cost of sales. Literature [29] systematically reviews the relevant research on the application of blockchain technology in enterprise management,

focuses on analyzing the characteristics as well as modes of blockchain technology in enterprise management, and looks forward to the future development direction of blockchain technology. Literature [30] focuses on the commercialization path of blockchain technology in enterprise management based on the method of literature review, which provides an important reference for enterprise digitalization and intelligent construction. Literature [31] envisions an enterprise management system with blockchain technology as the core logic, and also uses bug monitoring and stress testing to argue the credibility of the proposed system.

2. Overview of Big Data and Application of Fuzzy Algorithm in Big Data

1) Basic meaning of big data. Big data can provide enterprises with many useful resources and information, and the common nature of data makes it possible. Any untimely products and ideas without innovation would be ruthlessly eliminated in the torrent of the times. For a company, the key to success or failure is the quality of its management model.

As far as the progress of social development is concerned, the age of big data is conducive to the development and progress of the whole society. In the age of big data, not all data has reference value, and some useless data would interfere with the direction of enterprise transformation. If people accidentally fall into the data trap and are led astray by the wrong decision, the consequences would be very serious. In terms of data processing, big data has brought about explosive growth of unstructured data, but traditional technology aims to collect and process structured or semi-structured data. Therefore, enterprises not only need to comprehensively collect and obtain traditional data, but also need to process some unstructured data. In such a data era, data is updated every second. How to make full use of, classify and optimize these data to obtain useful information is an urgent problem that enterprises need to solve. The amount of these data is huge, and they may pose a security risk. The problems faced by enterprises under big data are shown in Figure 1.

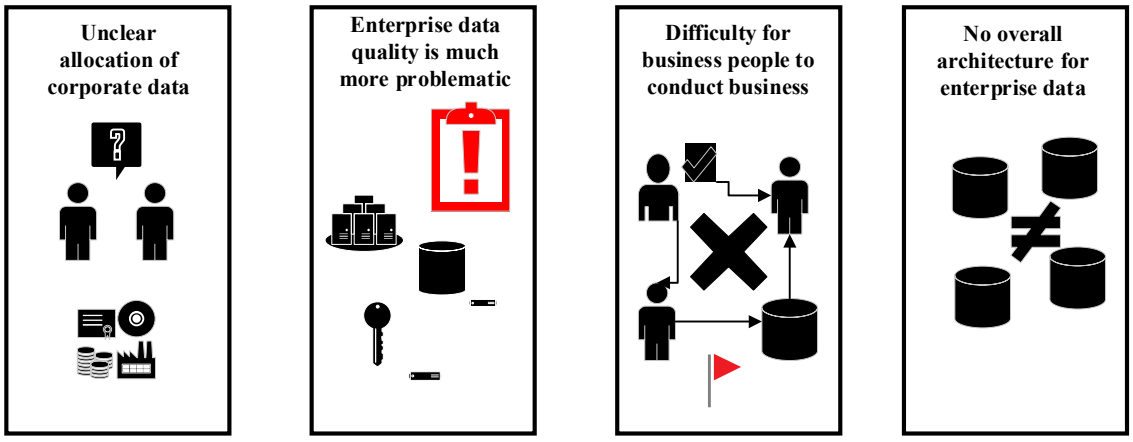

Fig. 1. The issues facing businesses with big data

2) Application of fuzzy K-Means clustering algorithm in big data. Fuzzy algorithm is an intelligent algorithm. When the system model is not well understood or when objective reasons do not allow an in-depth study of the management model of the situation, smart operators often play a minor role. At this time, it is necessary to use fuzzy algorithms. The commonly used fuzzy algorithms are mean modulus method, fuzzy Gaussian algorithm, etc. Data governance is very important in the digital transformation of enterprises. Therefore, this paper uses the fuzzy K-Means algorithm to discuss the application of big data in promoting the digital transformation of enterprise management. The aim is to increase productivity and reduce the running time of big data clustering.

