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Effective Knowledge Management in the Covid-19 Pandemic: A Model with Emphasis on Intellectual Capital in Medical and Healthcare Organizations Based on Blockchain

Mohammadreza Zahedi ^{1,*}, Morteza Piri ²

¹ Associate Professor, Industrial Engineering Dept., Management and Industrial Engineering Faculty, Malek ASHTAR University of Technology, Tehran, Iran. (Corresponding Author) zahedy182@gmail.com, 0000-0002-5745-0104

² Assistant Professor, Industrial Engineering Dept., Management and Industrial Engineering Faculty, Malek ASHTAR University of Technology, Tehran, Iran. mortezaa.piri@gmail.com

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ABSTRACT

The application of blockchain technology in the field of knowledge and intellectual capital management is gaining traction due to its ability to enhance key indicators such as security, non-forgery, unchangeable information, tracking, decentralization, and transparency. This technology is increasingly being utilized in knowledge and intellectual capital management, with its growth and promotion hinging on the need to prioritize the tacit knowledge and intellectual capital of employees. However, scientific contributions and successful applications in this area remain limited and are primarily in the proof-of-concept stage. The main focus of this paper is to introduce a value chain management model that emphasizes intellectual capital in medical and healthcare organizations through the use of blockchain technology. The study begins by extracting a framework for readiness to adopt blockchain technology through a review of previous studies and research. Subsequently, it identifies various areas within the value chain of medical and healthcare organizations. A questionnaire for pairwise comparisons was then distributed using a hierarchical approach. Finally, the TOPSIS questionnaire was used to rank the five identified areas of activity in the value chain and knowledge management of medical and healthcare organizations. Semi-structured interviews with experts from the organizations were conducted to provide further insights into promising methods for enhancing blockchain acceptance within the organization and to suggest meaningful research directions for future studies. ©authors

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1. Introduction

Blockchain technology has entered many industries and businesses these days. Even the field of health and hygiene has not been spared from this trend. Blockchain is slowly getting ready to enter the medical sector. Over the past five years, global technology giants such as IBM have devoted significant resources to conducting comprehensive studies on blockchain. The results of Senbekov and his team studies lead to a better understanding of the applications of this technology in the health field. (Senbekov et al.,2020)

The results obtained from research show that more than half of the executive directors in the health sector are strongly inclined to see some form of blockchain technology enter the medical system in the future. What is the application of blockchain in the field of health and medicine? (Bayat et al., 2021)

Blockchain technology will provide more efficient and safer tools for the field of health and medicine. The immutable nature of this technology can bring significant changes to the healthcare sector in Armaghan, making it highly suitable for this industry.

Harvard Medical School recently published a report that showed that about \$445 billion is lost annually in the healthcare sector due to fraud. In 2015 alone in the United States, more than \$700 million was scammed in this area. For this reason, this industry is in dire need of a system that has the capabilities to verify and check the authenticity of things. Blockchain can address this need, and therefore, implementing a blockchain-based system in the global health industry is really necessary.¹

The current medical system consists of many separate and centralized departments. Public and private hospitals, clinics, diagnostic clinics, private offices and other departments that operate separately. Of course, such a large and scattered collection of public and private organizations is not expected to be very effective. To clarify, the city of Boston alone has about 26 different

electronic medical record systems. This dispersion has a kind of chaos and is a big concern for the health field. For this reason, experts in this field have decided to find a way to solve this problem by forming a team of researchers from all over the world. MIT researchers have published a white paper describing a blockchain-based system that can help all these organizations exchange data in a more secure and efficient way. The system uses the Ethereum blockchain and smart contract technology to do this, something that was practically impossible just a few years ago (Khan et al., 2021)

Using a blockchain-based global health network, all patient treatment records can be securely stored in one centralized location. Each patient can be assigned a unique blockchain fingerprint to verify their identity and medical history. As the system processes large volumes of data, healthcare professionals will witness the accuracy and efficiency of this innovative approach. Unlike the current global health system, which relies on centralized patient files, many developing countries still rely on paper records. Implementing a blockchain-based patient record system is cost-effective, allowing all patient treatment records to be stored on a unified platform. Platforms like Medical Chain are already offering these services to healthcare professionals, demonstrating successful implementation.

Another significant application of blockchain is to enhance the global medical research process. With blockchain technology, it is feasible to track the outcomes of drug tests in real-time. The adoption of new treatment protocols is quite expensive, and the current system hinders the timely utilization of data. Through the implementation of blockchain-based supply chain, various aspects such as the timing and location of medicine distribution and supply can be more precisely monitored. Monitoring these modifications is easily achievable through blockchain, ensuring that all results remain immutable.

According to experts' estimates, counterfeit drugs cause more than \$200 million in

¹ <https://irantelemed.ir/default.aspx>

damages to the pharmaceutical industry every year (Connie, 2023). Blockchain technology is widely utilized in the supply chain, and now major transportation networks facing similar logistics challenges are extensively adopting this technology. Blockchain technology enables patients to verify the authenticity of medications. This system can also be programmed to provide patients with information such as the manufacturing date and other relevant details about the drugs. The MediLedger platform is another successful system in the pharmaceutical industry that offers pharmaceutical companies a cost-effective and reliable solution by incorporating features like compliance checks, tracking, tracing, and security protocols. This platform is interoperable with the GS-1 system and provides a dedicated portal for company managers to access crucial network information as needed. This platform uses blockchain where anyone needs permission to use the data. In this way, patient data can be protected against unauthorized use. The developers of this platform believe that blockchain-based supply chain systems will become completely legal by 2020. The Food and Drug Administration (FDA) has already reacted positively to this platform. With such a huge amount of money lost due to fraud, there seems to be no choice but to embrace emerging technologies. One of the other concerns in the field of health is data security. Unfortunately, in 2015 alone, about 140 million cases of unauthorized use of patient information occurred. Blockchain networks can protect the valuable information of patients and deny the possibility of any manipulation or deletion of information from malicious people. Healthcare providers are always concerned about data security, and only blockchain technology can provide the sector with the tools to protect the authenticity of online documents and verify their authenticity (Barbara, 2020).

After examining some of the uses and benefits that blockchain brings to the medical sector, it is easy to see why many healthcare professionals are looking to this new technology to eliminate unnecessary

work in the future. If this is done right, we will soon see the days when healthcare fraud will be completely impossible.

Blockchain is an exciting innovation that can revolutionize organizations and offer a variety of applications. Blockchain was created for the financial sector (Chen, 2018). But now researchers, academics, and industry are exploring blockchain for other applications in various fields (Kouhizadeh et al., 2021). It is commonly asked that if blockchain is distributed, then how can it provide a secure platform? Note that in blockchain technology, cryptography is used to generate digital signatures. The digital signature includes two items: "private key" and "information or data to be transmitted over the network. The private key can only be accessed by its owner, but each network member has access to the public key of the other network members. In the process of creating a digital signature and sending it to the blockchain network, this digital signature is decrypted by the network using the sender's public key, and the information is separated from the signature if the original information is the same as the information decrypted from the public key (Zahedi & Khanachah, 2022). Otherwise, the decrypted information is not the same as the original information, or if the original information was tampered with during the entry into the network, or if the digital signature is formed by the personal key of another person whose original owner is the information. is not ". This is how the network prevents information manipulation and detects it .

