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Knowledge Management using IoT-Blockchain Technology: State of the Art

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ABSTRACT- This research investigated the database of journal articles related to knowledge management and blockchain technology. Knowledge is the most important production factor in competition. The purpose of knowledge management is to improve the ability of knowledge to create value. Blockchain is a shared distributed database, and blockchain technology, as one of the most popular computer technologies in recent years, has received great attention from all over the world. *Purpose/Significance*: This article aims to review and comment on the domestic and foreign literature on the use of blockchain technology for knowledge management, outline the current research status in this field, and predict its future research directions. *Method/Process*: This article will mainly use the literature survey method and the inductive analysis method, retrieve and screen 212 articles (2000-2021) published in the past three years, and get a total of 40+ articles directly related to the use of IOT or blockchain technology for knowledge management The literature, and then conduct a summary analysis of the literature and analyze its content. *Result / Conclusion*: Find out the trends and characteristics of the development and application of blockchain technology, and explore the feasibility in knowledge management based on these characteristics. The blockchain itself has the characteristics of decentralization, self-operation and sharing, which is highly compatible in knowledge management, especially in the field of enterprise knowledge sharing, and has a higher application prospect in the entire knowledge management field.

General Terms: Blockchain, IoT.

Keywords: Knowledge, Knowledge Management, Blockchain Technology, Literature Review, IoT.

1. INTRODUCTION

Blockchain is a shared distributed database, and cryptographically ensures that it cannot be tampered with and is unforgeable, decentralized, trustless shared general ledger , Can safely store simple and self-verifiable data in the system. It is a new decentralized, overall maintained infrastructure and distributed computing paradigm, with the four major characteristics of decentralization, restlessness, collective maintainability, and reliable database. This research will mainly use the literature survey method and the inductive analysis method to analyze the relevant documents of the blockchain technology in the CNKI database to find out the trends and characteristics of the development and application of the blockchain technology, and explore the use of the blockchain technology based on these characteristics The

feasibility of creating a knowledge management process model for digital resources. The blockchain itself has the characteristics of decentralization, self-operation and sharing, which is highly compatible in the knowledge management of digital resources, especially in the field of knowledge sharing [1].

1.1 Definition of Knowledge

There are different definitions in academia. Knowledge in a broad sense refers to the correct, trusted, and verified information that is knowledge. Knowledge is sourced and applied to the brains of knowers. It is rooted in organizational culture and identity, daily affairs, policies, systems, documents, and individual employees, and is carried by them. Plato (1953) defines knowledge as "reasonable and correct belief". Nonaka and Takeuchi (1995) also regard knowledge as a "dynamic process of determining an individual's belief in 'truth'" and believe that knowledge can be defined as a reasonable belief that enhances the ability of an organization to operate effectively. This definition realizes the importance of individual understanding by recognizing that knowledge is an individual's "belief" and includes the need to "recognize" as "truth" [2]. Knowledge can formally and systematically share intangible knowledge that is difficult to express through data, rules, manuals, etc., including insight, intuition, and hunch. Believes that knowledge is the result of experience, and "knowledge itself is power." Foucault (1980) [3] claimed that "power always creates knowledge, and in turn, knowledge continuously guides the influence of power... It is impossible for knowledge not to create power."[4]

1.2 Classification of Knowledge

1.2.1 Tacit knowledge

Tacit knowledge and explicit knowledge exist at both the individual level and the group (organization) [5] level is shown in the Table below:

Table 1. Levels of Knowledge

Knowledge category	Individual knowledge	Group knowledge
Explicit knowledge	Gestures, Procedures, Rules	Rules, Stories, Practices
Tacit knowledge	Common sense, Judgment, Wisdom, Intuition, Know-how, expertise	Work process, Enterprise reengineering, Work practice, core competence, Organizational wisdom

The Danish scholar Johanneasen made a more detailed division of knowledge based on the degree of difficulty of knowledge exchange, the degree of difficulty of knowledge acquisition and understanding on the basis of Polish-Iranian research [6]. He divided knowledge into four types is shown in the *Table 2* below:

Table 2. Jdaanmaaen's Knowledge Classification

Knowledge classification	Easy to obtain and easy to understand	Hard to obtain and hard to understand
Easy to communicate knowledge	Explicit knowledge	Systematic knowledge
Hard to communicate knowledge	Relational knowledge	Tacit knowledge and hidden knowledge

Among the four types of knowledge described in *Table 1*, Wang Zhongtuo of Dalian University of Technology believes that tacit knowledge contains experience, skills, and know-how, and is obtained through practical exploration and experience [7]. It can be understood but not spoken. Therefore, it suggests replacing the concept of tacit knowledge with consensual knowledge.
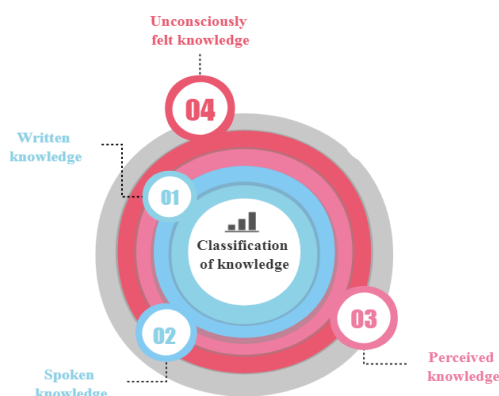

Figure 1: Wang Zhongtuo's knowledge classification (Wang Zhongtuo, 2004)

It can be seen from Figure 1 that the written knowledge is only a part of the said knowledge, and the said knowledge is only a part of the knowledge that is perceived by people [8]. The part of knowledge that is perceived by humans beyond the knowledge that can be said is conscious knowledge. But in fact, people still have some unspeakable knowledge that they have not even noticed, but they can display it under certain circumstances.

1.2.2 Organizational knowledge

Organizational knowledge is formed and crystallized in the knowledge network of the organization by communicating the knowledge generated by the individual with other people. In addition to the above-mentioned classification of knowledge that is widely cited, there are various other classifications that avoid the obscure explicit-recessive dimensions. For example, many people think that knowledge is public know-about or well-known knowledge, technical, principle, conditional, relational [9]. A more practical way to classify knowledge is simply to identify the categories of knowledge useful to the organization [10].

1.2.3 Required information

In order to obtain the required information and evaluate the value of the information, people need to obtain theoretical and practical knowledge-it means training or the implementation of actions. Kakabadse et al. (2003) [11] summarized a knowledge flow chain through literature, that is, data-information-cognition-action/reflection-wisdom is shown in the *figure* below:
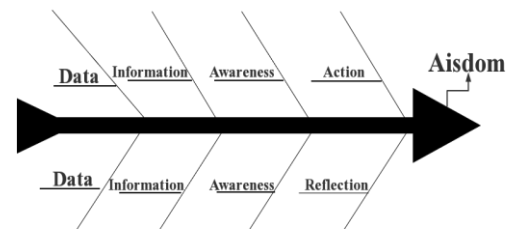

Figure 2: Knowledge Flow Chain

Based on this view, Alavi and Leidner (2001) believe that when information is processed in people's minds, information is transformed into knowledge, and when knowledge is expounded and expressed in the form of text, graphics, discourse or other symbols, knowledge becomes information [12].

2. KNOWLEDGE MANAGEMENT AND BLOCKCHAIN TECHNILOGY

2.1 Knowledge Management

Knowledge management is "providing the right knowledge to the right people at the right time, and helping people share and put information into action through efforts to improve organizational performance" (Jackson 1998)[13]. Others believe that knowledge management is "the formalization and acquisition of experience, knowledge and expert technology, which can create new capabilities, promote higher

performance, encourage innovation and enhance consumer value" (Beckman 1997)[14] O260 British and European companies 73% of them believe that knowledge management is "a collection of processes that can manage the creation, diffusion, and use of knowledge to fulfill organizational goals".

2.2 Process of knowledge management

Organization as a knowledge system includes four sets of "knowledge processes" formulated by society[15]. Generally speaking, at any time and in any part of the organization. Although these four parts are explained separately, they are not a linear sequence. And these four processes can be subdivided [16].