(1) Classical fuzzy K-Means algorithm. The principle of the classical fuzzy K-Means algorithm can be described as $A=\{a_1a_2,...,a_n\}$. H is the cluster number, and the data centers are represented as $s_1,s_2,...s_n$ respectively, and the following conditions are met:

$$S_i \neq \Phi(1 \leq i \leq H) \tag{1}$$

$$S_i \cap S_j \Phi(1 \leq i, j \leq H, i \neq j) \tag{2}$$

$$\bigcup_{i=1}^{H} S_i = \{a_1, a_2, ..., a_n\} \tag{3}$$

The objective function of clustering is to minimize the total distance between all data objects and the corresponding data center. The formula is as follows:

$$J(V,C) = \min \sum_{i=1}^{m} {v_{ij}}^m \sum_{l=1}^{B} \sum_{j=1}^{H} \left\| a_{ik} - s_{jk} \right\| \tag{4}$$

Among them, m is the fuzzy weight factor; v_{ij} represents the membership of the data object; the following formula should be met:

$$\sum_{j=1}^{H} v_{ij} = 1(1 \leq i \leq m) \tag{5}$$

Among them, $\left\| a_{ik} - s_{jk} \right\|$ is the Euclidean distance between the data object and the data center. Through the calculation of Lagrange multiplier method, the formulas are as follows:

$$v_{ij} = \left(\sum_{p=1}^{H} \frac{\left\| a_i - s_j \right\|}{\left\| a_i - s_p \right\|} \right)^{2/m-1} \tag{6}$$

$$S_j = \frac{\sum_{i=1}^{m} {v_{ij}}^m a_i}{\sum_{i=1}^{m} {v_{ij}}^n}, 1 \leq j \leq H \tag{7}$$

(2) Determination of clustering number. The data object set is assumed to be $A=\{a_1,a_2,..a_n\}$, and the within class distance can be defined as follows:

$$I(i,j) = \frac{1}{m_j - 1} \sum_{s=1 \wedge s \neq i}^{m_i - 1} \tag{8}$$

The within class distance describes the degree of similarity between data elements within a class. Therefore, the smaller the value, the better the result. That is to say, the distance between classes can be defined as follows:

$$IO(i,j) = \frac{O(i,j) - I(i,j)}{O(i,j) + I(i,j)} \tag{9}$$

Formula 9 is averaged to avoid the impact on clustering results in the calculation process. The formula is as follows:

$$avgIO = \frac{1}{m} \sum_{j=1}^{H} \sum_{i=1}^{m_j} IO(i,j) \tag{10}$$

Among them, the larger the value of $avgIO$ is, the corresponding cluster number is the optimal

cluster:

$$H^* = \arg \max_{H \in \{h_1, k_2, \ldots, k_n\}} \{avgIO \ (H)\} \tag{11}$$

In order to detect whether the fuzzy K-Means algorithm can improve the data efficiency in the class application of big data, this paper carries out analysis and research on this. It carries out simulation experiments on five data classes from small to large and compares them with traditional algorithms to analyze their operating efficiency, as shown in Figure 2.

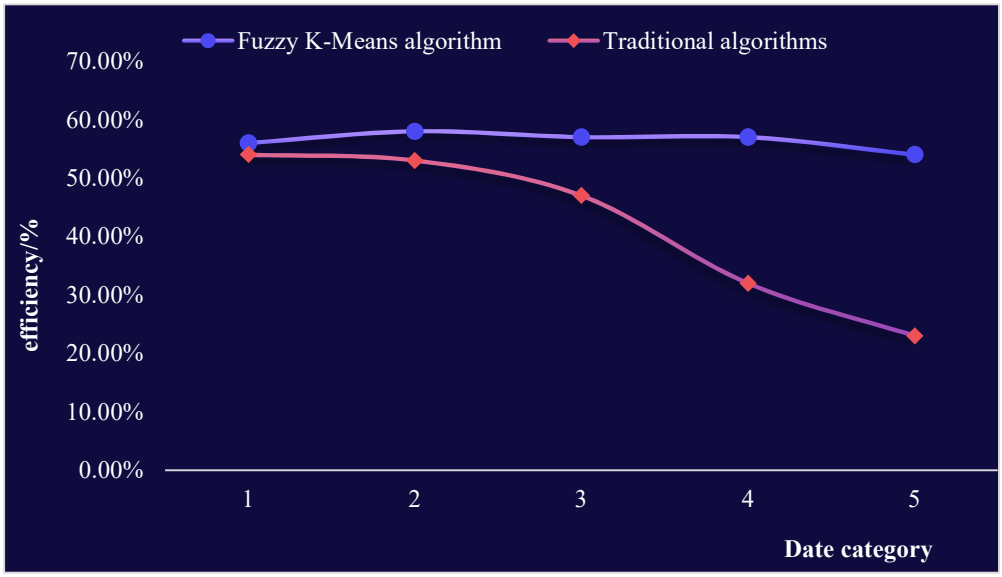

Fig. 2. Fuzzy K-Means algorithm for class applications in big data

Figure 2 shows that the fuzzy K-Means algorithm is superior to the traditional algorithm in class application of big data, and the efficiency of the traditional algorithm would decrease with the increase of class data. The fuzzy K-Means algorithm maintains stable efficiency, and its efficiency is higher than that of traditional algorithms. It is comparable in data integration and accelerates the digital transformation of enterprises.