In the existing literature, several contexts have been proposed for the use of blockchain (Al-Mamun et al., 2018). In addition to common financial applications such as the digital payment system, cryptocurrencies, and cash transactions such as smart contracts, scientific, cultural, artistic, health, and various political and governmental sectors, potential areas for the use of blockchain were mentioned (Perera et al., 2020). In the field of data storage, before the development of blockchain, companies stored their data traditionally or through a cloud database. Blockchain can share data in addition to data storage and provide high-

level security and protection without the need for a third party or organization (Fernández-Caramés et al., 2019). Blockchain can also be used in government and political sectors and can affect the structure of policies, governments, and societies (Berryhill et al., 2018). Managing identity, criminal records, and access to accurate information about individuals in a community, such as driver's licenses, passports, and visas, are other benefits of using blockchain in government (Mainelli & Smith, 2015). The need for a government agency to oversee the performance of government agencies and pay taxes by using blockchain smart contracts reduces administrative and auditing costs. The blockchain-based electoral system is another application of this technology in the public and political sectors (Peters & Panayi, 2016). As a revolution, blockchain can change business processes and supply chain networks in various industries at the international level, creating value for organizations and improving trade and the economy (Min, 2019). In the field of financial transactions, companies can use blockchain to register, control, or track their assets globally (Kshetri, 2017). Murray et al. (2019) introduced the use of blockchain in human resource activities of organizations, such as hiring labor for different parts of the organization, where degrees, education, and previous employment of individuals in various institutions and companies can be implemented as a blockchain, and information about candidates should be available to different recruiting companies and tracked (Murray et al., 2019). In the field of art and music, the founder of a new style, idea, or work, especially in art and music products, can encrypt his style, idea, or work to protect against imitation in the blockchain (Finucane, 2018). Also in the health sector, for medical research, the use of a blockchain to record the physical and mental condition of each patient leads to patient information with full detail and accuracy in special situations such as war and earthquakes or when the patient's condition is severe, reducing errors in recording patient

information, reducing the bias of medical research, increasing the security of recorded data, and reducing the risk of data loss due to cyber-attacks can be mentioned (Benchoufi & Ravaud, 2019). In the pharmaceutical sector, blockchain as a suitable solution leads to security in drug distribution and reduction of drug counterfeiting, reducing the possibility of tampering with drug ingredients, and preventing the delivery of expired drugs (Bell et al., 2018). The questions of this research are:

1. How is blockchain used in human resource management in medical organizations?
2. What are the factors influencing human resource management in blockchain-based medical organizations?
- What are the priorities of the mentioned factors?
4. How do factors influence each other?
5. How are the cause and effect relationships of the factors?
6. What challenges does the studied community face in using blockchain in human resource management?
7. What are the ways out?

2. 2. Literature Review

2.1 Value chain knowledge-based management

Today, in different countries, including Iran, managers are eager to create knowledge management systems in organizations to benefit from its useful results. One of the most important and common processes in the various structures introduced for knowledge management is knowledge sharing. Motivating people to share their knowledge in organizations is also an important priority. Is involved in knowledge management (Asrar-ul-Haq & Anwar, 2016).

knowledge sharing is an activity through which knowledge, information, skills, and expertise are exchanged between people, friends, family, communities, or organizations. The role of knowledge sharing in knowledge management is so important that some authors have stated that the existence of knowledge management is to

support knowledge sharing (Al Saifi et al., 2016). Therefore, an organization that supports information sharing and knowledge creation among its members can better define effective and efficient processes and improve their organizational performance.

With the shift from an industry-based economy to a knowledge-based economy, organizations have also sought to increase their competitiveness by relying on knowledge and information and using it in the business process (Navimipour et al., 2018). Thus, in a knowledge-based economy, intangible assets (intellectual capital, experience, organizational knowledge, and organizational information rather than tangible assets) (machinery and equipment) have increasingly become a competitive determinant (Hekmati, 2022).

Businesses, organizational reputation, skills, and technical knowledge of employees are seen as the essence of competitive advantage, so to stay competitive, organizations must focus on how to implement knowledge management, create knowledge, and value knowledge (Malik et al., 2020). Simply put, it provides the conditions for creating more benefits than the cost and success of an enterprise in the long run, and this means that managers create value for the sympathy of the organization's stakeholders, i.e. customers, shareholders, vendors, employees, and society in the broadest sense. Otherwise, any of the stakeholders who do not receive value from the organization will leave the organization and jeopardize the success of the organization, so the company's value chain will allow managers to gain insight into the company's processes. Factors or main components of product production with Institutions' service delivery begins (Smith et al., 2013) and includes all the processes that take place to satisfy customers. Art strategy is worth creating. The mindset strategy provides conceptual models and guides ideas, allowing corporate executives to identify opportunities to create value for customers and transfer that value as a benefit (Zahedi & Khanachah, 2019).

2.2 Criteria for assessing the readiness to accept blockchain in the organization

The blockchain readiness framework is more of a management issue than a technical one, and organizations need to develop benchmarks to measure it (Kshetri, 2018). The technical debate, however, is one of the most important factors (Demirkan et al., 2020). For example, the company may have the necessary technical infrastructure to enter into a smart contract, but because the legal infrastructure does not exist in the event of a dispute and a claimed authority, the smart contract may not be effective in practice. Interoperability in the application of blockchain includes both technical and organizational, structural, and inter-organizational dimensions (Savelyev, 2017).

One of the key questions in using blockchain is "time" to use it (Queiroz et al., 2020). From a technical point of view, blockchain technology can be implemented in several scenarios; But certainly, not every situation is suitable for this. In particular, there are situations where the application of blockchain technology creates significant value over existing technologies. Of course, it must be ensured that the main capacities of the blockchain are used and that large investments are worthwhile. Positive answers to questions such as "Do different parties share the information? Or do they update it? Is there a need for approval? Are intermediaries removable and this reduces cost and complexity?" This indicates that there is a potential scenario for blockchain applications. Of course, depending on the sensitivity of the issue, a more diverse range of questions and considerations can be considered. For example, it is suggested that to design a winning business strategy in blockchain, a set of key considerations and questions should be considered before taking any action. In principle, six thematic groups (as shown in Figure 2) are considered in preparation for the blockchain, and the relevant questions under each of these groups are considered. In the future, with each relevant question and answer, a mechanism should be activated to evaluate the opportunities. It is predicted that if the answers to these questions are determined before any executive activity, the chances of success in obtaining results and benefiting

from the benefits of blockchain will increase (Wang et al., 2019). Of course, launching a transparent operating model and organizing a comprehensive consortium effectively solve

the next problems in the management of the platform and its responsibilities.

