International journal of innovation in Engineering

journal homepage: www.ijie.ir

Research Paper

Evaluating Blockchain-Based Supply Chain Challenges (A Survey)

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ARTICLE INFO	ABSTRACT
	Blockchain technology is an emerging technology that will have a significant impact on the business of organizations. One of the influential areas of blockchain technology is the supply chain sector. Supply chain is a network of people and companies that focuses on the production and distribution of a specific product or service from the stage of primary producers to customers and consumers. Most supply and distribution networks face problems with managing all these components together. Many problems of current supply chains can be solved through blockchain technology; Because blockchain offers us very good and pristine ways to record, transfer and share information. The literature in this field is more focused on the technological sector and pays less attention to other sectors. In this research, it is emphasized the need to pay attention to the relationships between supply chain partners and change management when adopting this technology. Also, the current research identifies some of the challenges of adopting blockchain technology with a comprehensive view for the first time and places these challenges in a new classification. These challenges are classified in the groups of organizational challenges, inter-organizational challenges, external/environmental challenges, and technological challenges.

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1. Introduction

Modern supply chains are inherently complex chains. The expansion of the number of levels of the current supply chains and their wide geographical spread have faced many challenges in the management of supply chain processes. Globalization and diverse regulatory policies and diverse cultural and human behaviors in supply chain networks have faced many complications in evaluating and managing information. Improper transactions, forgery, fraud, and poor practices by supply chain parties have led to the need for greater trust and, consequently, the need for better sharing and stronger validation of information (Fallah et al., 2021). Considering the increasing number of international industries to join international supply chains and the vertical and horizontal globalization of industries and the challenges that exist in this direction on the way of international trade, as well as the desired added value created by the applications of information technology in this field. , a lot of motivation has been created to identify the different aspects of the commonality of the two areas of information technology and supply chain management and to take steps to meet the industrial and technological needs of industries. Blockchain technology has been able to gain a high position in this regard in the opinion of industry managers and researchers in the world (Nozari & Szmelter-Jarosz, 2022). Therefore, suitable opportunities for research and identification of operational applications have been provided; However, before this technology is introduced to the operational level, it is important to know in which areas the implementation of this technology is more necessary and also which features of this technology will be effective on which functions of the supply chain (Chandan et al., 2023).

Blockchain is a technology that can enable the communication of authentication data between each player in a supply chain without the intermediary of a trusted central organization. By verifying and adding data in real-time, blockchain can increase transparency throughout the supply chain (Nahr etal., 2021). Lack of transparency is one of the challenges that creates economic, environmental, social and even safety problems throughout complex supply chains. The lack of timely tracking has caused a lot of damage to the supply chains, and also the risk of counterfeiting and fraud causes many counterfeit raw materials, parts and products to enter the supply chains (Aliahmadi et al., 2022). These challenges can impose huge costs on supply chains. The production and distribution of low-quality and spoiled food in food and agricultural supply chains, the lack of access to correct and timely information, and other such matters, the importance and necessity of using solutions that create transparency and traceability in order to build trust in supply chains. shows more than the past. Blockchain technology can have the potential to solve the aforementioned challenges and problems (Nozari et al., 2021).

Blockchain can increase the traceability and transparency of the food supply chain, reduce the losses caused by trade in fake markets or gray markets, and reduce the cost of management. Supply chain visibility means that "product" information is properly collected and recorded throughout the production cycle. A mutual understanding of these opportunities, challenges and enabling priorities will underpin effective collaboration. Governments can encourage traceability and support adoption. Technology companies have the potential to develop the transformative traceability technologies needed to reduce costs, improve delivery and maximize efficiency. Retailers can take the lead when meeting with other stakeholders to develop appropriate multi-stakeholder partnerships to create transparency. Agribusiness companies can support the application of traceability to food value chains by coming to the negotiating table with an open mind, considering new business opportunities and advancing existing commitments (Rafierad et al., 2022).