3. Introduction of Blockchain Technology

Blockchain is a distributed shared ultra-thin ledger used to store historical transaction records or data information, which is jointly maintained by all nodes in the network. Without the support of a trusted third party, it has the ability to securely transmit data and transactions between any node. Its basic principle is a new distributed infrastructure and computing paradigm, which uses blockchain data structures for data verification and storage. The consensus algorithm between distributed nodes creates and updates data, and asymmetric encryption is used for secure data transmission and access.

Since the introduction of decentralized peer-to-peer trading system in 2008, the Bitcoin cryptocurrency system has attracted the attention of researchers in various fields, and the blockchain technology behind it has gradually emerged. Through blockchain technology, the trust problem among people around the world is transformed into a distributed consensus mechanism-proof of work mechanism, which realizes the safe circulation of Bitcoin virtual currency around the world, and fully proves that “trust is the most effective currency in circulation”.

1) Blockchain structure. Each block of a chained data structure is made up of two major parts. The main meaning of the block header storage are the hash of the preceding block (PreHash) and the

hash of the current block (Hash), which are used to concatenate the blocks. The block body mainly contains transaction information, such as transaction time and quantity recorded in the block. The data structure of the blockchain makes each block contain the information of the previous block, which has strong traceability. The combination of asymmetric encryption and smart contract technology makes data difficult to access or manipulate, which further guarantees the authenticity and integrity of data in the blockchain. These characteristics make it possible to use it in scenarios such as data verification and transfer transactions, as shown in Figure 3.

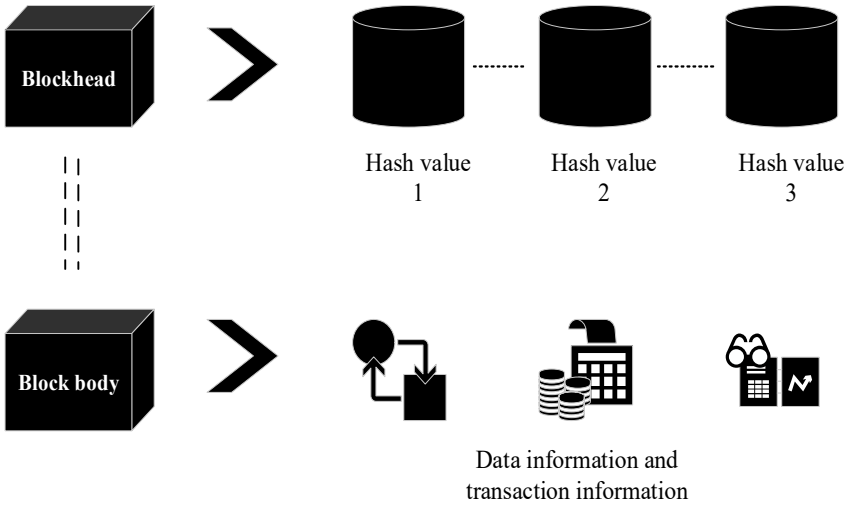

Fig. 3. Chain data structure framework diagram

2) Blockchain guarantees data privacy. Blockchain-based data desensitisation guarantees the confidentiality of the information and provides a solution for opening up the data with the guarantee of confidentiality. Data desensitisation is mainly done using cryptographic methods, such as hashing. By computing data without having access to the raw material, data privacy can be protected. The implications can be represented in Figure 4.