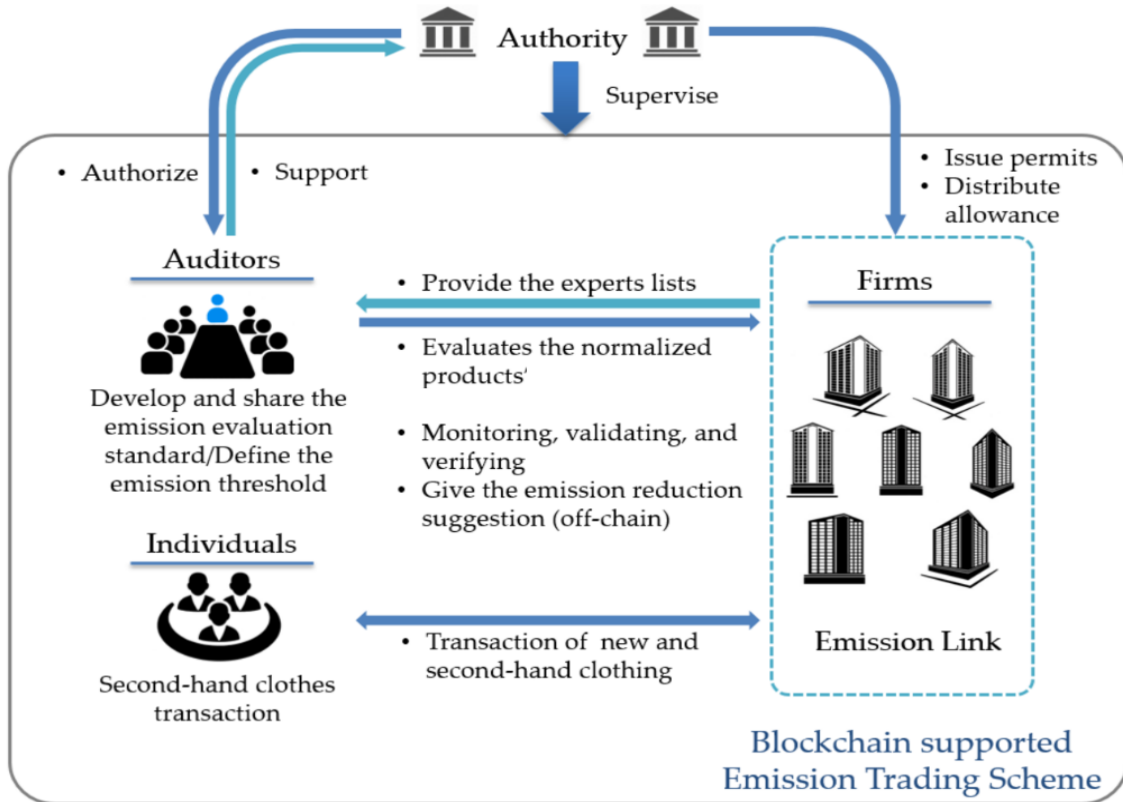


Figure 1. Blockchain-supported emission trading scheme (Fu, Shu, & Liu, 2018).

It is important to note that in the application of blockchain technology, the issue is not merely mediation, but there are deeper issues. In this regard, Mackenzie Institute's in-depth interviews with managers of major industries around the world show 90 separate applications and at different maturity levels in major industries. Therefore, managers need to know with what application they should expect what results. In other words, managers must determine with a pragmatic and skeptical view how much and to what extent the impact of blockchain on their business is possible (O'Dair, 2018). Even more precisely, companies must look to the core of their pain to seek treatment and blockchain applications. In addition, measures such as shaping the ecosystem, setting standards, and resolving legal barriers

should be on the agenda (Seppälä, 2016; Zahedi et al., 2020).

If the right strategy for blockchain development is chosen, companies can create value in the short term. Also, the top and dominant actors who can present their blocks as market solutions will now be able to present their services as a leading market maker. Therefore, the main issue is the choice of strategy, and the analysis shows that there are three main dimensions to the strategic value of blockchain technology: Dimension 1: It does not matter if the blockchain technology is unmediated to create value. This means that other values can be created by reducing complexity, increasing transparency, and preventing counterfeiting and corruption (Abeyratne & Monfared, 2016). Second dimension: The short-term value of blockchain is mainly in reducing costs and then in creating business

transformation models. Explain that, it is true that blockchain is the basis of an evolutionary technology, but its primary effect is to improve operational productivity. Blockchain can achieve operational efficiency by avoiding existing processes, eliminating intermediaries or administrative activities to maintain documents, and consolidating transactions that lead to "attracting lost revenue and creating new revenue for service providers."

In the evaluation of blockchain applications, it is estimated that 70% of the short-term available value is in cost reduction. This 70% leads to revenue generation and capital liberalization. For example, one of the much-anticipated developments is the creation of a distributed digital identity for consumer identity, customer processes, and related services (Nouri et al., 2022). Dimension 3: It will take between 3 and 5 years for blockchain to become feasible on an appropriate scale, first because of the difficulty of resolving the "competing" conflict to establish common standards. In other words, the strategic value of blockchain will only be understood when Real-scale business must be usable; that is, it must be feasible in the face of standards, technology, assets, and ecosystems, so in a situation where most companies are testing blockchain technology, significant scalability will take that long.

Another issue is where organizations should compete in the field of blockchain To start (Fraga-Lamas & Fernández-Caramés, 2019). The answer is that blockchain applications are diverse, but the main suggestion is to pay attention to specific and promising applications. "Companies can evaluate their options with a pair of glasses of practical skepticism and in a structured

way. They must first determine that sufficient and affordable value Is there a focus on the real problem that is problematic for the customers? Otherwise, companies should not enter the second step, which is to determine the strategy of adapting to the blockchain. If companies are to compete in blockchain, they must develop their strategy based on the market position. Many of the feasibility issues raised earlier need to be considered. Even technological and financial constraints can be managed through a set of debt consolidation solutions (Kурpjuweit et al., 2019). Therefore, the optimal strategic solution for a company's development of blockchain technology is primarily determined by two key factors: 1. Market dominance: The ability of an entity to influence the primary parties involved in an application. 2. Legal barriers and standards: Requiring legal approval or adherence to standard requirements. When considering these factors, it is important to recognize that the value of blockchain technology stems from network effects and the interoperability of involved parties. Consensus on a specific standard is essential for all parties (Mandolla, Petruzzelli, Percoco, & Urbinati, 2019). It is crucial to avoid isolated behaviors and multiple solutions as they offer minimal advantages. With technological advancements, market standards will evolve, and investing in various standards will prove to be counterproductive (Rajabi et al., 2022). As illustrated in the figure below, the optimal blockchain solution for each application is customized based on market positioning and the capacity to influence legal barriers and standards. Consequently, even followers must be prepared for swift adaptation to emerging standards (Meinert et al., 2019).

