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Investigating the Barriers of Using Blockchain Technology in Iran's Automobile Industry

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ABSTRACT

This study evaluated the obstacles and challenges of using blockchain technology in Iran's automobile industry. The statistical population of the present study is all specialists and experts who were familiar with blockchain technology. However, due to the impossibility of identifying and studying all the people and the lack of access to everyone, sampling was conducted using a purposive judgment approach. Accordingly, ten academic and industrial experts were selected as the expert. To study the theoretical background and literature related to this study, a library study was used. In order to evaluate obstacles and challenges, a survey method was also used. During this stage, a questionnaire designed by the researcher was used to gather the views of the experts. To conduct this research, the following process was followed: first, theoretical backgrounds and related literature were reviewed. After that, a questionnaire was designed and distributed to the experts. Following this, the data was analyzed using the Fuzzy Dematel Technique. Based on the findings, among the seven factors of the leading technical and technological component, three sub-components, namely, the lack of the necessary security against cyber attacks, the storage problem, and the lack of standardization in different blockchain systems, ranked first to third, respectively, indicating the importance of technical and technological factors.

Keywords— Blockchain, Automobile Industry, Fuzzy Dematel Technique

1. Introduction

Nowadays, businesses and institutions have embraced cutting-edge and contemporary technology in order to employ them to enhance their processes and obtain a competitive advantage. Implementing new technology is a fundamental decision for organizations and will have significant impacts on the organization's processes, and as a result, it should be seriously considered. It is important to evaluate potential risks and manage current risks when opting to incorporate technology and profit from its advantages so that the chance of project failure is decreased and the system's efficacy is increased [1] When technology is a fundamental component of the organization's infrastructure, this issue becomes more significance. One technology that has the potential to support many key organizational operating systems in the near future is blockchain technology [2].

According to the latest Gartner survey, only one percent of large organizations have implemented blockchain-based projects. But what are the applications of this technology for organizations, and why only a few have succeeded in implementing the applications? Based on the report of the Gartner Institute, apart from the current block chain technology craze, the use of this technology in large organizations has not increased significantly. According to Gartner's survey of more than 3,100 chief innovation officers, only one percent of large organizations have implemented blockchain projects in their organization, and only 8% of them have a clear and short-term plan to use this technology. Many industries have concluded that using this technology will bring added value only when there is a need for cross-organizational cooperation on common and valuable data. The use of existing centralized systems will lead to many errors and discrepancies. Before using and implementing this technology, companies must answer the question of what problem will be solved with the help of blockchain technology that the current systems cannot solve. However, there are companies, regardless of the applications of this technology and without valid reasons, are looking to use this technology. With the emergence of blockchain technology and its capabilities, we can hope for the blockchain applications in daily life and its realization.

Blockchain technology is a revolutionary new protocol which will transform organizations and various industry sectors [3]. Blockchain (block chain) is a distributed database technology among members that does not depend on any centralized entity to verify transactions [4, 5]. This

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technology uses a peer-to-peer network of computer servers maintained by decentralized network members. Each member (node) maintains a copy of the entire blockchain and can directly interact with other members of the network and monitor, track, and audit previous transactions [6].

It can be said that the blockchain, like any other technology, is associated with challenges in its application and use, the lack of clarity which prevents the expansion of its use by various organizations and sectors. Besides, with the rapid growth of the functions of this technology, achieving a clear understanding of the nature and applications of this technology, providing the necessary infrastructure for the use of this technology and the consequences of its application and development in the country is an important need for policymakers and strategic decision makers. Meanwhile, the automobile industry is one of the most important and influential industries in the world and Iran's economy. In addition to its economic importance, this industry also has a special place in terms of technological adaptability. Hence, experts and innovators present and apply new technologies and ideas daily in this industry. With the advent of blockchain technology, the use of this technology in the automobile industry has become one of the efforts of automobile companies.

But what is more important than anything else here is to identify the obstacles and challenges in using this technology in the automobile industry. Based on this, this research aims to assess the obstacles and challenges of using blockchain technology in the Iranian automobile industry. Based on this, the objectives of the study are considered as follows:

Main objective:

Evaluating the barriers to applying blockchain technology in Iran's automobile industry using the Fuzzy Dematel technique

Sub-goals:

- Identifying the obstacles and challenges of using blockchain technology in Iran's automobile industry
- Ranking of obstacles to the application of blockchain technology in Iran's automobile industry
- Evaluating the severity of the effect of each of the obstacles and challenges of using blockchain technology in Iran's automobile industry

2. Theoretical Backgrounds and the Related Literature

Blockchain Technology

Blockchain consists of two words, block, and chain, which means blockchain or blockchain. The reason why this name was chosen for this technology is that in this technology, information is placed in a set of blocks, which are connected in a chain. Hence, this blockchain technology is named exactly according to its function. Experts have provided different definitions of blockchain, some of which are mentioned below:

- Blockchain is a distributed and decentralized ledger that can store a large amount of information related to various transactions and makes all this stored information available to all network members [7, 8].
- Blockchain allows transactions to be verified by a group of unknown people. This technology provides a distributed, immutable, secure ledger [9].
- Blockchain is a distributed ledger for recording transaction data records dynamically and without a central institution using a mechanism based on a universal agreement to check the validity of transactions [10].
- Blockchain is a distributed database containing records of transactions, and digital events shared among participating parties [11].
- Blockchain is a technology in which any participant can write information in ledgers and view it, but no one can change its rules [12].

