BLOCKCHAIN TECHNOLOGY ADOPTION EFFECT ONKNOWLEDGE MANAGEMENT STATE OF THE ART SURVEY

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ABSTRACT

Globalization has influenced information dissemination speed and retrieval. Exchanging information using the latest technologies is feasible regardless of geographical location and time. Organizations' sustainability depends on how knowledge is created, retained, and used efficiently. However, nowadays enterprise environment is built on a centric paradigm unsuitable for web 3.0 technologies, including blockchain; hence, transforming to an adaptable form is needed to maintain their rank in the competitive world. This paper surveys the impact and performance of blockchain technology on the enterprise's knowledge base. The overall aim is to assist blockchainadoption decisions for enhancing knowledge asset management, considering factors including their intellectual capital and overall business needs. The review reveals that utilizing blockchain can benefit enterprises' knowledge capital, including cost reduction and digital representation of assets while maintaining them immutable, transparent, and secured. The results recommend further research utilizing a quantitative analysis of activities andtrajectories.

KEYWORDS

Knowledge Management, Blockchain, Decentralized, Enterprises, Performance.

1. INTRODUCTION

The traditional systems with conventional execution and storage infrastructure require more trust and include transparency issues. The centralized paradigm hinders the possibility of distributing information with multiple parties while maintaining their ownership rights. Also, the rapid development of technologies and real-time interaction with various parties over the internet forces challenges on different business trajectories and limits their level of efficiency. On the other hand, blockchain-based knowledge management models alleviate encountered problems. The cryptography and consensus mechanisms prevent cyber-attacks while promoting knowledge sharing across network parties. Also, the real-time information exchange enhances transparency characteristics and promotes community- built trust.

This survey paper focuses on state-of-art blockchain concepts, types, consensus algorithms, and trade-offs. Our main contribution is to address the gaps mentioned above by providing detailed blockchain- based use cases to enhance knowledge resources management for organizations in multiple domains.

Also, we discuss the importance of selecting a suitable blockchain solution to leverage the business performance level.

Nevertheless, viewing the existing solution as still viable is relevant. Therefore, further research is necessary to explore the quantifiable effect of blockchain solutions on knowledge management modelsand expected benefits and related challenges.

2. KNOWLEDGE MANAGEMENT

Knowledge represents the "know-how" crucial for accomplishing a task. It is more abstract compared to information and data but has more value. The most conceptual view of knowledge defines it as information that enables action and leads to an outcome. Knowledge is a valuable resource for making optimal decisions for organizations. It can reside within the organization's employees, vendors, and customers in a tacit form and other locations as a structured form within the organization's artifacts and manuals [1]. The ability to transfer tacit and explicit knowledge through knowledge management practice, as proposed by Nonaka's research in 1994 [2] assisted organizations in leveraging their business activities and leads to better decisions. Enterprises must manage knowledge internally and externally through knowledge management systems (KMS) [3].

Knowledge resources management effectively is an ultimate goal. Implementing knowledge management (KM) can assist in achieving and maximizing the return on investments [4]. *Knowledge Management* definition, as expressed by the information management perspective, defines the organization's ability to handle and store knowledge and distribute it wisely [5]. In contrast, a similar definition from the Information technology perspective defines *it* as improving knowledge capturing, storing, and sharing [6]. As commonly said, knowledge management is an umbrella term that focuses on the efficient handling of organizations' intellectual assets, including creation, storage, analysis, sharing, and application [7], [8].

Knowledge management includes six core processes, knowledge recognition, creation, capturing, processing, sharing, and application [9]. Another view of the knowledge lifecycle divides it into four phases: discovery, capture, sharing, and application [10]. The core of knowledge management successis knowledge sharing [11]. Our focus in this research will be on knowledge sharing and application. Employees use the knowledge management system to transmit their documented work problems and proposed solutions in the knowledge-sharing phase. Then other employees will utilize the knowledge base through the knowledge application phase to reduce errors and enhance work quality in relative tasks [12]. For organizations' knowledge is vital Susanto, Permata, Sensuse, and Elisabeth (2021). Ensuring knowledge resources available whenever needed can positively aid the decision-making process and assists organizations in building sustainable competitive advantage [4], [13]. A *knowledge management system* is an application commonly used by organizations to preserve employees' knowledge for future efficient usage [14]. Budianto and Sardjono (2022), higher management has a significant role in providing proper training for their employees on how to use the KMS effectively, always up to date, and increase their awareness about the necessity of sharing knowledge on the organization's efficiency level [12].