Blockchain enables unprecedented visibility at every stage of the supply chain, helping to increase transaction transparency, safety and quality, as well as reducing fraud and waste. In addition, it serves as a digital solution to reduce operational costs and improve efficiency in the supply chain. The implementation of blockchain solutions can help participants to record price, date, location, quality, certification and other relevant information for effective supply chain management. Blockchain is an emerging technology with the potential for progress, but achieving Return on investment requires a careful assessment of the technology's suitability

for your company's supply chain profile, as well as the predictability of the return on investment. The following five features can help shape blockchain prototyping timing and value decisions (Nozari et al., 2021). Once a concept is agreed upon, starting with a prototype on a test network with mock data before piloting the blockchain externally can be done to prove the concept before investment. Blockchain is still a nascent technology, so its limitations and improvements are constantly being discovered and developed. Some of today's potential limitations and risks include (Iranmanesh et al., 2023):

- *Integration concerns: Blockchain solutions require significant changes or complete replacement of existing systems. Reducing the risk of this issue requires designing a long-term plan to transfer the systems needed for support.*
- *Control, security, and privacy: While there are solutions including private or permissioned blockchains and strong encryption, there are still concerns about cybersecurity breaches that need to be addressed before the public entrusts sensitive data to a blockchain solution. become*
- *Cultural acceptance*

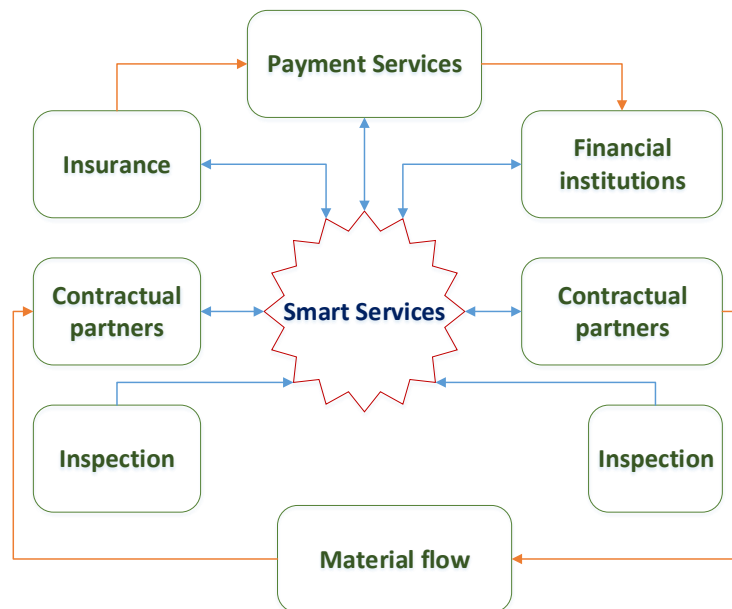Figure (1) shows the dimensions of the smart supply chain.

Fig. 1. smart supply chain dimensions

In this research, in order to investigate the challenges of blockchain-based supply chains, an overview of this technology and its developments and its effects on the supply chain has been made. Therefore, this review is divided into the following sections. These sections are shown in Figure (2).
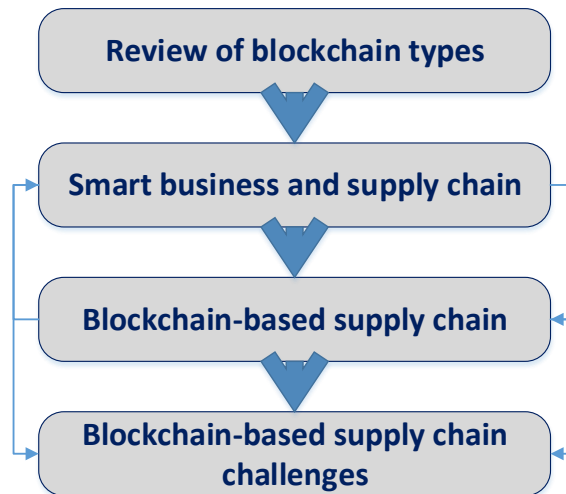
Fig. 2. Analytical research methodology

2. Blockchain and Its Types

One of the most useful divisions for better understanding and design of blockchain-based solutions is to pay attention to the two factors of data infrastructure ownership right (that is, the right to be a member of the network) and the right to register information in the blockchain. Based on the data infrastructure ownership right, blockchain solutions They are divided into two groups, public and private. In public blockchains, the servers for storing information are public, and as a result, anyone can become a member of the network and become an infrastructure provider and have access to blockchain information. In private blockchains, information They are kept on private servers, and access to blockchain information depends on being eligible to be a member of that blockchain's private network (Nozari et al., 2021).