Blockchain is a technology that requires the approval and consensus of several people or different departments to perform a specific activity. This activity can be uploading a file, buying a house, a transaction, a vote, an agreement between two departments, etc. For example, in purchasing a cryptocurrency, the blockchain must verify the authenticity of the currency, the amount of agreed value, and its transfer, which network miners often do. Blockchain has great potential to transform the lives of every single person. The possibility of hacking and manipulation in this technology is very low. The data that exists on the blockchain is distributed on hundreds or thousands of computers worldwide [13].

Blockchain is a chain of interconnected blocks that record data in hash functions (cryptographic technique) with a timestamp and a link to the previous block [14]. Each block contains several transactions, and each transaction generates a hash code. When a transaction requests to join the network, this request is sent to all members in the blockchain. Before a new transaction can be added to the system, it must be validated, a transaction that has been validated by consensus [14, 5]. To achieve consensus, members must verify the new transaction's hash and then search for the hash for the next block. After verification, the new hash code is combined with the hash code of the previous block to create a new block and add it to other blocks in the chain [15]. A change in the block data causes a difference in the hash of that block, which automatically changes the hash stored in the next block as the previous block's hash. This change shows itself in the network, and the mismatch between these two hashes prevents the block data from changing. By changing the information of a block, the hash of that block also changes, and as a result, all subsequent blocks become invalid [16].

Blockchain is based on a distributed and decentralized ledger (Figure 1). Blockchain technology can be defined according to its essential components and concepts. In blockchain technology, the ledger is the main record keeper that maintains the list of blocks. Each block stores data or information. This data and information can have any coordinates and quality. Normally, a central device is responsible for all the data and can do whatever it wants with it. In other words, many devices are connected in a peer-to-peer manner. So this system is not centralized, and all these devices have a copy of the ledger. The structure of a distributed

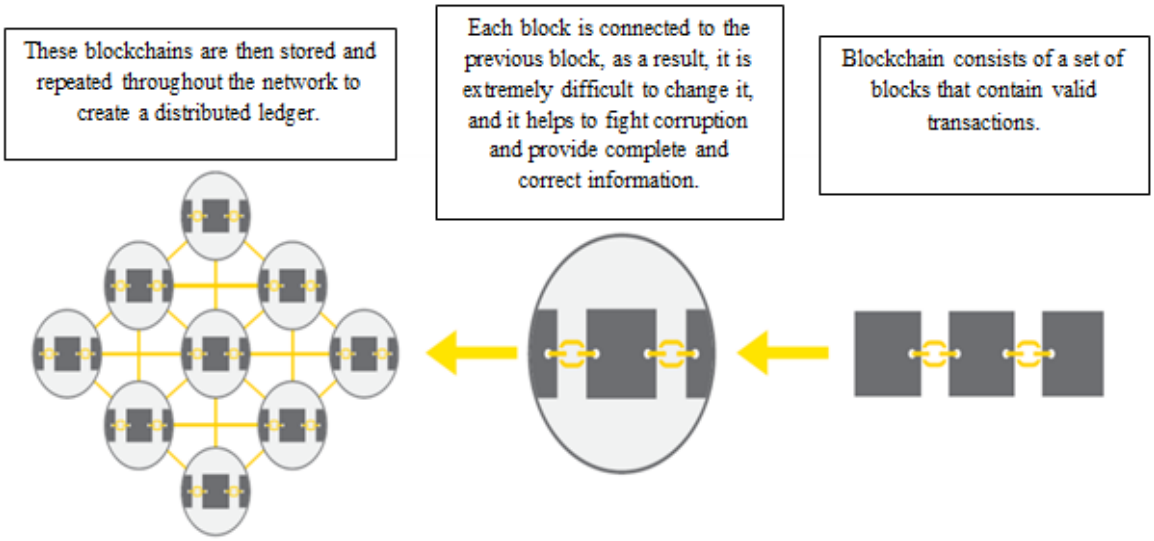

Figure. 1. Structure of a distributed ledger [17]

ledger is described below. According to this structure, it is clear that the information defined in each block is dependent on the previous block, and there is a distributed version. It is challenging to change and corrupt the data.

News distributed on the blockchain is also debatable in terms of its accessibility. To better understand the distributed ledger, blockchain can be thought of as a digital contract that allows one person to complete a transaction or settlement (for example, selling oil) directly and peer-to-peer with another person. The meaning of peer-to-peer concept is that all transaction information is stored in a network, that all computers (including seller and buyer devices and other network members) have access to its data. This means that the ledger is shared among all the people in a blockchain network, and when something is added to it anywhere in the network, a copy of the entire ledger is available to each member of that blockchain. Blockchain functionality can be explained with a simple example of a financial transaction [8].