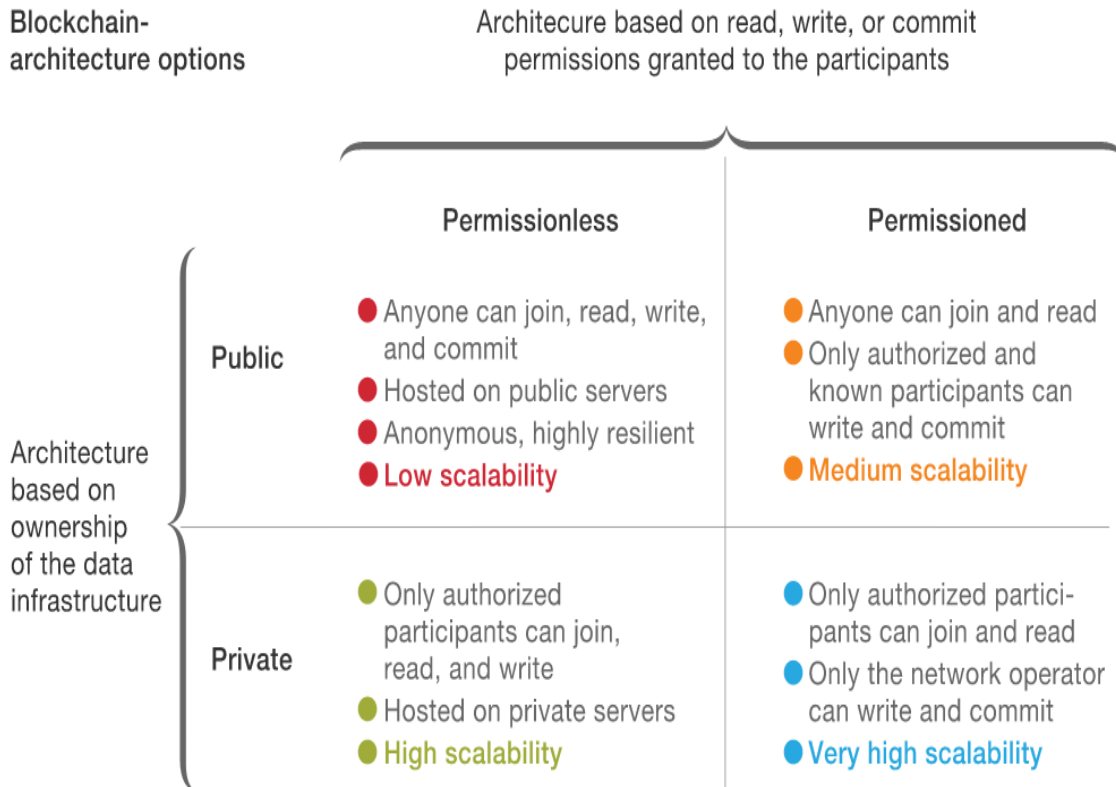


Figure 2. Review and level to determine the appropriate strategy for implementing blockchain(Carson et al., 2018)

The figure above appears to be four separate strategic areas for the development of blockchain technology, but in practice emphasizes the prioritization of applications according to the position of companies; Therefore, managers can learn about their internal and external environment and choose their field of application depending on the results (Lohmer et al., 2020).

Specifically, for the field of knowledge management and value chain in medical and healthcare organizations, according to studies conducted in this field, 5 steps are proposed for action in the field of blockchain, which is described separately below. It is worth noting that in most of the steps suggested by the report, two issues are important, first, the choice of application appropriate to the mission and program of the organization, and second, the focus on legal issues and challenges(Maroun et al., 2019).

2.3 Create an interdisciplinary and agile working group for blockchain

Working groups are formed to review the applications of blockchain with a

combination of the whole organization and create coordination between different departments. This combination of technical capabilities to business skills must be present. The working group prepares and proposes business cases and thus gains the support of the organization's leadership. This group acts as a startup and has features based on flexibility and transparency. The key elements of "continuous experimentation" and "drawing a way to validate assumptions and ideas" need to be considered. Entrepreneurship in an environment such as blockchain also requires the empowerment of working group members and full authority to implement the program (Moşteanu & Faccia, 2020).

2.4 Identify appropriate blockchain applications

value chain companies need to be careful not to develop technology because of technology. These companies need to move beyond the exaggerations of blockchain technology and act more carefully. It is better to answer some basic questions first and then

make a decision based on the answers (Sulkowski, 2018).

What problems do companies in the supply chain of project-oriented organizations aim to solve with this technology?

Today, one of the biggest challenges that organizations face is the lack of trust among partners. Consequently, organizations require technology that enhances trust among partners. In addition to transparency issues, centralized information, and data variability, another disruptive factor in the value chain is variability.

What are the current solutions to these problems? With the advent of the Fourth Industrial Revolution, we are witnessing technological advancements in various sectors. One significant technology that can address these issues is blockchain technology. Blockchain technology is a decentralized network that comprises blocks, public keys, private keys, transactions, and more.

The blockchain technology is the only application that solves this problem. Blockchain technology incorporates a consensus mechanism between nodes. When a transaction occurs between two partners, it must first be approved by the consensus mechanism. Subsequently, once the credentials are verified, the transaction is executed using the public and private keys of the two partners. All the information is then stored in a block and added to the blockchain. Each block possesses a unique and encrypted hash. This process enhances security, making it extremely difficult to hack, while also boosting trust and reliability.

What are the working requirements of these applications? Fortunately, since 2016, blockchain technology has had a special place among researchers and practitioners. It is increasing at a high rate. Integrating blockchain technology with various areas such as supply chain management, where the value chain is situated, has led to improved performance in organizations and companies, enhancing productivity and efficiency. This integration has also elevated satisfaction levels among organizations. Public key, private key, consensus mechanism, smart

contract, and solvers are key features of blockchain technology. Furthermore, the necessary services and requirements of the parties are stored in the blockchain pool, facilitated through a combination of services provided by Salvor.

Blockchain is the right technology to meet these requirements. Many current supply chain and value chain problems can be solved through blockchain technology because it offers innovative ways to record, transfer, and share information.

What is the value proposition of blockchain compared to other technologies? One of the most important differences between blockchain technology and other databases is that blockchain technology is a decentralized database and distributed network, and all information occurs instantly and in real-time while other databases are centralized. The main difference is that database control remains with database administrators, and access control and permissions are maintained by a central authority. In a way, database admins can delete data and information whenever they want. But in blockchain, network users own the database information, and the information on the blockchain is not deleted. The database distributed by Blockchain technology essentially creates a completely different digital backing. But Control of centralized databases is in the hands of their owners.

How does blockchain integrate with existing technologies, processes, and systems in use today? Today, the combination of blockchain technology with various fields including supply chain, finance, insurance, logistics, and transportation, IoT has received a lot of attention and is used by different countries. Supply chains are at the heart of the process of delivering products to customers at the right time and the right cost. No matter what kind of products an organization produces or sells, keeping customers satisfied and achieving financial goals depends on building an efficient and reliable supply chain network. Achieving customer satisfaction requires integrated collaboration and coordination across the value chain of suppliers, manufacturers, banks, regulators,

logistics service providers, and retailers. (Mohd et al., 2022)

At the same time, supply chain disruptions increase costs and, more importantly, lead to a loss of revenue. Most significantly, these disruptions are worsened by inefficient processes that rely on ineffective data (data that is unreliable and unclear). Organizations are striving for transparency, flexibility, and agility in their supply chains to manage these disruptions. Blockchain, as a part of efficient technologies in corporate supply chains, fosters trust, transparency, and consensus among all stakeholders, providing benefits for each participant and ensuring adaptable business outcomes. One example that illustrates this is the food supply chain, where customers can easily track the entire product journey from harvest to store and verify its quality (Wang & Yang, 2022).