Enhancing organizations' performance is possible through knowledge sharing. In [15], quantitative research statistically evaluated the effect of sharing knowledge between employees at all levels and preserving it through documentation. The research results also aid the innovation of products and services provided to consumers, positively reflecting customer relationships. For healthcare organizations enriching the knowledge base is the highest priority due to several factors, including the decreasing number of professionals in the future, the necessity of sharing expertise with young generation employees, and the rapid evolution of healthcare industry tools and medical practices [16].

Managing knowledge empowers employees to work and increase their innovation [17]. The importance of managing organizations' knowledge has drastically increased for many reasons, including globalization, technological development, and the necessity to communicate between employees to share their expertise, service quality, and achieve overall goals [18]. Moreover, many organizations intend to manage their knowledge and work toward implementing knowledge management; however, people support and contribution to establishing a communicating culture is a complex process [19]. As a result, deciding to implement the knowledge management initiative needs to be taken wisely to achieve desired outcomes [20]. In addition, multiple factors can influence the initiative implementation success rate, including collaboration and trust, commitment from employees at all levels, and top management support [21].

3. BLOCKCHAIN TECHNOLOGY

Decentralized web or *Web 3.0* is the last successful iteration of the internet evolution [22]. It eliminatesthe need for a central authority or entity to control and ensures user data and identity ownership and privacy over the internet. Web 3.0 has many applications like distributed autonomous organizations (DAO), decentralized finance (Defi), and metaverse [23]. Also, it offers enormous benefits, including openness, anonymity, high availability, and compatibility [24]. In contrast, web 3.0 introduces a decentralized network known as Blockchain with main characteristics including distributed storage, processing, and access [25].

Blockchain, also known as distributed ledger technology (DLT), facilitates maintaining the informationvisible to all network parties securely [26]. Satoshi Nakamoto introduced Blockchain in 2008 for the cryptocurrency Bitcoin [27]. Since then, it has extended to provide various applications across many domains, including financial and healthcare, identity management, governance, manufacturing, and logistics [28], [29]. *Blockchain* is a peer-to-peer (P2P) interaction that provides the ability to record theinformation only if it gets approved among all participants added to the chain as a new block, and in order to maintain the network integrity, consensus algorithms used, including Proof-of-Work (PoW) and Proof-of-Stake (PoS) [30]. For PoW, generating a new block begins with solving a mathematical problem by the miner, but it consumes energy. On the other hand, the PoS mechanism is related to theamount of stake, so the node that owns the highest stake among network participants is more capable of generating a new block; however, that rich node will get more prosperous consequently, which can negatively reduce the overall mining legitimacy [31]. Blockchain functional mechanism is shown in Figure 1.

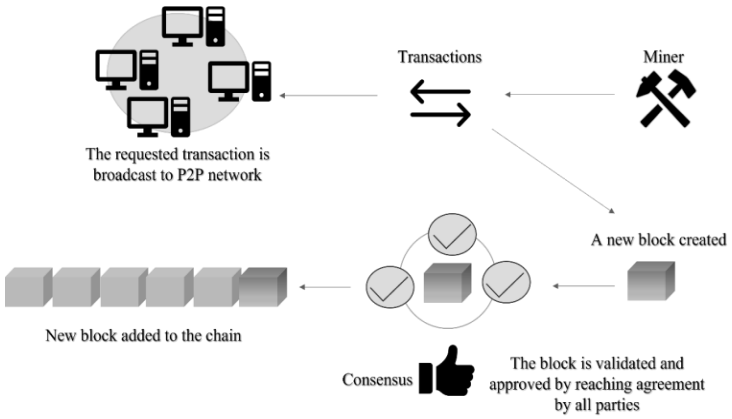

Figure 1 Blockchain Functional Mechanism © 2019 [29].

Blockchain technology is invented creatively by merging cryptocurrency, digital signature, decentralization, and distributed computations. Also, it provides a running environment for a self-executable program known as a S*mart Contract*, introduced by Nick Szabo in 1994 [32]. In addition, many benefits of smart contracts, including trust, speed of transactions, accuracy, and autonomy. In the blockchain, the probability of manipulation or false alteration is not possible since each block in the chain contains a hash value of the previous block (i.e., each block references the block created before it in the sequence) and the timestamp of the previous block, which is also a tamper-proof, an illustration provided in Figure 2 [33], [34]. As a result, the blockchain network is transparent, traceable, andimmutable [35].