- Person A wants to make a transaction.
- Person A performs the transaction.
- Person A sends the transaction to the network.
- A device on the network validates the transaction and provides confirmation.
- A new block has been created for the transaction of individual A in the blockchain network.
- The updated blockchain is distributed among all members of that blockchain.
- The transaction has taken place.

3. Basis of Work and the Way Blockchain Technology Works

Blockchain is often represented as a long chain of DNA. In fact, at regular intervals, information about new transactions is added to the end. Each transaction generates a 64-character code. Each code is combined with the previous code to create a new block. Transactions are grouped into blocks (this is where the name blockchain comes from) and are sorted sequentially with their previous block. Blockchains are maintained by a network of nodes that verify the validity of transactions and add them to a new block [18]. In fact, in the blockchain, any complete node (which can be anyone) can take the role of both the consumer and the producer of information. In other words, each complete node in a blockchain network stores a copy of all information in its system and can independently check and even update its information. In blockchains, each complete node checks the accuracy of its information using algorithms such as "proof of work", "proof of share" and by calculating the new information received from the network (New transactions received from other nodes) with complex cryptographic algorithms (for example, the proof-of-work or proof-of-work algorithm), it adds new transactions or information in the complete copy of the information that is only with that node itself. As mentioned before, in blockchain systems, adding further information; In terms of mining, it is called a new block. In other words, to add new information, each node must put it in a new block and extract it. In this method, any node that extracts a block earlier than the rest of the nodes informs other nodes. After receiving the new block's information, all other active nodes in the network check its validity with cryptographic algorithms. If this new block is acceptable, they add it to the blockchain stored in their system memory. In other words, the blockchain has no central database, and each complete node stores a complete copy of all blockchain information. A node also initiates the smallest change in the information of this blockchain, and only in case of general agreement of other nodes and adding that block to the information stored in their memory, it gradually becomes the main reference of information.

The thing to be mentioned must be stated, extracting a new block requires a lot of computing power. For this reason, it is much more difficult to manipulate information in blockchain networks than in client-server networks. In addition, the most minor changes in a blockchain system must be monitored and approved by most other nodes, and all of them will be informed of these changes before it is finalized. An event that rarely happens in a client-server

configuration. Since the editing and changes of information in blockchain networks require a lot of computing power and time, the data stored in blockchains is indestructible [19]. Figure 2 shows how blockchain works.

4. Advantages of Blockchain

Blockchain technology is revolutionary and disruptive, so it is expected to have significant benefits. Part of the benefits of blockchain lies in its unique applications, which are discussed in the third part of this report (Applications). Here are the main advantages of blockchain technology that make it attractive.

One of the critical advantages of blockchain technology is its security. Blockchain technology uses a powerful cryptographic language to create tamper-proof transactions and shared truth. It is also a handy tool for sharing information. According to experts in the field of oil, gas, and energy, compared to other systems, this technology has a significant reduction in costs. With blockchain, the speed of transactions is high. Also, blockchain is scalable, and by using it, it is possible to quickly increase the number of processes, users, and participants. Another point is that blockchain technology can innovate the business model by removing the mediator and central intermediary.

One of the other key advantages of blockchain is increasing transparency. The point is that this transparency is associated with saving time and money. For example, buyers issue purchase orders, shipping companies issue packing lists, sellers issue invoices, and banks release funds; All of these are covered in agreements, terms of contracts, and plans that handle tracking, delivery, and payment. The use of blockchain both mediates the above processes and helps to make the process more transparent. More importantly, the high cost of companies to trust traders and subsequent risks and disputes are reduced by blockchain. This advantage is due to the registration and tracking of all contracts, agreements, reporting, and monitoring internally and about service providers and all their related documents. Suppose the documents, the identity of the participants, locations, property type, and value are added in the blockchain. In that case, any problems and disputes that arise can be resolved by referring to the unique ledger in which all the information is recorded. .

With a holistic view, blockchain technology is based on the advantages of transparency, security, responsiveness to the customer, autonomy, and automation (Figure 3). These advantages are realized with the help of unique solutions of this technology. By preventing fraud and tracing the origin, blockchain technology also helps to reduce risk and prevent disputes. From the legislator's point of view, the advantage of blockchain technology is quick and simple access to data for evaluation. Especially the prevention of fraud and changes in data has made blockchain attractive to legislators. It is worth mentioning that digital ID plays a fundamental role in forming this advantage.

5. Research Background

Although the background of the blockchain topic is a new topic; however, much research has been conducted in this regard, both inside and outside of Iran. Some of them will be reviewed below.

Aghajani Mir et al. [20] researched "Identifying and prioritizing the challenges of implementing blockchain technology in the supply chain". The challenges were identified in this research after reviewing the literature and background. Then, they determined the importance of these challenges using the multi-indicator group decision-making method. The results indicate that security, technical and organizational challenges are the most critical challenges of the studied company in implementing this technology. Also, among all challenge sub-indices, sub-indices of poor scalability, information privacy/confidentiality, and cyber attacks were of the highest importance.