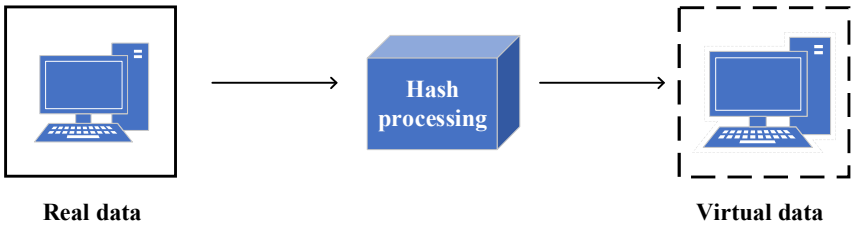

Fig. 4. Blockchain guarantees data privacy implications diagram

3) Advantages of applying blockchain technology. Blockchain technology clarifies the ownership of data, and the data in the system is measurable and readable. The nodes can reach consensus efficiently through the consensus mechanism, which greatly reduces the credit and transaction costs. This promotes the flow of data assets and improves the overall value of assets.

The traceability of the blockchain allows the metadata to be collected to the transaction process and stored in a distributed database in chronological order to achieve full traceability. The process information is stored in the distributed database in chronological order and can be tracked at any time, which realizes the integrity and reliability of the data. This greatly increases the validity of the subsequent data analysis results and the accuracy of the data mining. The powerful trust support of distributed systems enables data to match their owners, which eliminates the threat of arbitrary data tampering. This paper analyzes the irreducibility of blockchain. It analyzes the data groups under

different enterprises and compares them with traditional methods, as shown in Figure 5.

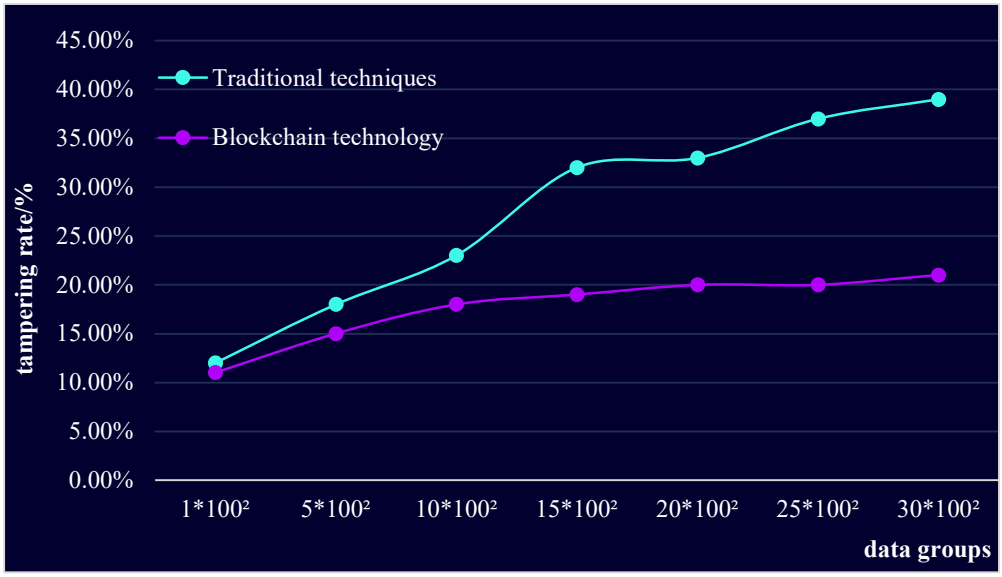

Fig. 5. Blockchain technology for tamper-evident data groups

Figure 5 represents the data groups under the blockchain technology are highly non editable and can better protect data, thus enhancing the security of enterprise data. Data governance is the only way for enterprise digital transformation. Therefore, the introduction of the technical advantages of blockchain in enterprise digitalization would help to determine data permissions and promote transactional and streaming data exchange, so as to improve data authenticity and achieve efficient, stable, safe and reliable data positioning.

4. Investigation of the Integration of Big Data and Blockchain

1) Big data+blockchain. In the past, blockchain, big data and other technologies were developed separately. At first glance, they may be considered mutually exclusive, but this view is changing. At the same time, people increasingly expect that distributed ledgers would help companies solve big data problems, but big data faces many challenges. Blockchain and big data are both powerful. However, when they are combined, they can open up a lot of opportunities. It can even be said that blockchain and big data are “very suitable”.

The combination of blockchain technology and big data can create many interesting opportunities. Blockchain can help manage big data in many ways. For example, in terms of data analysis, blockchain technology ensures data quality. This means that data captured and verified on the blockchain would be of greater value to businesses, as shown in Figure 6.