2.5 Design experiments and define successes in blockchain and create a value proposition

Once blockchain applications are identified, the working group should focus on pilot design. First, a time must be set for determining the success criteria and expectations of the organization leader. The challenge at this stage is to change the internal view of specific financial results and the exact rate of return on investment in the pilot “mindset of experiencing learning experience.” The main goals in these early steps are to understand the potential possibilities, constraints, and business models. If the pilot outputs include "where blockchain technology excels" and "how blockchain brings new performance to the customer", then these gains should be considered a victory (Khan, 2019). Once the applications are selected, the next step is to choose the right location for the blockchain. Establish initial feasibility studies, which formulate the program's value proposition and provide a cost-benefit analysis for legislators, users, and customers (Andoni et al., 2019).

2.6 Focus on collaboration and joint creation of blockchain Blockchain

pilots in the value chain can reap great benefits from industry-wide collaboration. Cooperation between oil and gas companies, utilities, major equipment manufacturers, and startups can add unique value to each of these companies and their customers. Each of these organizations has unique capabilities, relationships, and benefits that reduce risk. It should be noted that working together with various stakeholders, especially customers, will be crucial to designing and launching a successful blockchain pilot (Ezell et al., 2018). Collaboration should go beyond industries and geographies and not be limited to specific pilot designs. Knowledge sharing is critical to better understanding how blockchain evolves and what its most appropriate uses are. Industrial consortia can help build an ecosystem of participants and accelerate the development and dissemination of industry standards (Giacalone et al., 2021).

2.7 Legislators will be needed to empower blockchain experiences

The value chain and knowledge sharing of the organization's intellectual capital will benefit from legal efforts to facilitate experiences and pilot blockchain and other innovations. For example, the UK Supply Chain Consortium and the Supply Chain Governing Body have created a body of legislation that allows supply chain companies to test innovations without compromising common legal requirements (Saber et al., 2019). As pilots continue to demonstrate results, there will be greater transparency about the technical and operational requirements of the platform and the functions of the blockchain. Ensuring the security and reliability of these platforms before developing common standards is one of the main tasks of legislators (Min, 2019). In general, all eyes are on the output of these blockchain pilots. The successful design, planning, and implementation of these experiences will be critical to helping to recognize the full potential of blockchain technology in the area of knowledge sharing in an organization (Francisco & Swanson,

2018). At the end of this section, using the roadmap tool, a process is proposed that is based on three main processes. These three processes focus on applications, concept proofing, and scale implementation (Francisco & Swanson, 2018).

To evaluate blockchain applications, a scale is proposed that is based on reliability, feasibility, and desirability. Of course, these frameworks are a good guide for implementing blockchain, but with the decision to implement blockchain, there is a long way to go, the first step of which is awareness of the technology itself (Rezaee, 2019).

3. Method

This study seeks to evaluate the applications of blockchain in various fields in the value chain and knowledge management and intellectual capital of the organization. For this purpose, first, by reviewing previous studies and researches, the framework for readiness to accept blockchain was extracted, and then the different areas of the value chain of medical and healthcare organizations were identified. Then, a questionnaire for pairwise comparisons was distributed using a hierarchical approach. Finally, the TOPSIS technique was distributed to rank the 5 identified areas of activity in the value chain and knowledge management of medical and healthcare organizations. Figure 1 and 2 shows the process of actions taken schematically.

To identify and evaluate blockchain readiness and rank the scope of activities of companies in the supply chain and network of project partners, in this study, the opinions of experts and specialists in the field of the value chain and knowledge management in medical and healthcare organizations are used. To complete the AHP and TOPSIS technique, the expert opinions of 25 experienced experts who worked in key and related positions in the knowledge and intellectual capital management of the organization and were also familiar with the concept of blockchain technology were used. The method of selecting these people was based on expertise and access. Data

collection was done in two ways: library and field. The method of collecting secondary data was a library and the method of collecting primary data was field; That is, using a questionnaire, the required data were collected from a sample of the community of experts and specialists and designated experts. In this study, two questionnaires were used. The data collected in the research were first weighted based on the technique of hierarchical analysis process and then using the TOPSIS technique, the domain of the companies' area of activity was ranked.

The TOPSIS method is one of the multiple criteria decision making (MADM) methods that deals with the ranking of options. In this method, two concepts of "ideal solution" and "similarity to ideal solution" are used. The ideal solution, as its name suggests, is the solution that is the best in every way, which generally does not exist in practice, and we try to get close to it. In order to measure the similarity of a plan (or option) to the ideal and anti-ideal solution, the distance of that plan (or option) from the ideal and anti-ideal solution is measured. Then the options are evaluated and ranked based on the ratio of the distance from the anti-ideal solution to the total distance from the ideal and anti-ideal solution. The word TOPSIS is derived from the first letters of the term Technique for Order of Preference by Similarity to Ideal Solution.

TOPSIS views a MADM problem with m options as a geometric system with m points in n -dimensional space. The method is based on the concept that the alternative should have the shortest distance from the positive-ideal solution and the longest distance from the negative-ideal solution. TOPSIS defines an index called similarity to positive-ideal solution and distance from negative-ideal solution. Then it chooses the alternative method with maximum similarity to the positive-ideal solution.

If an option is similar to an ideal solution, it has a higher degree. An ideal solution is a solution that is best in any aspect that does not exist in practice, and we try to approximate it. Basically, to measure the similarity of a plan (or option) with the ideal and non-ideal level, we consider the distance

of that plan from the ideal and non-ideal solution. The basic assumptions of this method are:

A- The desirability of each criterion must be uniformly increasing or decreasing. In other words, the desirability of the criterion, whether it is qualitative or quantitative, always increases and decreases with the change of its value. The criteria should be uniformly decreasing or increasing so that the best available value can be considered as ideal and the worst value as anti-ideal

B- The criteria should be designed in such a way that they are independent of each other (independence means the absence of internal relationships).

C- Since the exchange rate between the criteria is usually a value other than unity, the distance of the options from the ideal and anti-ideal solution is calculated as the Euclidean distance.

Advantages of TOPSIS method

It is possible to make a decision if there are positive and negative criteria (even together in the same issue). Positive criteria are criteria that have a beneficial aspect, such as product quality, and negative criteria are criteria that have a negative aspect, such as the difficulty of work.

To determine the best option, a significant number of criteria can be examined, while in the AHP method or the ANP method, there are practical and inherent limitations in this field.

This method is simple and has a good speed, and it responds well to a large number of options and criteria.

In the TOPSIS method, it is easy to quantify qualitative criteria, and decision-making is possible despite qualitative and quantitative criteria.