Qolhaki and Farhang Adib [21] investigated "Blockchain technology and its impact on payment systems and the banking industry". According to the findings of this research, a comprehensive review of this technology, including its uses, advantages (one of the most important of which is increasing security in financial transactions) and disadvantages, and finally, taking into account the possible risks of using any new technology, banks should be familiar with the threats and opportunities that arise and consider a specific strategy to face each of them and also the special sensitivities and considerations that exist towards the development and modernization of banking and payment systems and considering that blockchain technology will challenge almost all bank departments.

Najafi Shoushtari and Bechari Lafteh [22] researched "Blockchain technology applications in the maritime transport industry". This research's results clearly show that information technology infrastructure plays a vital role in supporting maritime transport. Of course, it should also be noted that information technology, as it is essential for the maritime transport industry, may also become a weakness because to apply any innovation, it needs to be accepted by the general actors of each industry.

In research, Asgari Mehr and colleagues [23] identified and prioritized the challenges of implementing blockchain technology in the banking industry. In this research, first, by reviewing the literature, a number of indicators and challenges were identified. Then, other challenges were identified to complement the factors identified using the Delphi method. At the end, the challenges were ranked using the fuzzy AHP method.

Ekbatani Fared and Falahatgar [24] investigated "Blockchain's role in strengthening cyber security and protecting the privacy of the smart home". This research suggests a new position of secure, private, and lightweight architecture for the Internet of Things, which is based on blockchain technology that removes the overheads of blockchain while maintaining most of its security advantages. This research presents a light blockchain example for special use for the Internet of Things by removing the concept of proof of work and the concept of a coin. This approach is exemplified in a smart home environment and includes three primary levels: cloud storage, overlay, and smart homes. Each smart home is equipped with an always-online, high-resource device known as a mine, which manages all communications inside and outside the home. It also protects a private blockchain used to control and audit communications. We demonstrate that the proposed

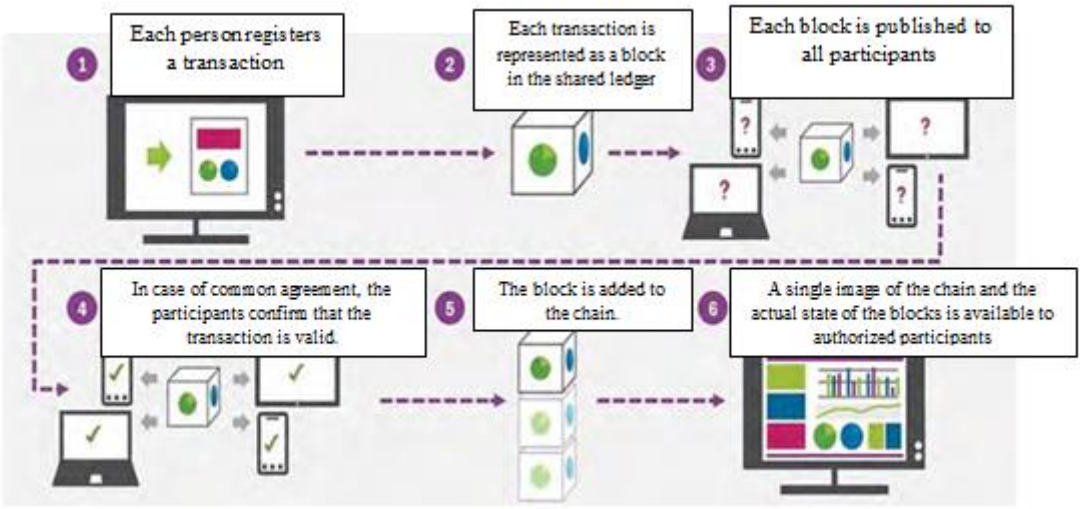

Figure. 2. How blockchain works? [8]