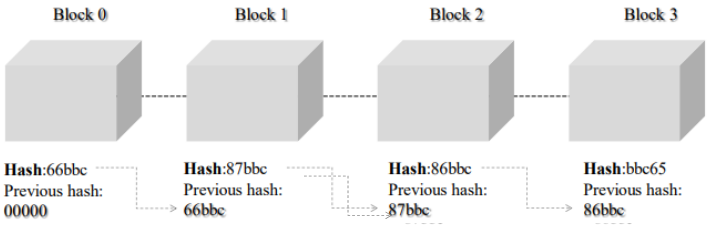

Figure 2 Blockchain Reference Structure © 2018 [33].

Blockchain has three types: public, private, and consortium blockchains. A *public blockchain*, also known as a *permissionless blockchain*, is open for public participation, offering excellent transparencyand audibility. In this type, the identity remains confidential, and no single authority controls transactions exchange mainly used for mining cryptocurrencies like Bitcoin and Ethereum [36]. On theother hand, it usually incorporates many participants, which requires more scalability and consumes high energy. Also, the speed of committing the transactions by participants is relatively low, which reduces the overall efficiency [37].

The second type is a *private or permissioned blockchain*, where participants are known and can only participate if authorized. In this type, a single organization or authority has complete control, and the transactions verifying speed is high compared to the public blockchain. Private blockchains are more appropriate than public ones, especially when dealing with sensitive information and the necessity for privacy [38]. Renduchintala, Alfauri, Yang, Pietro, and Jain (2022) state that traditional centralized knowledge management banks are working toward using permissioned blockchain due to its benefits, like fast processing, higher security, and low-cost processes [34]. Also, it can help manage supply chainsand logistics [39].

A *consortium blockchain* is the third type, a combination of public and private blockchains. In this type, to access the network, a participant needs permission, similar to private blockchains, but the informationis not visible to all participants. Also, a consortium node selected as a representative has only the right to verify transactions, enhancing flexibility and performance. It is used in governmental and financial organizations [40].

Despite growing interest in adopting blockchain technology, it incorporates some limitations, as expressed by Wang, Li, Chen, Ryan, and Hardjono (2022); the difficulty in tracing the financial transactions in blockchain due to its autonomy characteristic, which complicates calculating taxes, monitoring cash flow, and maintaining overall security [24]. Other hurdles related to storage capacity, as expressed by Lu, Xu, Liu, Weber, Zhu, and Zhang (2019), the blockchain works in an append-only mechanism that increases the storage space. In addition, a critical issue related to the transaction throughput of the network as measured by transaction per second and the limitation faced with the chainblock capacity [36].

4. BLOCKCHAIN AND KNOWLEDGE MANAGEMENT SYSTEMS

Technology assists in facilitating employees' daily tasks. Employees contribute and use the organization's intellectual capital, which holds valuable information that creates a competitive advantage for an organization. Traditional knowledge management systems use central knowledge bases, which can be vulnerable to security attacks and difficult to distribute among multiple parties. Also, content integrity may reduce through false alteration.

On the other hand, blockchain-driven knowledge bases are decentralized and immutable, and their content integrity is guaranteed using cartographic methods, which are more robust to cyberattacks [41].Each block in the chain stores validated transactions that originated from their source and cannot be replicated, forming a trusted source and enhancing the decision-making process for sensitive matters. An attacker must modify the transactions for all blocks linked to each other in the chain. This attack, called 51%, requires more than 50% of computational power, which is not possible, and as an outcome,assures blockchain integrity [42].

Enterprises focus on success measures and how to be more innovative, which can be very challenging, especially for supply chain activities that suffer from uncertainty, privacy, and ownership issues [43]. *Supply chain management* (SCM) includes a combination of business processes and various stakeholders like customers, suppliers, and partners to transform raw materials into beneficial productsfor end users smoothly and efficiently [44].

The supply system starts when the buyer places an order, then a middleman acting as central authority calculates corresponding fees and monitors the order status among the chain, including transmitting it next to the manufacturer, then after production to logistics until it arrives at the buyer. This process involves multiple parties, and with SC nature, it mainly involves short-term business interactions, whichcan involve different trust issues and produce conflicts among them in case of delay or errors. To address the problem of trust lack, an approach to map business processes through SC infrastructure viastoring transactions on the blockchain is expressed in [45]. With this solution’s aid, central authority iseliminated, and the full transparency of records among shared ledgers creates a trusted base and aid in overall cost reduction. An overview of the approach is shown in Figure 3.