Based on the right to register information in the blockchain, blockchain solutions are divided into two groups: those without permission and those that require permission. In blockchains without permission, anyone who is a member of that blockchain network has the right to process and record information. In blockchains that require permission, the right to register information is limited to licensed members, and other members can only view the information (Aliahmadi et al., 2022). In a public blockchain without the need for permission, anyone can participate in any capacity. This allows anyone to approve new blocks during the mining process, while in a private blockchain that requires permission, only some parties They can participate in the network. Processing or mining is limited only to selected members or organizations in the network. While there is no cost to realize its benefits, the cost of creating a network remains significant because private blockchains still depend on trusted parties (Tavakkoli Moghaddam et al., 2022).

Five major innovations based on blockchain technology have been created in the last ten years.

- *The first blockchain-based innovation was Bitcoin, which is a digital currency. Currently, the investment in its market is calculated between 10 and 20 billion dollars. In addition, Bitcoins are used by millions of people for online and secure payments, including the banking sector.*
- *The second invention was the blockchain itself, which, despite having the hidden technology of Bitcoin, separated itself from digital currency and was used for all kinds of collaborations. Most major financial institutions are conducting blockchain research. Predictions show that more than 25% of global banks will use blockchain in 2020.*
- *The third innovation was named as "smart contract". The second generation is called Ethereum. Ethereum integrates small programs directly with the blockchain. This makes it possible to offer*

financial instruments such as loans or bonds instead of bitcoin currency tokens. Investment in the Ethereum market in 2017 was about one billion US dollars, and a large number of projects are moving towards the market.

- *The fourth major innovation, the most important innovation of blockchain thinking, is "Proof of Stake", the true generation of blockchain is secured by "Proof of Work" where decisions are made by a group with the greatest amount of computing power.*
- *The fifth important innovation is a blockchain scaling. Currently, in the blockchain, each member of the network processes each transaction, which is really slow. Using a scalable blockchain, it is possible to speed up the process without any threat to security. The idea is to know how many computers are needed to validate each transaction and optimize the work process using these statistics.*

Table 1. Common types of blockchain

	Public blockchain	**Private blockchain**
Overview	Completely decentralized and without the need for network complexity: proof of work or ownership is recorded for assurance.	A central authority as a reliable intermediary to control and ensure the accuracy of the register
License	Anyone can read and write information without the need for permission.	Permission Requirement - Write permissions are centralized to a single entity
Confirmation of transactions	The records are approved by the majority of "miners" to their validity.	The central authority confirms the transactions
Data storage	Records are distributed: a copy of the entire record is available to all users of the peer-to-peer network.	Records are stored by the central authority
Transaction fees	Low cost for transactions	Transaction fees are announced by the central authority.

3. Blockchain and Supply Chain

Blockchain is expected to change the supply chain and logistics industry. Supply chains can include hundreds of suppliers in many different countries and regions, and as a result, it can be a complex and extensive process to review and manage. Due to the complexity and lack of transparency of current supply chains, attention to how it can be used to create transparency and traceability has emerged in recent times. One of the problems of today's large and complex supply chains is the difficulty of engaging parties to know the true value of products due to the lack of transparency in the current system, as it is difficult to determine that supply chains do not involve illegal or unethical practices (Salehi Koocheh Baghi et al., 2021).

Each time a product is transferred from one party to another in the supply chain, this transaction can be immutably recorded using the blockchain, thereby creating a permanent document of the product's history. The prediction of the following actions related to, for example, a supply chain process, can be immutably recorded and secured by using blockchain, thereby creating a permanent, transparent and traceable record of supply chain actions. Supply chain traceability refers to "the ability to track any product, or material used for consumption, through all stages of production, processing and distribution".