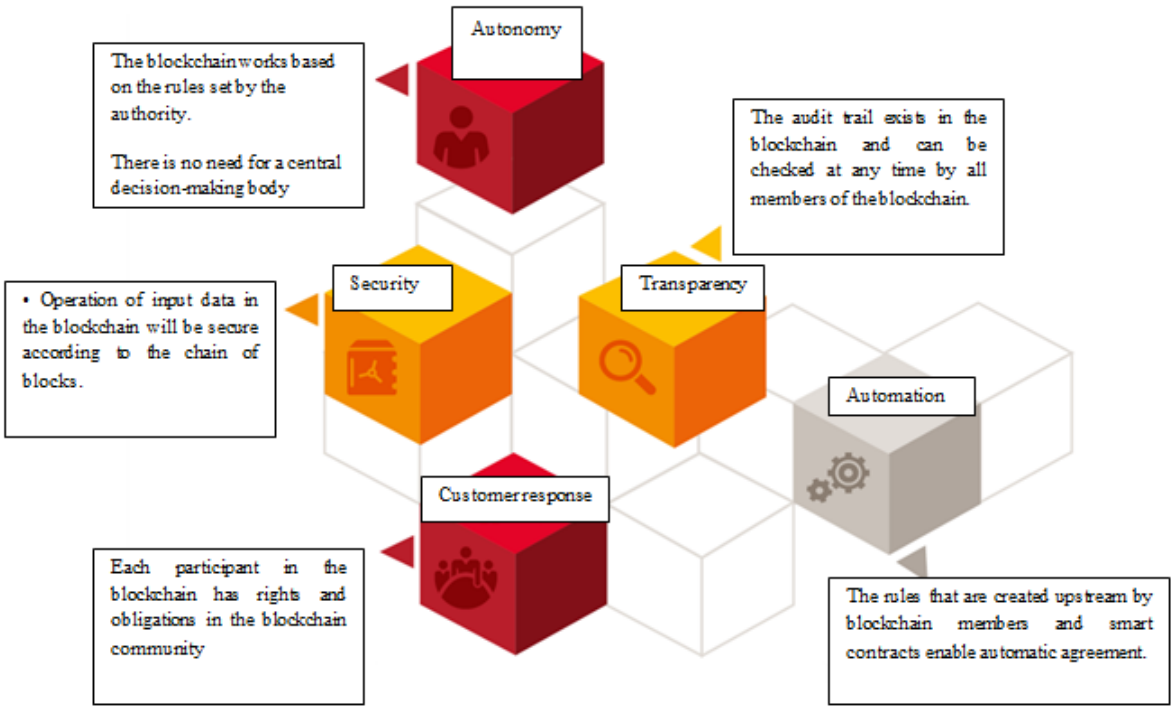

Figure. 3. Advantages of Blockchain [8]

blockchain-based smart home framework with full security is secure concerning security, integrity, and availability.

Sanka et al. [4] explored blockchain breakthroughs, applications, and challenges. In this research, a comprehensive review of blockchain cryptography is presented for a better understanding of the technology and an analysis of public blockchains and economic enterprises.

Kouhizadeh, M., Saberi, S., and Sarkis, J. [25] in a study, used the technical-organizational-environmental framework and the opinions of academics and industry experts to identify barriers to blockchain adoption in the supply chain. These barriers were analyzed using Dematel's technique. This research showed that technical barriers are the most critical barriers to blockchain adoption in the supply chain.

Özkan, B., Kaya, İ., Erdoğan, M., and Karaşan, A [26] evaluated and prioritized the risks of blockchain technology using a fuzzy hierarchical analysis process. The main criteria of this research were organizational, cultural, financial, security, and technical risks. The results of this research showed that risks related to security issues are more critical, and managers should give more priority to these risks.

Drljevic, N., Aranda, D. A., and Stantchev, V [27] examine the standards and risks that can support or hinder the sustainable use of blockchain on a large scale. In this research, first by reviewing the literature, the risks related to

the adoption and use of blockchain were identified, and then the selected risk management models were presented. The results indicated that risk management is essential for blockchain's successful adoption and us.

Dutta et al. [15] researched blockchain in the supply chain. This research investigates the success in reforming various industries using blockchain and various blockchain challenges. It helps researchers and professionals to understand and identify areas where the supply chain and different industrial sectors can use blockchain.

Saberi et al. [28] examined the potential application of blockchain technology and smart contracts in supply chain management and identified barriers to blockchain adoption in four categories. They introduced inter-organizational, intra-organizational, technical, and external.

Hughes et al. [5] addressed the uses, benefits, and limitations of blockchain implementations with a comprehensive review of the research literature. In this study, examples from India's migrant population and low-income farmers and other examples from the supply chain and logistics industries are used as cases where blockchain technology can provide significant changes and benefits. This research showed that this technology has significant potential for widespread use in the industry despite the small number of blockchain applications. There are many obstacles to adopting and implementing this technology.

Litke, A., Anagnostopoulos, D., and Varvarigou, T [29] analyzed the application of blockchain technology in the supply chain. This research showed that while modern blockchain features can improve supply chain management performance, this technology still faces many technical challenges; Therefore, a wide range of required changes and further research is needed to achieve a universal blockchain.

Zheng, Z., Xie, S., Dai, H. N., Chen, X., and Wang, H. [30] discussed the classification of blockchain and introduced various types of consensus algorithms. In this research, they reviewed blockchain applications and discussed technical challenges and recent advances in dealing with their challenges.

Kim, K., & Kang, T [31] The role of blockchain technology to combat corruption and empower global communities. These researchers identified the risks and challenges of this technology. They concluded that without considering the risks in all structural stages and not having a planned policy to manage these risks, blockchain could have negative effects and hinder sustainable growth.