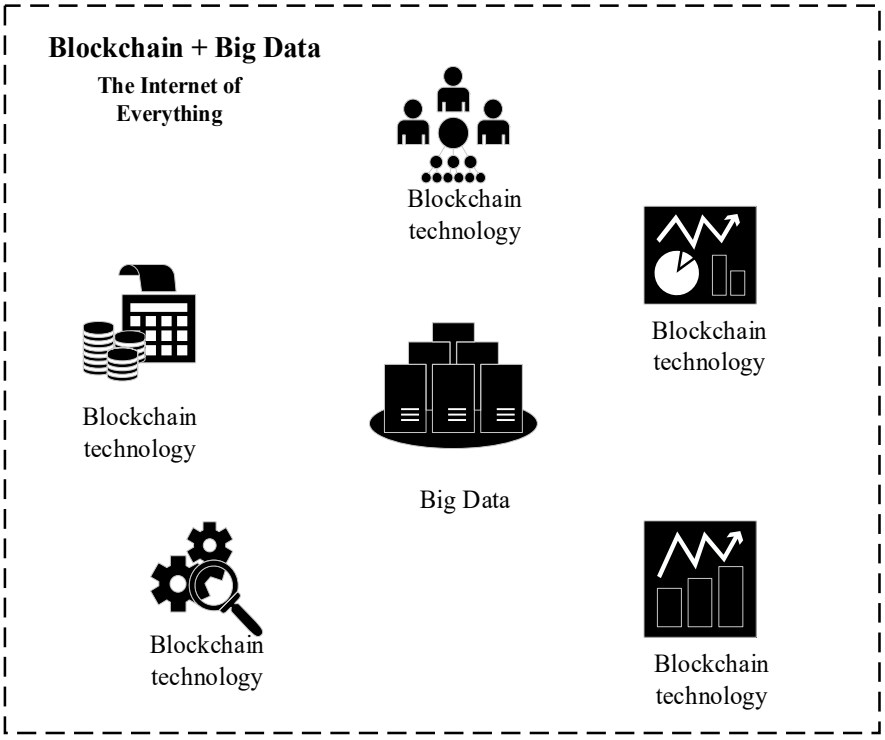

Fig. 6. Big data+blockchain framework diagram

2) Benefits of blockchain+big data combination:

(1) Enhancing data quality. Blockchain technology brings forth innovation in data protection. By using blockchain to replace traditional storage methods, the quality of information can be improved to make it complete and structured. Businesses are more likely to make informed decisions more easily when the data collected by large enterprises is more safe, secure and available.

(2) Enhancing data security. The biggest advantage of blockchain technology for big database analysis relates to the safety of the messages in the blockchain. The fact that the system is distributed means that no one can control it, and its control cannot be changed without the consent of all relevant parties.

(3) Preventing fraud. In the financial services sector, huge volumes of information have yet to address the challenges of fraud detection and risk assessment. This is due to the fact that current methods of detection and evaluation rely on historical information. Blockchain technology enables financial organisations to examine individual transactions in real time. If financial institutions are able to use blockchain as a vehicle for transactions, they would eventually be in a position to assess risk and recognise suspect patterns in real time. This would assist in protecting banks and their patrons from scams.

(4) Simplifying data. By storing huge amounts of information in a distributed ledger, all information can be processed faster and more efficient than a centralised solution. The removal of security barriers and associated risk controls would also accelerate the transaction journey and reduce the cost of remittances.

(5) Facilitating information visits. The further way in an effort to enhance big data and analytics is by simplifying accessibility to data. Different users from different parts of the organization can be made part of the blockchain and they can access the data they need in the analysis process.

(6) Saving cost. Blockchain technology, as part of the big data analytics model, can significantly lower preservation expenses and turn data into real data assets for businesses by providing insight into business decisions through this information.

For a more intuitive understanding, the benefits of the combination of blockchain and big data are shown in Table 1.

Table 1. The advantages of combining blockchain+big data

Advantages	Meaning
1. Enhanced data quality	Blockchain technology brings innovation to data storage and improves data quality
2. Enhanced data security	The greatest advantage of blockchain technology for data analysis is associated with the safety of the messages in the blockchain.
3. Fraud Prevention	Use of blockchain as a means of transaction, enabling real-time assessment of risk and identification of suspicious patterns
4. Simplification of relevant information	Processes all its data faster and more efficiently than a centralised solution by storing it in a distributed ledger
5. Promoting the collection of relevant information	Blockchain enhancement and analysis is simplifying access to relevant content
6. Cost savings	The use of blockchain technology for analytics can significantly reduce storage costs

The blockchain is set to grow in size due to its popularity. The convergence of different blockchain business scenarios has further expanded in scale and richness; although blockchain offers its integrity, its statistical analysis capabilities are weak; with the integration of blockchain and big data, big data can release more data by taking advantage of blockchain's trust, security and high processing difficulty; at the same time, the use of the smart contract feature of blockchain, smaller granularity of data trading operations, such as input transactions, overload transactions, data exchange transactions, etc., can be achieved, thereby altering the present business model of data trading.