2.2.1 Knowledge creation

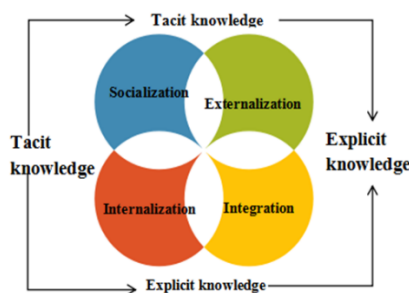Knowledge creation model is shown in the *figure* below :

Figure 3: Knowledge Creation Model

2.2.2 Knowledge storage/retrieval

Knowledge storage includes obtaining knowledge from organization members and/or external sources, coding, indexing knowledge (for later retrieval) and possessing it. The two basic models of information retrieval are the "push" and "pull" models. Collective or organizational memory is defined as "the way in which past knowledge, experience, and events influence current organizational activities"[17].

2.2.3 Knowledge transfer

Most literature focuses on the third factor, the channel of knowledge transfer. The most difficult element to control is the fifth: knowledge must undergo a process of re-creation in the recipient's brain. Transfers between teams will not only be challenged by the lack of memory in the shared plot, but will also be affected by the semantic memory. Internal boundary spanners (internal boundary spanners, generally refer to those who contact multiple organizations or teams, they are at the junction of the contact, may or may not belong to any organization or team)[18] can be used as the link between the episodic memory of the two teams, so Can improve knowledge transfer. In order to improve knowledge management.

2.2.4 Knowledge application

A team with the necessary knowledge and expertise can combine to solve the problem. Then which rule to choose to solve a specific situation will be a problem. problem. However, by logging knowledge into the corporate intranet.

2.3 Blockchain technology

2.3.1 Blockchain

Blockchain technology, is one of the hottest computer technologies in recent years, has received a high degree of global attention. Blockchain technology has the following characteristics of "decentralization" and "openness and transparency"[19]. Blockchain technology has also extended from the initial application of Bitcoin's digital currency to the Internet of Things, finance and other fields that can be explored. The maturity of technology makes Blockchain has begun to affect the global economic and social development. On the whole, blockchain technology has involved almost all areas of our lives. The rapid participation of blockchain in various fields, many innovative entities have also joined the layout of blockchain intellectual property rights[20]. The protection of property rights should be carried out as soon as possible in this aspect. Blockchain technology has the following four characteristics: one is distributed storage, the other is asymmetric encryption, the third is consensus mechanism, and the fourth is smart contract. Blockchain has great advantages in application. Due to its four major technical characteristics, it has the advantages of decentralization, openness and transparency, non-tampering, safe and reliable collective maintenance, etc., and there is a connection between each advantage. It also has a certain degree of independence.

2.3.2 Blockchain technology characteristics

2.3.2.1 Decentralization

In blockchain technology, the most basic feature is decentralization. This feature means that blockchain technology is no longer the same as the previous technology and can only use central processing nodes, but is relatively independent. Each node itself has the function of storing, transmitting and using data, and the data is realized between the nodes[21]. Distributed recording, management and update. Since each blockchain node must follow the same rules, in the entire blockchain technology, there is no superior-subordinate relationship, and equal knowledge sharing can be achieved when applied to the knowledge management of digital resources.

2.3.2.2 Security

Knowledge is an important asset within an enterprise[22]. Whether it is the use or sharing of knowledge, the security of its process must be ensured. Generally speaking, the data stability and security of blockchain technology are very high. That is because in the blockchain system, this information will not be stored permanently. It can be changed again. The key technology of blockchain to ensure data security, non-tampering and transparency includes two aspects: one is the data encryption and signature mechanism; the other is the consensus algorithm. Through these two substantive means to ensure the security of corporate knowledge.