Mthethwa [32] while examining different forms of blockchain technology, investigated the challenges of using this technology. According to the research results, the most important factor and challenge in using this technology is people's lack of familiarity. He believes that the most critical risks related to using this technology are awareness and understanding, security and privacy, regulations and governance, and lack of processing power. In the section examined the theoretical backgrounds and the related literature. This work results in the achievement of obstacles to using blockchain technology in organizations and industries. The following tables show this result. As it is known, based on the review of the theoretical backgrounds the related literature, the obstacles to the use of blockchain technology can be divided into four categories: intra-organizational, inter-organizational, legal, and technological.

By reviewing the literature and research background, the obstacles and challenges of blockchain implementation were identified. Table 1 shows the results.

6. Research Method

This research is practical in terms of its purpose because its results can be practically used by managers, companies, and organizations active in Iran's industrial sector. In terms of data collection and analysis, it is also among descriptive survey research.

The statistical population of this research is all specialists and experts familiar with blockchain technology. But due to the impossibility of identifying and studying all members of the society and the lack of access to all of them, sampling is done by a purposeful judgment method. Based on this, the number of at least 10 academic and industrial experts who meet the following conditions are selected as a statistical sample:

1- Having at least a master's degree

2- Familiar with blockchain technology

3- Being a member of the academic faculty of a university or being among the managers of one of Iran's automobile companies

In this study, document study is used to study the theoretical foundations and background of the research. In this way, the latest materials and concepts related to the subject are reviewed by referring to scientific sources, including books, articles, and theses. The survey method is also used in the evaluation stage of obstacles and challenges. The process of conducting this research is as follows: first, the theoretical background and the related literature of the research are examined. Then the research questionnaire is designed, distributed among the experts, and compiled. After that, the data is analyzed using the fuzzy Dematel technique. In this step, Expert Choice software is used. In the end, discussion and conclusions are presented.

In this research, the Fuzzy Dematel technique is used to evaluate the obstacles and challenges of using blockchain technology in Iran's automobile industry. For this purpose, Excel software will be used. In the following, the fuzzy Dematel method will be introduced. Fuzzy Dematel is a method to identify the pattern of causal relationships between decision-making criteria with the approach of fuzzy inference. This method is an extension of the traditional Dimtel method using fuzzy logic. Lin and Wu [68] used Dimtel's technique with a fuzzy approach in an article titled "Development of Managerial Competencies" for the first time. In fact, the fuzzy approach has been used to deal with the uncertainty and ambiguity in the verbal expressions of the respondents. The Fuzzy Dematel technique is superior to other multi-criteria decision-making techniques, such as Analytical Hierarchy Process. This technique displays the interdependence between the factors of a system through a causal diagram, which is ignored in traditional techniques. This technique consists of the following steps:

Table 1. Obstacles to the use of blockchain technology resulting from the background and theoretical foundations of the research

Row	Main category	Sub Category	Reference
1	Technical and technological barriers	Lack of data security and privacy	[33, 34, 35, 36, 37, 38, 4, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 16, 55]
		Slow processing and transactions and lack of scalability	
		Lack of security against cyber attacks such as DOS, malware attacks	
		Lack of standardization in different blockchain systems and complexity of use	
		Lack of RFID and IoT infrastructures	
		Inability to include all transactional aspects in smart contracts and the risk of fraud in contracts	
		Data storage problem	
2	Internal barriers	Lack of proper estimation of the cost of implementing blockchain technology	[56, 41, 57, 58, 59, 49, 38, 42, 44, 36, 60, 55, 40, 16, 61, 62, 63, 64, 15, 65]
		Lack of proper knowledge and understanding of blockchain technology and its impact on performance	
		lack of commitment and desire of senior managers to improve and make fundamental changes (conservative approach)	
		Creating a fundamental and fundamental change in the current structures and processes of the organization, if blockchain technology is used	
		Unbelievability of the need to use blockchain technology	
		Absence of a specific department in the organization to be in charge of the implementation	
		Confusion about how to combine blockchain technology with the organization's existing software	
3	Obstacles related to laws and regulations	Lack of necessary and specific laws for legal support of smart contracts	[66, 64, 46, 42, 40, 65, 62, 67, 44, 59]
		The absence of a clear law for financial and cyber crimes in the context of blockchain technology	
		There is no specific law for tax and insurance in the context of this technology	
4	Inter-organizational barriers	Lack of proper awareness about blockchain technology among supply chain members	[46, 15, 63, 16, 59, 61, 42]
		Lack of access to all supply chain partners and related stakeholders of the organization to information technology systems	
		Lack of adequate financial resources for supply chain partners and related stakeholder organizations to apply blockchain technology	
		The difference in the approach of chain partners in sharing information	

First step: forming a group of experts to collect their group knowledge to solve the problem.

Second step: Determining the criteria to be evaluated and designing the language scales: In this step, the research's factors and indicators are identified using experts' opinions.

The third step: creating the fuzzy matrix of the initial direct connection by collecting experts' opinions.

The fourth step: Normalization of the direct correlation fuzzy matrix.

The fifth step: calculating the fuzzy matrix of the total connection (same).

7. Research Findings

First step: forming a group of experts to collect their group knowledge to solve the problem

Second step: Determining the criteria to be evaluated as well as designing language scales. In this step, research factors and indicators were identified (Table 2).