5. Overview of International Power Trading System

The international electricity trading system needs to be considered from three aspects:

1) Market theme. It mainly includes transmission mechanism and power consuming entity; transmission institutions include power trading centers, transmission, grid owners and ancillary service providers; distribution agencies are distribution service providers, network owners and auxiliary service providers; the distributor is the distribution service provider. The person selling electricity is the retailer.

2) Access conditions. For power enterprises and users, there must be certain access conditions to ensure the security of the power security market. In order to ensure the security of the power market, power generation companies should first have independent legal personality and financial accounting functions. The power generation process must be stable and efficient, and the requirements applicable to the market access of power consumers are independent legal personality, independent financial accounting and good credit. These access requirements would ensure a safer and more efficient electricity market.

3) Transaction type. The main types of transactions are centralized bidding and listing transactions. Centralized trading mainly refers to the way that many power trading entities submit bids to the electronic trading center, and conduct trading volume on the electronic trading center and the price trading through electronic equipment. Listing transaction is a transaction mode in which power

suppliers submit power demand and user information to the trading platform. Both parties interested in trading would delist the price on the trading platform to reach a transaction. This type of transaction is not transparent and is completely based on free negotiation between buyers and sellers.

Based on the principle of "unified, open, competitive and orderly" power market, the blockchain technology is applied to power trading, which forms a power trading scheme that uses smart contracts to store power trading information and is automatically executed by computers. This also makes the settlement process simpler and more orderly.

6. Investigation and Evaluation of Big Data and Blockchain of Fuzzy Algorithm to Promote Digital Transformation of Enterprise Management

In order to analyze whether the big data and blockchain of fuzzy algorithm can promote the digital transformation of enterprises, four power enterprises are studied and analyzed. Enterprise 1 and Enterprise 2 are the digital transformation of enterprises in the traditional mode, while Enterprise 3 and Enterprise 4 are the digital transformation of big data based on fuzzy algorithm and power enterprises based on blockchain. Their transformation speed process is studied and analyzed for one year, as shown in Figure 7.

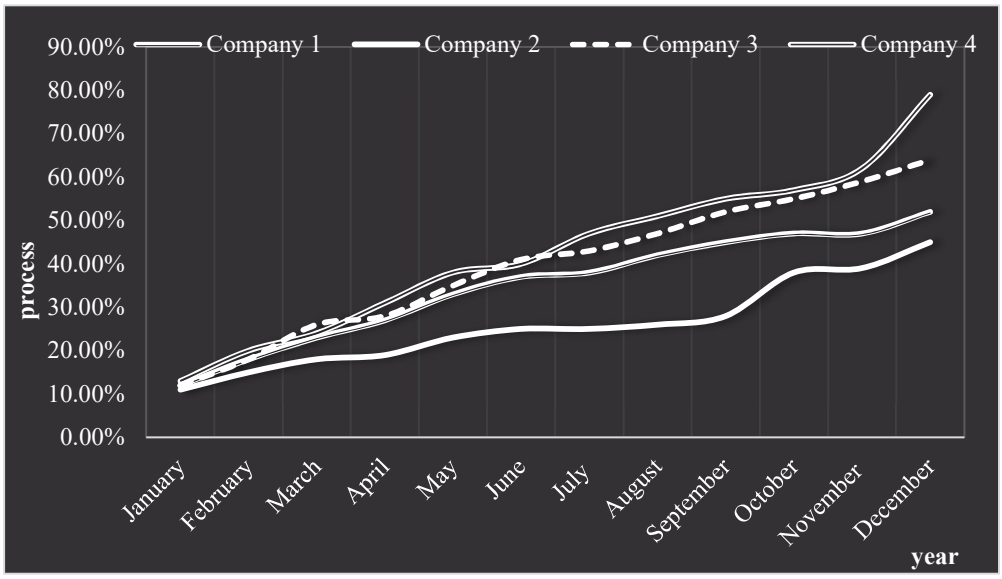

Fig. 7. A study of fuzzy algorithms for big data and blockchain for digital transformation process of enterprise management