The output of the system is quantitative and in addition to determining the best option, the ranking of other options is expressed numerically. This numerical value is the relative closeness that expresses the strong basis of this method.

Topsis method has appropriate mathematical foundations. This method deals with spaces. TOPSIS selects the option that

has the largest distance from the worst option and the smallest distance from the best option as the optimal option, and for this reason and its mathematical basis, it is superior to other MADM methods.

The TOPSIS method has another advantage over some MADM methods, which is one of the compensatory methods. It means that the weight of all the options and criteria are included in the decision making and no weight is ignored in this method.

3-Determining the weighted scaleless matrix: in this step, we must multiply the weight of the criteria obtained from other methods in the normal matrix to obtain the weighted matrix (the TOPSIS method alone is not able to calculate the weight of the criteria, so we must use other methods such as AHP, entropy, etc., calculated the weight of the criteria and gave it as input to this method).

4- Finding the ideal and anti-ideal solution: Here, the type of criteria must be specified. The criteria are either positive or negative. Positive criteria are criteria whose increase causes improvement in the system, such as the quality of a product. This criterion is of a positive type, and its ideal solution is equal to the largest area of the criterion column and the anti-ideal is equal to the smallest area of the cell. For negative criteria, vice versa.

For criteria that have a positive load, the positive ideal is the largest value of that criterion.

For criteria that have a positive charge, the negative ideal is the smallest value of that criterion.

For criteria that have a negative load, the positive ideal is the smallest value of that criterion.

For criteria that have a negative load, the negative ideal is the largest value of that criterion.

5- Calculating the distance from the ideal and anti-ideal solution: In this step, based on the following relationship, we calculate the distance of each option from its positive and negative ideal.

The most important results obtained in this research are:

The components affecting human resource management were obtained through blockchain.

Achieving effectiveness or influencing factors on human resource management

Achieving the extent (intensity) of the influence and effectiveness of each of the

open innovation factors on each of the other factors.

4. Findings

Based on the studies, the indicators for assessing blockchain readiness are as follows:

Table 1. Blockchain Readiness Assessment Indicators

Row	Indicator	Explanation	Code
1	Consortium	Ability to work with key actors to ensure network impact	C1
2	Technology	Route with rapid technological changes	C2
3	Operation	Ability to perform actions related to the main activities	C3
4	Talent	Finding the right people to lead the operation	C4
5	Conformity	Compliance with laws and regulations	C5
6	Business Impact	Understanding the effects on core business processes	C6

AHP technique was used to weigh each of the above indicators.

Table 2. Average opinions of experts in the pairwise comparison questionnaire

Row	Indicator	C1	C2	C3	C4	C5	C6
1	Consortium	1.000	0.416	0.167	0.383	0.698	1.154
2	Technology	1.835	1.000	0.260	0.875	1.425	1.176
3	the operation	3.625	2.666	1.000	2.052	2.020	3.416
4	Talent	2.066	1.014	0.363	1.000	1.836	3.016
5	Conformity	1.150	0.554	0.394	0.415	1.000	1.527
6	Business Impact	0.696	0.682	0.183	0.230	0.513	1.000

The incompatibility rate of the above pairwise comparison table is 0.021, which is less than 0.1 and indicates a compatibility rate of more than 90%.

The weights and final rank of blockchain acceptance indicators are calculated below.

Table 3. Weights and ranking of acceptance readiness indicators in medical and healthcare organizations

Row	Indicator	C1	C2	C3	C4	C5	C6	Final weight	Index rank
1	Consortium	1.000	0.416	0.167	0.383	0.698	1.154	0.093	5
2	Technology	1.835	1.000	0.260	0.875	1.425	1.176	0.155	3
3	Operation	3.625	2.666	1.000	2.052	2.020	3.416	0.341	1
4	Talent	2.066	1.014	0.363	1.000	1.836	3.016	0.198	2
5	Conformity	1.150	0.554	0.394	0.415	1.000	1.527	0.123	4
6	Business Impact	0.696	0.682	0.183	0.230	0.513	1.000	0.084	6

After pairwise comparison, it was found that the ability to perform activities and actions and operations are the most important indicator of readiness. After that, the talent and ability of organizational resources to do it is the second priority. In

third place is the route with rapid technological changes.

In the theoretical foundations of the research, in the field of the value chain and knowledge management and intellectual capital, the applications of blockchain technology from its young identity; That is,

cryptocurrencies in the form of jointly distributed accounts have gone further and become facilitators of smart contracts. Blockchain takes on the role of a reliable guardian and provider of a platform for transparency, creating more value than increasing productivity by eliminating legal and financial intermediaries in an agreement. The key areas and opportunities of blockchain technology in the field of the value chain and knowledge management and intellectual capital, which are currently based on studies and research are time

management, knowledge chain, communication, knowledge update.

Value Chain Policy and Knowledge Management (A1), Sustainability of Collaborations (A2), Information Sharing (A3), Structures, Rules and Regulations (A4), and Operational Strategies (A5) The five activities of the value chain department and the management of knowledge and intellectual capital have been studied according to the indicators of acceptance readiness using the TOPSIS technique. The following table shows the normalized matrix and the weighted normalized matrix.

Table 4. Normalized matrix

Row	Scope of activity of companies	Consortium	Technology	Operation	Talent	Conformity	Business Impact
1	policy	-0.53772	-0.52882	-0.2482	-0.67599	-0.58357	-0.53944
2	Sustainability of collaborations	-0.7203	-0.52882	-0.7646	-0.67599	-0.77446	-0.81416
3	Information sharing	-0.17257	-0.52921	0	-0.1615	-0.19612	-0.12736
4	Structures, rules and regulations	0	0	-0.2452	0	0	0
5	Operational strategies	-0.35515	0.52882	-0.5064	-0.1715	0	0

Table 5. Rhythmic normalized matrix

Row	Scope of activity of companies	Consortium	Technology	Operation	Talent	Conformity	Business Impact
1	policy	-0.0509	-0.084	-0.088	-0.1365	-0.0729	-0.0467
2	Sustainability of collaborations	-0.0679	-0.084	-0.2649	-0.1365	-0.0972	-0.07005
3	Information sharing	-0.0169	-0.0506	0	-0.0341	-0.0243	-0.01168
4	Structures, rules and regulations	0	0	-0.0884	0	0	0
5	Operational strategies	-0.0339	-0.084	-0.1766	-0.0341	0	0

After calculating the distance between the options to the ideal and anti-ideal response, the final weights of the options and the rank of each are calculated based on the weight obtained.

R+J indicates the degree of influence of the desired factor in the pattern or system, and the larger it is, it indicates that the desired

factor has more interaction with other factors of the system and is of high importance, and R-J is the influence of each factor. shows, in general, if R-J is a positive number, the variable is considered a causal variable, and if it is negative, the variable is considered an effect variable. The values of R+J and R-J are as follows.