It encourages the ability to trace the cooperating parts and enables full transparency in a supply chain and encourages the company to operate in a sustainable way. To keep costs and damages low and optimize a supply chain, achieving good performance is possible. Management tracking and monitoring with an efficient tracking system is vital. A tracking system provides data access support for supply chain members and good quality management practices. This scheme is implemented by collecting and storing product-specific

information about safety and quality related to the history of products along a supply chain, including where the product was processed, packaged and distributed.

Transparency is predicted to become significantly more important in the future as stakeholder awareness is increasing, which has a direct impact on consumer trust and a company's sustainability performance. Transparency and traceability are closely related, where traceability can be A vertical dimension of transparency can be seen in the food supply chain. Traceability is following a product and the process in which the product is produced, which leads to greater transparency. Therefore, it is possible to provide specific and required information to various actors and stakeholders without removing, distorting, delaying information. More motivation and drivers for increasing transparency and implementing the tracking system are: laws, food safety, food quality, society, Economy, technology, information sharing and productivity (Bayanati et al., 2022).

Transparency can build and strengthen trust in relationships, which in turn increases performance, synergy, and overall success. However, the level of trust is intangible and cannot be measured unlike profit, hence the incentives must be clear to all parties to create transparency like blockchain technology.

Using blockchain, an innovative IoT-based platform has been built that provides accurate measurement of every product in every part of the supply chain. Transfers a variety of data and analytics to dashboards; This will help customers make smarter inventory management and storage replenishment decisions. In addition, blockchain has been used to build a transportation management platform that manages transportation logistics to track and move shipments, drive fleet efficiency, and process deliveries; Whether it's for residential consumers, small businesses, agricultural concerns or other industrial users (Eisapour et al., 2013).

Blockchain technology is a way to prevent fraud or misuse of data. In other words, this technology can help increase the efficiency of your global business operations and reduce formalities and red tape by creating security and governance around data exchange. Blockchain is empowering new business models and many big players in the industry are starting to use the power of blockchain to get better data and to enhance their services. Logistics startups based on blockchain technology hope to change the capabilities of the industry and redefine its future. Properly applied, blockchain technology can ensure traceability throughout the entire supply chain. Blockchain technology offers a comprehensive approach to processing multi-enterprise business transactions. As the adoption of blockchain technology increases, EDI will continue to provide the essential conduit mechanism for connecting these networks (Xiao et al., 2023).

4. Blockchain Challenges

The adoption of blockchain technologies requires consideration of a wide range of factors, beyond technological factors. While the topical literature on blockchain technology has recently emerged, it is mostly focused on the structures of the technology and tends to ignore the organizational complexities of adopting this technology. Blockchain, like any new technology, will be resisted, abused, misunderstood, and rejected. But in the end it is accepted (Ghahremani-Nahr & Nozari, 2021).

For blockchain to become mainstream, it must first overcome its challenges. One of the most important challenges of blockchain is the human being. The challenges that most technology fanatics expect to be entirely technological are actually entirely human in origin. Attracting trust, the existence of transparency, equality, justice, right and rights, in fact, all go back to human needs. Blockchain challenges are divided into the following categories. In the following, we will see the interpretation of each section (Nozari et al., 2022).

- **Challenges within the organization**

These challenges are rooted in the internal activities of organizations. The support of senior management is a key factor for the successful implementation of any supply chain implementation. However, some senior managers have long-term commitment and support for the adoption of a new technology and support for multiple values. are not put on the agenda? Lack of management commitment prevents the integration of blockchain adoption activities and supply chain processes. The lack of awareness and management commitment in the supply chain is a factor that challenges the appropriate allocation of resources and financial decisions. The adoption of blockchain technology to collect information requires investment in new hardware and software, the cost of which is a challenge for organizations. It is considered important (Daneshvar et al., 2022).