Figure 7 shows that the digitalization process of Enterprise 3 and Enterprise 4 is faster than that of Enterprise 1 and Enterprise 2 in this year. Enterprise 1's progress was 12% in January and 52% in December; the progress of Enterprise 2 was 11% in January and 45% in December; the progress of Enterprise 3 in January was 12%, and that in December was 64%; the progress of Enterprise 4 was 13% in January and 79% in December. The average digitalization progress of Enterprise1 and Enterprise 2 was about 30.5%, and that of Enterprise 3 and Enterprise 4 was about 41.5%. The digitalization process of Enterprise 3 and Enterprise 4 was 11% higher than that of Enterprise 1 and Enterprise 2.

At present, the management digital transformation of four electric power enterprises is scored with satisfaction. Enterprise 1 and Enterprise 2 are traditional power enterprises, while Enterprise 3 and Enterprise 4 are power enterprises under the big data of fuzzy algorithm and blockchain. The respondents are all managers of the enterprise, which are named as Personnel 1, 2, 3 and 4

respectively. The full score is 10, as shown in Figure 8.

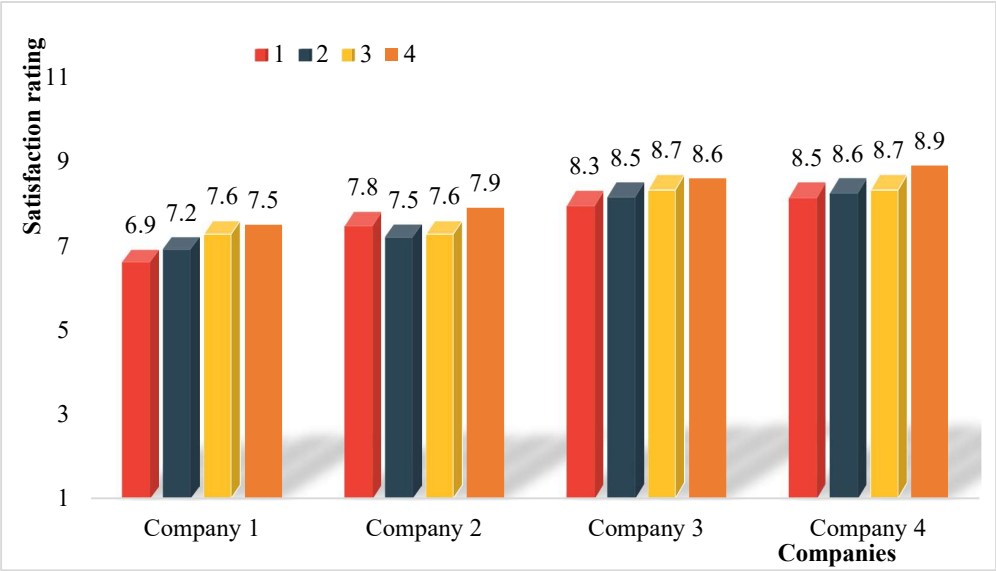

Fig. 8. Satisfaction rating for digital transformation of power business management

It can be seen from Figure 8 that the satisfaction scores of Enterprise 3 and Enterprise 4 are significantly higher than those of Enterprise 1 and Enterprise 2. The average score of satisfaction of Enterprise 1 was about 7.3; the average score of satisfaction of Enterprise 2 was about 7.7; the average score of satisfaction of Enterprise 3 was 8.525; the average score of satisfaction of Enterprise 4 was 8.675. The average score of Enterprise 1 and Enterprise 2 was about 7.5, and the average score of Enterprise 3 and Enterprise 4 was about 8.6. The satisfaction scores increased by about 14.7%.

7. Conclusions

With the arrival of big data era, digitalization of enterprise management is an important means to improve work efficiency and economic benefits and promote the implementation of innovation driven development strategy. With the emergence of big data and blockchain, people begin to define concepts such as big data. This paper combined the concepts of big data and blockchain to form the theoretical basis for the digital transformation of enterprise management. It also introduced the problems existing in the current electricity market transaction process of power enterprises, and used fuzzy clustering algorithm to optimize and improve enterprise data management. Big data and blockchain technology provided new ideas for enterprise digital transformation and realized intelligent decision-making, which also accelerated the speed of enterprise digital transformation.

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