Table 6. Results of weighting and ranking of areas of activity of project-oriented organizations in the field of knowledge management and intellectual capital in terms of readiness to accept blockchain

Row	Scope of activity of companies	di+	di-	ci	Final rank
1	policy	-0.53772	-0.52882	-0.2482	2
2	Sustainability of collaborations	-0.7203	-0.52882	-0.7646	1
3	Information sharing	-0.17257	-0.52921	0	5
4	Structures, rules and regulations	0	0	-0.2452	4
5	Operational strategies	-0.35515	0.52882	-0.5064	3

Based on the obtained results, the field of the value chain and knowledge management at the level of stability of knowledge relations and collaborations has the highest readiness to accept blockchain. After that, the value chain is in second place at the level of policies. In third place are operational strategies such as knowledge processes and integrated intellectual capital in the field of the blockchain-based organization value chain. The fourth position is related to structures, rules, and regulations such as incentive alignment, and the last rank in terms of readiness to accept blockchain in the field of the value chain and partner network is related to knowledge and information sharing.

According to the contents and evaluation and familiarity with the important indicators of the value chain, the presentation of a knowledge management system based on blockchain technology is presented to fill the gaps in the knowledge management system of the knowledge-based organization. In this proposed system, considering a knowledge-sharing platform, the validity of the role and its advantages are considered, considering that these items are of great importance in any organization. There is a need to examine whether a particular user is the real owner of a particular role related to a particular source of knowledge. Without a proper authentication process, the system will not be secure and the access control mechanism will be unreliable. For example, passports and ID cards are commonly used as verification methods; But they cannot be used in the digital world. In this work, we introduce an efficient authentication and access control method based on elliptic curve encryption (ECC) and previously proposed by (Nyame et al., 2020) because it is the mechanism of the progress of blockchain systems. Our access control system must provide effective management of the knowledge repository, key release and deletion, and verification. The blockchain also has the transparency and immutability of knowledge resources.

The proposed system, as shown in Figure 3, consists of the following main components: user layer, knowledge processing, and

management units, blockchain, and cloud server. The various components are described below.

User-related layer: The user-related layer consists of two main parts related to knowledge, knowledge owner and knowledge user. Knowledgeable people upload their knowledge and experience to a repository in the cloud and determine which users have access to which knowledge and which privileges the user should enjoy. On the other hand, the knowledge user requests the use of knowledge and after successful confirmation, the request is accepted.

Knowledge Processing Unit: This unit includes a key exporter, a verification unit, and a role-determining unit. The exporter is responsible for generating cryptographic keys related to user profiles and used for network transactions. Some common trades include requesting knowledge, using knowledge, and so on. The verification unit, on the other hand, verifies all users on the network. Once the keys are generated and given to users by the issuer, all users must go through the authentication process before gaining knowledge. With the help of the verification unit, efficient access control is guaranteed. The assignment unit provides the role of system interaction rules. This determines what the role of each creature is and the privileges that each user enjoys.

Knowledge Management Center: This is the brain unit of the system. It includes a network processing node and a smart contract unit. Processing nodes are responsible for processing requests on the network and managing other processes in the blockchain. This works in tandem with the smart contract, which is responsible for generating knowledge policies. When requests are processed, the processing nodes receive the requests from the knowledge processing center and act on them. After processing, it closes the result and the final output is displayed to the user.

Blockchain function: This technology in the system is a growing list of all knowledge records (knowledge blocks) that are cryptically related to each other. In each block, there is a hash from the previous

block, timestamp, and transaction. Transactions are added to a block when the processing nodes complete their tasks and use them to connect to the internal

communication and authentication protocol. After recording, the knowledge item must be changed in all subsequent blocks, which is necessary to reach an agreement.

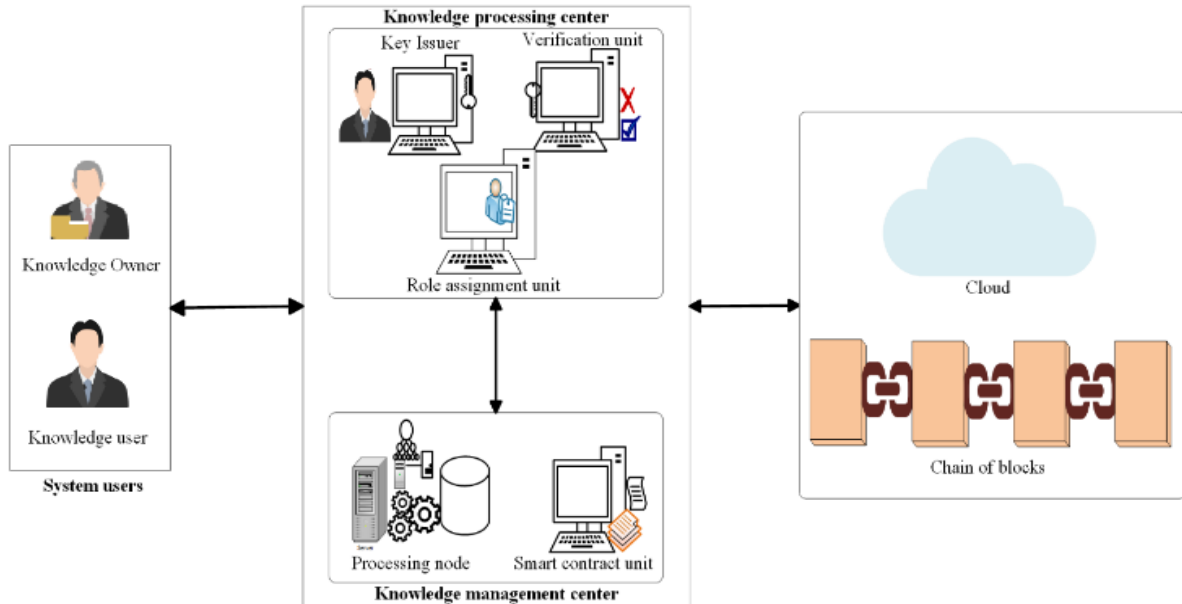


Figure 3. Proposed knowledge management system architecture (Niameh et al., 2020)

To create a knowledge block, the knowledge owner must enter their knowledge into the system (validation) and this becomes a block (not yet validated), and each block has a hash value. This hash is an encrypted string of characters. Therefore, the blocks are reliable and any owner can trust the knowledge of the next use. Block validation is performed by all nodes in the knowledge collaboration network and the organization's knowledge management

system. All knowledge in the network is a transaction that is stored between at least two entities involved in the process. All previous transactions related to this knowledge will be available to the person who needs the knowledge. With blockchain, knowledge is maintained and ownership is maintained and tracked in a secure environment.