The lack of new organizational policies needed to define the application of blockchain technology can be a challenge. The adoption of blockchain technology may change or alter current organizational cultures. Organizational culture defines the guidelines for work culture, values, and appropriate behavior in organizations. Also, the adoption of blockchain technology in supply chain processes requires defining new roles, responsibilities, and expertise to support Different aspects are the adoption of technology. The adoption of blockchain technology may cause many changes in the organization, because blockchain technology is considered a transformative technology and necessitates the need to change or replace the system (Tootian et al., 2022). Changing to new systems may change the culture. Change the organization or hierarchy and cause people and organizations to resist. According to these changes, reduce the power of some organizational elements. Therefore, in some cases, the use of blockchain technology leads to the resistance of some elements within the organization. The introduction of a new information system, such as the use of blockchain technology, will definitely change the way organizations work (Ghadir et al., 2023). The new platform will be useful and different, the data entry method will change, and the report formats will be different. Users often dislike these changes. They find it necessary and therefore refuse to accept them. Limited expertise and technical knowledge in the use of blockchain technology acts as a challenge to the adoption of this new technology in the supply chain. Although there is a growing interest in blockchain in the technical market, the limited number of applications and technical developers of blockchain is another challenge. Blockchain technology is derived from information technology. Conversion to new systems can change organizational culture or hierarchies and lead to resistance and doubt from individuals and organizations (Ghahremani-Nahr and Nozari, 2021).

The adoption of blockchain technology in the supply chain creates extensive changes in supply chain processes, which require the combination of supply chain processes with blockchain technology, which in itself is an important challenge, because it is a very sensitive task. And it is complicated. On the other hand, after adopting blockchain technology, it will not be possible to use traditional business methods in many cases, which in turn is considered an important challenge. Figure (3) shows the challenges within the organization.
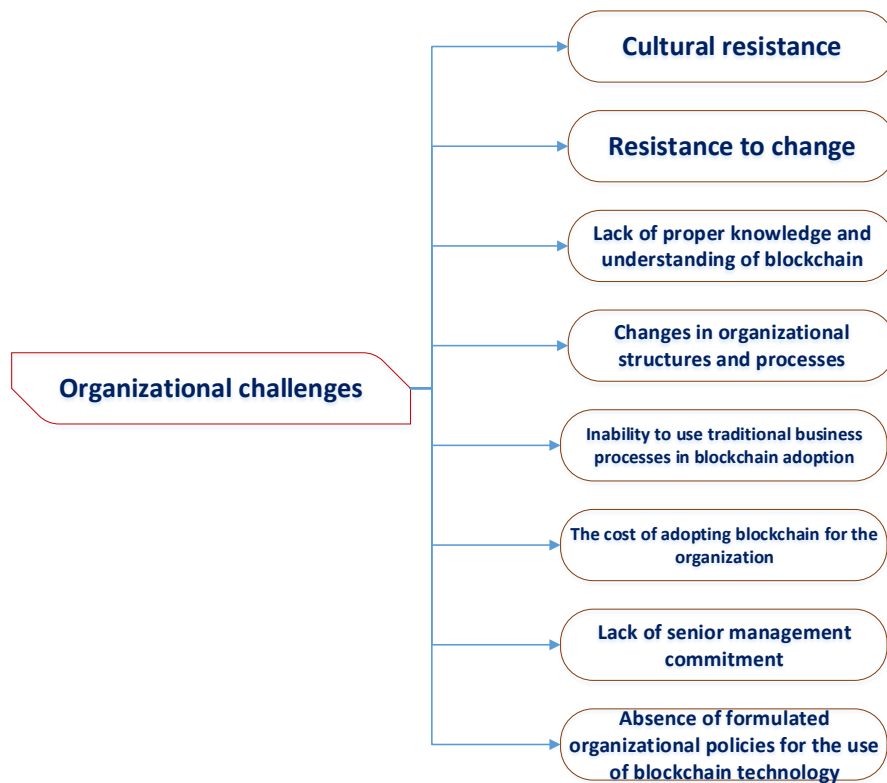
Fig. 3. blockchain Challenges within the organization