The third step: creating the fuzzy matrix of the initial direct connection by collecting experts' opinions.

It is worth mentioning that in this research, 10 questionnaires were collected in order to create a matrix and reach a consensus. In the roughness matrix, the average opinions of 10 experts were included for each cell. To measure the relationships between the criteria, they were placed in a square matrix, and the experts were asked to compare them in pairs based on their impact on each other. Table 3 shows the results.

The fourth step: Normalization of the direct correlation fuzzy matrix. To normalize the fuzzy matrix of direct correlation, linear scale transformation was used as a normalization formula to transform the scales of the criteria into comparable criteria. Table 4 shows the normalized fuzzy matrix.

The fifth step: calculating the fuzzy matrix of the total relationship.

Table 5 shows the total communication fuzzy matrix.

The sixth step: calculating the effectiveness and effectiveness of each component.

Table 2. Barriers to using blockchain technology

Row	*Symbol*	*Factor*
1	A1	Lack of data security and privacy
2	A2	Slow processing and transactions and lack of scalability
3	A3	Lack of security against cyber attacks...
4	A4	Lack of standardization in different blockchain systems and...
5	A5	Lack of RFID and IoT infrastructure
6	A6	It is not possible to include all transactional aspects in the contracts....
7	A7	Data storage problem
8	B1	Lack of proper estimation of the cost of implementing blockchain technology
9	B2	Lack of proper knowledge and understanding of blockchain technology and its impact on...
10	B3	Lack of commitment and desire of senior managers to improve and make changes...
11	B4	Creating a fundamental and fundamental change in the current structures and processes...
12	B5	Unbelievability of the need to use blockchain technology
13	B6	Absence of a specific department in the organization to be in charge of the implementation
14	B7	Confusion in how to combine blockchain technology with...
15	C1	Lack of necessary and specific laws for legal support of...
16	C2	The absence of a clear law for financial and cyber crimes in the context of...
17	C3	There is no specific law for tax and insurance in the context of this...
18	D1	Lack of proper knowledge about blockchain technology among the members of...
19	D2	Lack of access to all supply chain partners and organizations...
20	D3	Lack of suitable financial resources for supply and supply chain partners...
21	D4	The difference in the approach of partners and cooperating organizations in sharing...