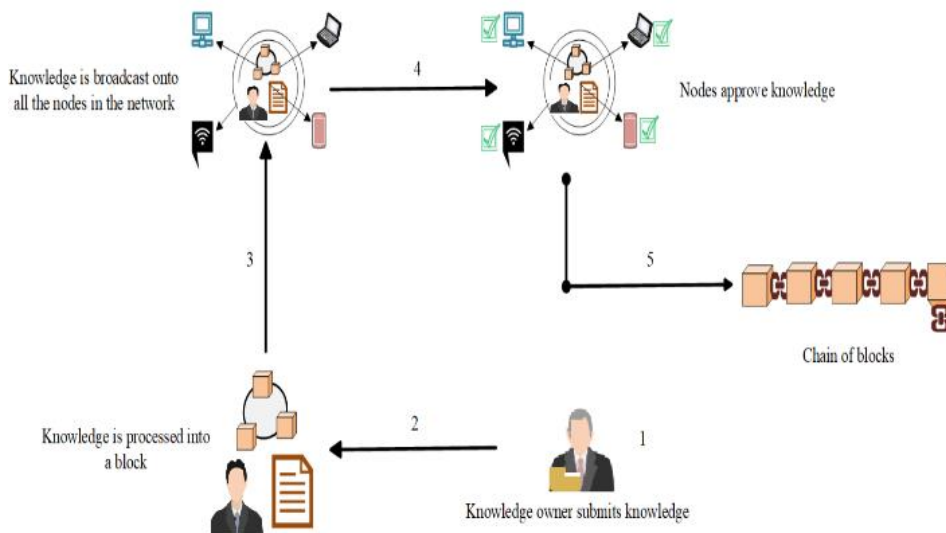


Figure 4. Creation of a knowledge block (Niameh et al., 2020).

5. Discussion

Security and privacy: Security and privacy conditions, especially authentication and integration, are critical to preventing multiple attacks in the knowledge management system environment. An expert electronic signature is a knowledge of a security mechanism that reduces attacks such as correction, fraud, denial of service, and cyber-attacks. The use of the algorithm ensures that only authorized users of knowledge are allowed in the network and knowledge items are accessible by these users. This ensures that users' identities are from a valid source and that an unknown source is ignored. By adding a blockchain, the integration of knowledge is also ensured. This technology ensures that the transferred knowledge package is not tampered with. Expert knowledge signatures provide cross-authentication knowledge to protect the knowledge repository. It can prevent human attacks in the middle (MITM), eavesdropping, forgery, retransmission, and reproduction. In addition, the use of small keys in an expert-based algorithm provides high-performance knowledge and appropriate calculation costs. Knowledge holders can check the validity of the roles according to the time the role is issued to the user.

Access control of individuals: Processing nodes in the blockchain allow efficient control of access to public keys of legitimate users. Before any transaction, if the user has their public key in the verifier database, the node responsible for processing this request must be verified by the verifier. This node can deny access to malicious inventory, as it must ensure that the blockchain contains only known transactions (transactions through authorized knowledge users). However, malicious nodes can process access to knowledge users without authorization. However, the Smart Contract Center also conducts verification checks, and in case of failure, the transaction is canceled. The smart contract also allows roles and other information or knowledge packages to effectively and efficiently legitimize

knowledge users on the network. Users can also be canceled if the user calls. This function is very important in cases where the user is found with intent.

Transparency of communication: This system achieves transparency because all operations are executed by smart contracts and entered into the blockchain. A covert operation cannot be carried out without the knowledge of other institutions. In addition, legal entities will not be able to deny any action because any action is related to their private keys.

Theoretical and managerial implications

The application of blockchain technology in the field of knowledge and intellectual capital management, due to the promotion of key indicators such as improving security in the context of non-forgery, unchangeable information, tracking, decentralization, and transparency, leads to the application of this technology in knowledge and intellectual capital management. Their growth and promotion depend on the tacit knowledge and intellectual capital of their employees to be given more attention in advance. However, scientific contributions and successful applications of knowledge in this field are still scarce and are mostly in the proof stage. First, by reviewing previous studies and researches, the framework for readiness to accept blockchain was extracted, and then the different areas of the value chain of medical and healthcare organizations were identified. Then, a questionnaire for pairwise comparisons was distributed using a hierarchical approach. Finally, the TOPSIS questionnaire was distributed to rank the 5 identified areas of activity in the value chain and knowledge management of medical and healthcare organizations. Semi-structured interviews with the organization's experts have been used to further explain the promising methods in the organization to improve the efficiency of blockchain acceptance and meaningful research orientations for researchers. These findings include the undiscovered potential of knowledge sharing

and collaboration networks, the expected evolutionary stages of the Internet of Things, and the elimination of intermediaries that lead to new business models such as token building and short-term rather than long-term relationships. Obstacles include staffing problems, legal uncertainty, loss of infrastructure and standardization, and unclear governance structures. Improving smart contract security and interoperability between private and public protocols will further expand technology.

6. Conclusion

Change due to blockchain requires readiness, and this readiness can facilitate the acceptance and implementation of blockchain. These preparations include structuring rules and regulations, stakeholder cooperation, and system readiness for adaptation and flexibility. Without examining the infrastructure preparation framework required to welcome blockchain, one cannot expect that different areas of activity in the area of the organization's value chain will receive a good or appropriate response from the implementation of blockchain projects. Therefore, the main issue of the present study is that a framework for preparing different areas for the acceptance of blockchain can be designed to evaluate the activities of companies in the field of knowledge management and intellectual capital and determine which areas. From the activities in the supply chain sector, the project-oriented organizations of the country can operate faster than other sectors. For this purpose, blockchain acceptance readiness assessment indicators were extracted and then the 5 main areas of activity of companies in the energy sector were evaluated. The results showed that the activity in the field of the value chain of the organization at the level of sustainability of collaborations has the highest readiness to accept blockchain. After that, knowledge management is in second place at the level of policies. In third place are operational strategies such as integrated knowledge management processes in the field of the blockchain-based knowledge management

chain. The fourth position is related to structures, rules, and regulations such as incentive alignment and the last rank in terms of readiness to accept blockchain in the field of knowledge management and intellectual capital and the network of partners related to information sharing.

Based on the obtained results as well as the mentioned experiences, it is suggested that the active departments in the field of knowledge management in organizations, especially medical and healthcare organizations, increase their readiness to accept blockchain. This readiness through the development of partnerships, identification of actors and increased interaction with them, monitoring of technology and events in the global community for companies and similar areas, flexibility and legality, regulatory and structural regulation, as well as strengthening infrastructure. It will be possible to increase operational capacity and identify and nurture talented and relevant people.

Also, based on the research (Nyame et al., 2020) and applying changes and improving its processes in completing the above operations, a model was presented in the form of a roadmap for implementing blockchain in the value chain and knowledge management of medical and healthcare organizations.

7. Future work

Our study showed that, while technologies, especially blockchain technology, themselves have limited potential but very high potential for security in terms of their inherent ability to transmit tacit knowledge, more accurate analysis and understanding of blockchain can make real sense for its formality and structure. It is a very significant part of tacit knowledge, meaning it is difficult to codify, disseminate and appropriate by third parties, making it less implicit, but if it becomes available and pervasive, it can create new value. Little research has been done on this subject, both qualitatively and quantitatively. Future research can be done by using new tools and variables to develop the necessary

infrastructure and facilitate the entry of blockchain technology into the knowledge management of systems. In future research, we should also pay attention to the level of familiarity of people with blockchain technology and its impact on the performance of the organization's employees and design a suitable user interface for entering this technology in the knowledge management departments.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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