2.3.2.3 Autonomy

Blockchain can in a trustless environment, so that all nodes of the entire system can freely and securely exchange, record and update data information at will, mainly because the blockchain

uses negotiated specifications and protocols, and anyone Without intervention, the trust in the individual is transformed into the trust in the system[23]. The autonomy of the blockchain is reflected in the absolute jurisdiction of the account owner over his own account. The user holds a personal private key and manages his account in accordance with the unified smart contract of the block, so that employees can share knowledge anonymously and equally.

2.3.2.4 Open and transparent
The open and transparent characteristics of blockchain technology rely on the P2P network technology mentioned above, as well as the Merkle tree technology and consensus algorithm. P2P network technology is responsible for the accuracy of the information transmission of the originating point to other points[24]; Merkle tree technology is a tree-like operating structure generated by the use of a hash algorithm, which is responsible for the accuracy of the transmission of information; the consensus algorithm uses a consensus mechanism or a reward mechanism to ensure Data synchronization, there is no deception.

2.3.2.5 Smart contract
There is a computer protocol, here called a smart contract. This kind of contract is to use information to transmit, verify and then execute [25]. Due to the immutability and high trustworthiness of blockchain data, it can automatically carry out agreed regulations. Its essence is a kind of Transaction processing and storage mechanism. The system records conditions for opening contained in the event explanatory data. When the event trigger conditions are met, the system will judge and process by itself according to the pre-set contract content [26].

2.3.3 Principles of Blockchain Technology Operation
The six-layer technical model of the blockchain.The concept of blockchain was first mentioned in the article "Bitcoin: A Peer-to-Peer Electronic Cash System" published in 2008. At present, the industry-recognized definition of blockchain has not yet formed. With reference to the first domestic blockchain standard released by the Ministry of Industry and Information Technology in May 2017-the "Blockchain Reference Architecture", the definition of a blockchain can be defined as an unforgeable, unchangeable and reproducible through transparent and credible rules. Traceable block chain data structure, realize and manage transaction processing in a peer-to-peer network environment. According to different actual scenarios, there are three application modes that have been reformed and progressed under the development of blockchain technology with different degrees of centralization, namely, Private chain, public chain, alliance chain. Under normal circumstances, the six layers of application, contract, incentive, consensus, network and data together form a blockchain system[27]. Among them, the data layer, network layer, and consensus layer are necessary parts of each blockchain system, and the other three layers are added according to specific scenarios.

⊞ 3. INTEGRATION OF LOT-BLOCKCHAIN TECHNOLOGY AND KNOWLEDGE MANAGEMENT

3.1 Blockchain technology platform operation process
Blockchain technology has great advantages in sharing corporate knowledge management. Through the introduction of blockchain technology, a private chain enterprise management knowledge management platform is built, Pow (Proof of Work)[28] is selected as the consensus algorithm, and work is proved based on the number of visits and awards of knowledge providers, and a special knowledge currency is given to the enterprise is shown in the *figure 4*.
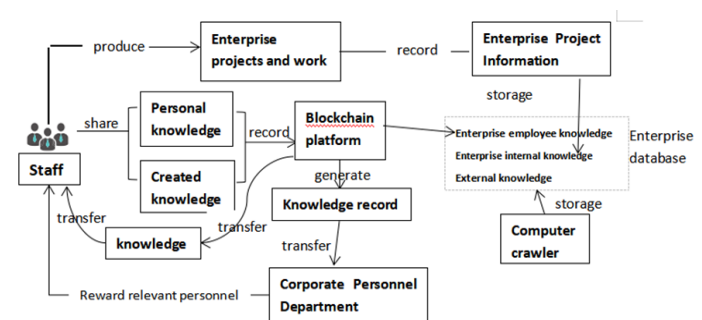

Figure 4: Operation flow chart of enterprise knowledge management platform based on blockchain

The operation of the entire platform consists of three aspects: employees, knowledge management online platform and enterprise database. The enterprise knowledge database mainly includes the enterprise internal knowledge database, the employee knowledge database and the enterprise external database. The internal knowledge database of the enterprise is mainly the documents generated in the daily work and projects of the enterprise, as well as the skills and knowledge required by the employees of the enterprise, part of the patent content and other general knowledge that can be used by ordinary internal personnel. The main form is enterprise information such as documents [29]. The external knowledge database of an enterprise is the main source for an enterprise to obtain external knowledge. In order to help the enterprise understand the industry situation, obtaining industry trends plays an important role. The employee knowledge database is the source for employees to share and create knowledge, and it is also the core of the enterprise knowledge management platform under blockchain technology.