- **Inter-organizational challenges**

This classification mainly identifies and introduces the communication challenges of supply chain partners. At its core, supply chain management is about managing relationships between partners to create value for stakeholders. However, relationships between partners can be challenging, especially when it comes to information technology integration and transparency (Jum'a et al., 2023). Blockchain technology helps to share information through the supply chain. Although information transparency and validation need to evaluate the sustainability performance of a supply chain. Some organizations may assume information as a competitive advantage, which makes them reluctant to share valuable and important information. Hesitation to disclose information. Some partners may limit the full benefits of using blockchain technology and hinder the successful implementation of this technology (Rahmaty et al., 2022). Due to the transparency of information in blockchain technology, information sharing rules and policies must be defined and managed in the supply chain network. The lack of strong rules for information sharing will eventually affect the cooperation between chain partners. The lack of cooperation and effective communication between supply chain partners with different and even conflicting operational goals and priorities will affect the sustainability and activities of the supply chain and the implementation of blockchain technology to create disrupt sustainable values. Communication challenges will worsen where supply chain partners are geographically dispersed with different cultures. In order to adopt blockchain technologies, organizations must overcome cultural resistance by market leaders. Furthermore, Resistance in customers and companies to change can affect the adoption of blockchain technologies. Customers need to accept the fact that all their electronic transactions are safer and more complete. Intermediaries (e.g. payment providers such as Visa and MasterCard) are forced to change tasks and roles. They need to invest and modify their platforms to become a blockchain-centric organization, while still providing They are more engaged in customer service and communication (Shayannia, 2023).

In addition, the possible decentralization, transparency, and accountability created by this technology could create new settings where people are less dependent on controlled and sometimes inefficient services that are provided through related and intermediary service providers. It was said before that smart contracts are computer codes that attempt to automatically implement the terms of the contract between the two parties. The mere existence of computer codes and the automatic implementation of the terms of the contract causes a lack of proper understanding of smart contracts between supply chain partners, which is a challenge. It is important to adopt blockchain technology in the supply chain. It is obvious that the technology is not uniformly distributed among all members of the supply chain, because the supply chain may consist of large organizations as well as small and medium-sized organizations, which the access of all these organizations Blockchain technology is another challenge for adopting blockchain technology in the supply chain (Chen et al., 2022).

- **Environmental/external challenges**

This group of challenges arises from external stakeholders who do not directly play a role in supply chain processes, but somehow influence these activities, such as regulatory bodies, governments, legislators, etc. External pressures and support for stable and transparent processes and technological practices can lead organizations to incorporate them in their processes. The lack of appropriate government and industry policies and unwillingness to guide and support stable and transparent measures are an obstacle to achieving stability and transparency and advanced technology support mechanisms. Government laws and regulations are still unclear regarding the application of blockchain technology. In fact, the harmful policies published by several governments regarding Bitcoin are a concern for markets and organizations that can affect the broader use of blockchain for commercial purposes. Accordingly, NGOs, industries, and professional associations should work together to promote the technology. Blockchain, which leads to the creation of stability and transparency, introduce this technology as a useful and transformative technology. This is why the lack of customer demand for transparent and stable products leads to the lack of proper investment by organizations in the processes. supply chain (Shayan Nia & Mirataollahi Olya, 2021).

Some researchers claim that despite the opportunities it offers, there are more challenges to the wider adoption of blockchain. Blockchain helps to build trust in the supply chain and in a way strengthens cooperation between organizations and all organizations with rules. and the regulations are involved. But currently, the laws that realize the involvement of all organizations in the supply chain have not been formed by regulatory organizations and governments. The main reason for the existence of some blockchain-related cybercrimes is the absence of these regulatory laws. Technological laws and regulations should be established to monitor and prosecute people involved in fraudulent activities such as money laundering.

In order for blockchain technology to be widely implemented, laws must be rewritten or modified to take into account the nature of blockchain technology. Also, issues such as data security must be considered as a matter of increasing importance. Decisions such as where data is physically stored must be answered by regulators.