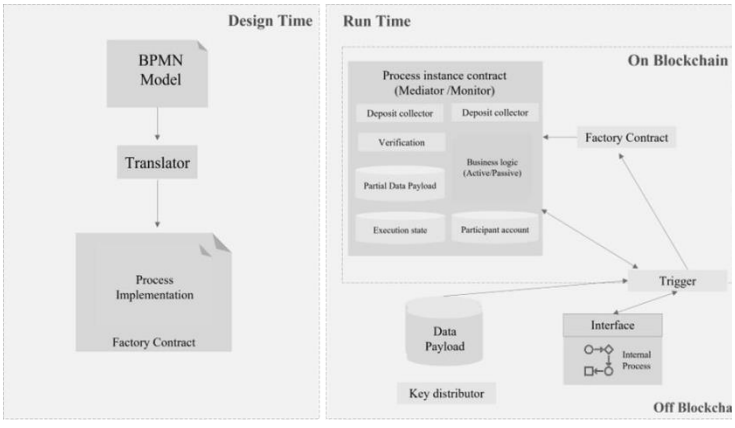

Figure 3 Blockchain-based System for Business Process Management ©2016 [45].

A blockchain-based systematic approach to managing the supply network was proposed in [46]. The results proved the solution’s viability by accomplishing better control over network activities and establishing transparency from production until delivering products to the user. Also, the data storage cost reduction through blockchain-based models distributed mechanism [47]. In addition,

Ilbiz and Durst (2019) presented a conceptual roadmap for small and medium-sized enterprises (SMEs) proposed to support deciding on deploying blockchain technology to manage their knowledge base based on theirneeds and expected outcomes [42].

Traditional management models need to improve on crucial issues related to persuasion or misinterpretation of knowledge and the necessity of proving ownership. Many influential individuals, i.e., politicians and popular organizations, strive to communicate with the public freely, like newspapersand news agencies, to improve their online presence. However, with the current infrastructure, it is notfeasible. In [48], a solution is proposed based on a permissioned blockchain that only allows some members to add and verify blocks, and agreements between participants are maintained with acommittee voting consensus algorithm. The solution applied to facilitate knowledge sharing between seven universities in the same country while preserving each knowledge source. The results approved that the blockchain-based knowledge model is more accountable, decentralized, immutable, andapplicable to related domains.

Blockchain solutions enhance overall performance and create companies' competitive advantage through audibility and immutability characteristics. philsoophian, Akhavan, and Namvar (2022) expressed that the knowledge-sharing issues encountered with traditional knowledge management are solved by implementing blockchain for efficient knowledge transfer of shared expertise and know-howbetween parties while supporting relations and building trust. Also, the instant access and high-security measures incorporated with this technology can improve knowledge management practices and supports the integrity and privacy required [43].

However, as expressed by Ilbiz et al. [42], blockchain technology is not always a suitable solution for various trade-offs, including the technology is still very novel and the absence of national and global regulations. Mittal, Gedeon, and Caldwell (2018) stated that another potential issue is related to the scalability of the P2P network, especially if the participant number is too large [48]. Moreover, blockchain-based supply chain models have been implemented in many projects, as stated by Della Valle and Oliver (2021). However, the overall performance is less than required and must be improvedto work efficiently [46].

5. CONCLUSION AND FUTURE WORK

This survey paper comprehensively explained the knowledge and knowledge management systems, including their role in managing enterprises' knowledge assets and the expected benefits and corresponding challenges. Centralized knowledge management systems are ineffective for distributed knowledge sharing while preserving intellectual ownership rights—they also need access monitoring to knowledge assets by authorized users only. Therefore, adopting a blockchain-driven knowledge management system with provided features, including transparency, audibility, decentralization, and security is necessary. However, enterprises' decision-makers must evaluate their business needs and intellectual capital. Then, select suitable blockchain-based models to achieve their overall goals and benefits of investment.

The primary limitations of this survey are the low number of published papers related to blockchain technology and knowledge management practices. Also, the lack of analytical results aids the decisionto invest in this technology.

Future research should investigate the quantitative benefits of blockchain-based models for organizations' knowledge asset management, including performance metrics and practical implantationdetails. Along with technical papers to discuss the practical implementation of the

proposed models andthe necessary infrastructure changes to guide the transition smoothly. Also, the financial gains of blockchain-based models' investment in the business activities and achievement level.

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