In the operation of the platform, the database is the source of the enterprise's information flow, and the knowledge source of the enterprise's internal knowledge database is the daily work of the employees and patent research and development. The external knowledge database of the enterprise relies on the collection of the enterprise network technology department to collect industry-related information, based on the corresponding knowledge for the needs of employees. The internal database of the enterprise is provided by the

employees, using the blockchain platform as an intermediary. The employees of the enterprise use their personal private key to verify the login, and share it on the blockchain platform to confirm the source of knowledge, and broadcast and record it on the entire platform [30]. The acquisition of blockchain also needs to be authenticated by a private key to confirm the recipient of the knowledge, and the evaluation of the recipient is used as the basis for judging the value of subsequent enterprise knowledge. The acquisition of knowledge can be free or a lower platform virtual currency as the cost. In the reward mechanism, the company can set the exchange ratio of virtual currency to cash, and the personnel department of the company will transfer it to the corresponding real account for reward.

In the whole process, it does not rely on third parties and can be shared anonymously, which is conducive to shaping the atmosphere of free knowledge sharing and transmission. It also rewards employees in the form of actual materials, encourages salt workers in the enterprise to innovate and share knowledge, and guarantees the vitality of the enterprise's knowledge innovation. Employees do not need manual intermediary to acquire corresponding knowledge, and rely on smart contracts to achieve acquisition, ensuring the low-cost operation of the platform [31].

3.2 Implementation of Enterprise Knowledge Management Database Based on Blockchain

The decentralized structure of the blockchain can efficiently solve the decentralized problem of the enterprise's existing knowledge base. Another advantage of the blockchain is that its decentralized structure (flat organization) and non-centralized logic (less top-down) can reduce latency. More parallel and less vertical structures overcome the long-term challenges in product development [32]. The distributed form of the blockchain, combined with the algorithm that will be incorporated into the cluster device, releases reliable cluster behavior, thus achieving more complete knowledge management [33]. Blockchain can fulfill this potential in two ways: first, it provides a cluster memory to form the cornerstone of the cluster action, and second, it provides a way to connect and communicate between the cluster and the cluster [34]. Take Chengfei's enterprise-level institutional knowledge base construction as an example. In such a large military enterprise, factors such as information islands, institutional complexity, collaboration delays, and restrictive barriers complicate and limit the management of information and events in the organization's network. The enterprise builds a unified institutional knowledge base. But under the blockchain technology, it can be built gradually from bottom to top. First, various departments build multiple knowledge bases, and finally they are combined to form an enterprise-level institutional knowledge base. It is a blockchain alliance and a central blockchain. The technical path to achieve is as follows: First, establish a consensus network. This deployment first has a sub-control order [35], the core of the consensus algorithm, which uses a set of technologies to reach agreement. This consensus network is centered. It consists of several key departments of the company (such as human resources department, operation management department, etc.) [36] to establish a consensus structure, which is a weakly centralized blockchain system.

If a department needs to join the consensus network, it first needs to be a node called a peer, and then it can be connected to the consensus network [37]. A single node can access the consensus network through such an application to conduct various consensus transactions with other departments. Then the second user may be another department that joins the consensus network. After more and more nodes are added, it becomes a network environment for running shared data. The network environment can form a blockchain by discovering each other. After the formation, all these departments after joining the network need to have a unified identity certificate. Simply put, the computer is the certificate, like the USB shield of bank online banking. With this certificate, you will know who the corresponding department is, and all the businesses you do are towed by certificate [38].