- **Technological challenges**

Blockchain technology is in the early stages of its development and in terms of scalability and handling a large number of transactions, it is considered an immature technology. Data security and privacy concerns are also among the challenges of using blockchain technology. However, humans are still involved in the use of this technology with the possibility of mis-recorded information. Even if key owners can edit the data and update it with additional information, there will always be mis-recorded data in the blockchain where the data is stored. Another challenge of blockchain technology is scalability. As the transaction volume required for the service is greater than Bitcoin transactions, the blockchain is not large enough to handle it at this stage. Figure (4) shows the technological challenges of blockchain (Barzegar Keliji et al., 2021).
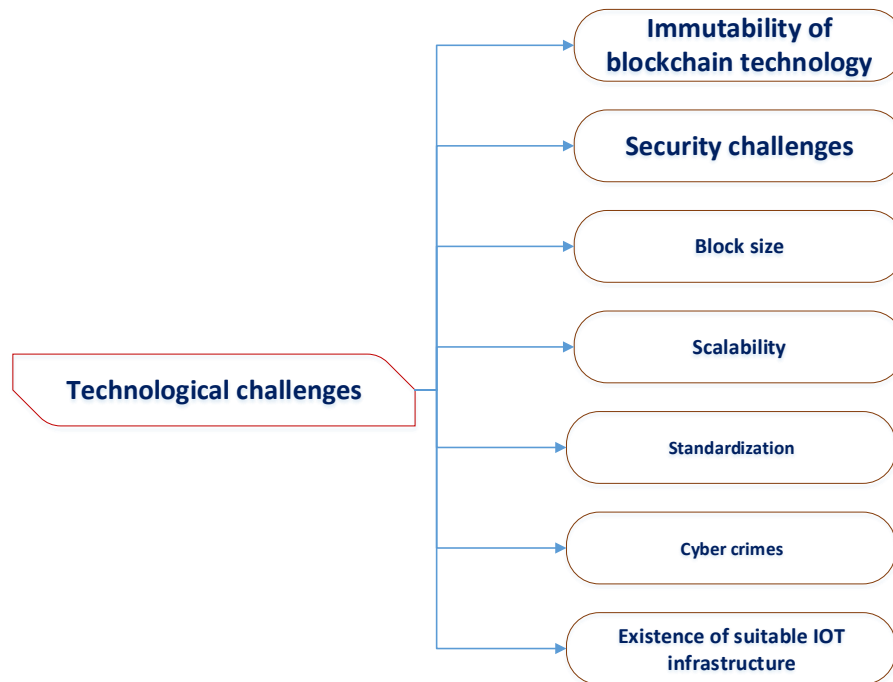
Fig. 4. Blockchain technological challenges

5. Conclusion

Blockchain is one of those new and transformative technologies that its use in supply chains brings with it many advantages such as security, anonymity, quality, transparency, targeting intermediaries, etc. The evolution and development of blockchain-based supply chains, which enables the creation of shared and secure ledgers as well as smart contracts, realizes trust in transactions between untrusted supply chain partners and provides security and privacy.

On the other hand, the review of the literature in this field indicates that the focus in the supply chain and blockchain sector is concentrated on technological aspects, and other important aspects of adopting blockchain technology in supply chains have not been paid enough attention. However, as discussed in this article, in order to adopt blockchain technology in supply chains, all possible aspects that may affect this goal must first be considered. The present article, with a comprehensive view, deals with the classification of aspects affecting the adoption of blockchain and places the challenges of blockchain adoption in a different category than the previous literature for the first time. This categorization attempts to identify the challenges of blockchain adoption, placing the challenges in 4 categories: a) organizational challenges b) inter-organizational challenges c) external/environmental challenges and d) technological challenges. Significant factors affect each other. How these factors interact has a lot to do with the platform in which the blockchain is adopted.

As mentioned before, the focus in this field is on the technological sector, but the current research shows that the management of communication between supply chain partners has a very significant role in the adoption of blockchain. On the other hand, considering that technology Blockchain is considered a transformative technology, its adoption in organizations and supply chain processes will bring many changes. The current research considers it very important to pay attention to the discussion of change management. Future research should include the proposed framework in Experiment in different areas. The current study identifies the factors that influence blockchain adoption, future research is still needed to provide solutions to these

challenges. This study has limitations that future research can address. Future research can identify challenges and identify and provide requirements to solve these challenges.

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