3.3 Blockchain and IoT convergence

3.3.1 Blockchain and IoT fusion theoretical architecture

IoT devices are connected to networks, generating large amounts of data and integrating powerful data analytics capabilities that are expected to change the way people produce and live [39]. However, while providing development opportunities, there are still many problems in scalability, compatibility, and security in the IoT industry at this stage, which seriously limit the space for the integration and development of IoT with various industry sectors and hinder the realization of its potential value. Blockchain, as an emerging technology fused with IoT, can be an effective solution to the problems of trust, data management, security, and privacy problems in the IoT growth.

3.3.2 The Imperative Need for Blockchain and IoT Integration and Innovation

As an emerging technology, the IoT is more widely used. At this stage, there are still many problems in the IoT industry. The industry chain in IoT is long, involving a wide range of technical fields, and the value conduction effect of the market channel is slow. The trust system and value system among all parties in the IoT system such as devices, various users, and service platforms are not clear yet, which makes it difficult to integrate IoT into other industries [40]. The centralized IoT platforms built by manufacturers or service providers mostly have the authority to collect and analyze user data and control user devices without user authorization, which poses a great danger to device security and user privacy. The integration of blockchain and IoT can effectively solve a series of problems faced in the development of IoT and help scalable devices to build efficient, trusted, and secure distributed IoT networks and deploy massive data-intensive applications, while providing valid safeguards for user privacy.

3.3.3 Convergence architecture for blockchain and IoT

The IoT architecture developed by integrating blockchain technology is a "limited" service framework (as shown in *Figure 6*). The blockchain IoT strategy [41], [42] can be

broken down into a user-centered application background, service and support layer network public chain layer, and device awareness layer. In this regard, the device sensing layer is linked to physical objects and supports the collaboration of IoT entities in a "decentralized" mode and is able to collect information through sensors [43], [44].

4. DISCUSSION

The key factors for the application of blockchain need to be viewed from two perspectives; one is what characteristics the blockchain has; the other is what pain points exist in the target scenario (He Bin, 2018). When the technical characteristics of the blockchain can just "symptomatic" the problem of the target scenario, the application of the blockchain will have meaning and value. Aiming at the reasons for the formation of barriers to knowledge sharing in knowledge management, and analyzing the characteristics and advantages of blockchain technology, we can find solutions to the problems.

Blockchain is a decentralized and centralized system, which corresponds to the problem of isolated islands of information in the construction of knowledge management; the blockchain system is open, which is conducive to the sharing and utilization of knowledge; the blockchain is trustless, which is why It solves the trust problem in knowledge management sharing; the immutability and traceability of blockchain data is conducive to the establishment of an open and transparent incentive mechanism, thereby promoting the sharing of knowledge management.

5. CONCLUSION & FUTURE WORK

This article summarizes and analyzes the domestic and foreign related research on the definition of knowledge, knowledge management, blockchain technology related concepts, and the theoretical framework of blockchain technology and knowledge management integration. The research provides lessons for us. The research of knowledge management is still in its infancy stage. Researchers try to apply it to the process of knowledge management by paying close attention to the preferences of users, and then give the people the power of knowledge management. This study does have some shortcomings. First, only articles published in major knowledge management journals or conferences were collected, which omitted source documents such as books, government documents, or professional reports. Secondly, although the validity of the analysis results is valid in the framework of this research, factors not considered in this research may change the validity of some results. Finally, the literature review has a certain focus, which aims to analyze current research hotspots, find existing research deficiencies and provide directions for future research, but the method itself cannot yet complete all the functions of the literature review proposed by the predecessors. There are still many directions waiting to be explored, and many problems still waiting to be solved.
In the future, with the in-depth development of knowledge management, a series of problems such as information security, privacy protection, and safety supervision will

continue to emerge. The obstacles to knowledge sharing are gradually emerging, which seriously restricts the development of knowledge management. And further popularize the application. Blockchain technology provides us with an idea and method to solve the obstacles of knowledge sharing. The types and volumes of knowledge that can be excavated will continue to increase, and digital knowledge management still has great space for exploration in terms of mining methods, management mechanisms, and theoretical frameworks. Develop the blockchain and then deploy it to improve knowledge management capabilities, which can create a solid platform for independent innovation of enterprises and enhance their R&D capabilities and efficiency.

6. FUNDINGS

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