Table 3. Fuzzy matrix of primary direct connection

DM	A1			A2			A3			A4			A5			A6			A7		
A1	0	0	0	2.5	3	3.4	0.5	1	1.5	0.9	1.4	1.9	1.5	2	2.5	1.5	2	2.5	0	0	0
A2	0	0	0	0	0	0	1.7	2.2	2.7	0.7	1.2	1.7	0	0	0	0	0	0	0	0	0
A3	0.8	1.2	1.6	1.9	2.4	2.8	0	0	0	3.3	3.8	3.9	1.9	2.4	2.8	1.3	1.8	2.3	0.9	1.4	1.9
A4	0.9	1.4	1.9	0	0	0	1.5	2	2.5	0	0	0	0.5	1	1.5	0.5	1	1.5	1.3	1.8	2.3
A5	0	0	0	0	0	0	3.5	4	4	0.5	1	1.5	0	0	0	1.3	1.8	2.3	0	0	0
A6	0	0	0	0	0	0	1.7	2.2	2.7	1.5	2	2.5	0.5	1	1.5	0	0	0	0	0	0
A7	0.7	1.2	1.7	0	0	0	2.1	2.6	2.9	0.7	1.2	1.7	2.5	3	3.5	1.5	2	2.5	0	0	0
B1	0	0	0	0	0	0	0.9	1.4	1.9	1.5	2	2.5	0.7	1.2	1.7	0	0	0	0	0	0
B2	2.9	3.4	3.7	1.5	2	2.5	0	0	0	2.3	2.8	3.3	0.7	1.2	1.7	1.3	1.8	2.3	1.1	1.6	2.1
B3	1.1	1.6	2.1	0	0	0	0.2	0.4	0.6	0	0	0	0.7	1.2	1.7	0	0	0	0	0	0
B4	0	0	0	0.5	1	1.5	0	0	0	0.1	0.2	0.3	0.1	0.2	0.3	0	0	0	1.9	2.4	2.9
B5	1.2	1.6	2	1.9	2.4	2.9	2.5	3	3.5	0.7	1.2	1.7	0	0	0	0	0	0	1.5	2	2.5
B6	1.5	2	2.5	0.5	1	1.5	0	0	0	0	0	0	2.3	2.8	3.1	1.5	2	2.5	0.7	1.2	1.7
B7	0	0	0	2.1	2.6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C1	1.1	1.6	2.1	0.5	1	1.5	1.3	1.8	2.3	0	0	0	0.4	0.6	0.8	0	0	0	1.7	2.2	2.7
C2	0	0	0	1.1	1.6	2.1	1.3	1.8	2.2	2.3	2.8	3.1	0	0	0	0	0	0	0	0	0
C3	0.5	1	1.5	2.9	3.4	3.7	0.5	1	1.5	0	0	0	3.1	3.6	3.7	2.9	3.4	3.7	1.3	1.8	2.3
C4	0.5	1	1.5	0	0	0	0	0	1.3	1.8	2.3	0	0	0	2.3	2.8	3.3	0.7	1.2	1.7	0
D1	0	0	0	0	0	0	0.9	1.4	0.7	1.2	1.7	0.2	0.4	0.6	0	0	0	0.7	1.2	1.7	0
D2	2.7	3.2	3.6	0.9	1.4	1.9	2.5	3	0	0	0	1.3	1.8	2.3	0	0	0	0	0	0	2.3
D3	0	0	0	0.9	1.4	1.9	0	0	0.8	1.2	1.6	0	0	0	0.8	1.2	1.6	0.2	0.4	0.6	0
DM	B1			B2			B3			B4			B5			B6			B7		
A1	0.5	1	1.5	0	0	0	0	0	0	2.9	3.4	3.5	0	0	0	0	0	0	0	0	0
A2	0	0	0	0	0	0	0.9	1.4	1.9	0	0	0	0.3	0.4	0.5	0	0	0	0.1	0.2	0.3
A3	2.7	3.2	3.6	0.9	1.4	1.9	2.5	3	3.3	0.5	1	1.5	0	0	0	0.5	1	1.5	0	0	0
A4	0	0	0	0.9	1.4	1.9	0	0	0	1.3	1.8	2.3	0	0	0	0.9	1.4	1.9	0	0	0
A5	1.5	2	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A6	0	0	0	0	0	0	0.6	1	1.4	0	0	0	0.2	0.4	0.6	0	0	0	0	0	0
A7	1.5	2	2.5	0	0	0	0	0	0	2.5	3	3.5	1.5	2	2.5	0	0	0	2.9	3.4	3.7
B1	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.2	0.3	0	0	0	0	0	0
B2	1.3	1.8	2.3	0	0	0	0.5	1	1.5	0.7	1.2	1.7	0	0	0	0.9	1.4	1.9	0	0	0
B3	0.7	1.2	1.7	0.4	0.8	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B4	0	0	0	0.4	0.6	0.8	0.1	0.2	0.3	0	0	0	0	0	0	0	0	0	0	0	0
B5	0.8	1.2	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B6	1.5	2	2.5	0	0	0	2.5	3	3.2	3.5	4	4	0.9	1.4	1.9	0	0	0	0.9	1.4	1.9
B7	0	0	0	0	0	0	0.2	0.4	0.6	1.7	2.2	2.7	1	1.4	1.8	0.2	0.4	0.6	0	0	0
C1	0	0	0	0.4	0.8	1.2	0	0	0	0.5	1	1.5	0	0	0	0	0	0	1.3	1.8	2.3
C2	0	0	0	0	0	0	0	0	0	1.9	2.4	2.8	0	0	0	0	0	0	0.9	1.4	1.9
C3	1.3	1.8	2.3	0.7	1.2	1.7	0	0	0	3.5	4	4	0	0	0	0	0	0	0.7	1.2	1.7
C4	0.5	1	1.5	0	0	0	0.5	1	1.5	0	0	0	2.3	2.8	3.2	0	0	0	0.9	1.4	1.9
D1	1.3	1.8	2.3	0	0	0	0.9	1.4	1.9	0	0	0	0.9	1.4	1.9	1.5	2	2.5	0	0	0
D2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.4	0.6
D3	0	0	0	0.2	0.4	0.6	0	0	0	0	0	0	0	0	0	0.5	1	1.5	0	0	0

DM	C1			C2			C3			C4			D1			D2			D3		
A1	0.5	1	1.5	1.3	1.8	2.3	0.7	1.2	1.7	0.7	1.2	1.7	2	2.5	0.7	1.2	1.7	0	0	0.3	3.5
A2	0	0	0	0	0	0	0	0	0	1.5	2	2.5	2.8	3.3	0.7	1.2	1.7	1.3	1.8	0	1.7
A3	2.3	2.8	3.2	0.5	1	1.5	0	0	0	2.3	2.8	3.3	0	0	0.7	1.2	1.7	0	0	0	2.1
A4	0.9	1.4	1.9	1.1	1.6	2.1	0	0	0	0	0	0	0.2	0.3	0.1	0.2	0.3	0	0	0	0.9
A5	0	0	0	0.6	1	1.4	0	0	0	0.1	0.2	0.3	1.2	1.7	0	0	0	0	0	0	0
A6	0	0	0	0	0	0	0	0	0	0.7	1.2	1.7	0	0	2.3	2.8	3.1	1.5	2	3.7	0.2
A7	1.5	2	2.5	0.5	1	1.5	0.5	1	1.5	0	0	0	0	0	0	0	0	0	0	0	0
B1	0	0	0	0	0	0	1.5	2	2.5	0	0	0	0	0	0.4	0.6	0.8	0	0	0	2.5
B2	0.7	1.2	1.7	0.5	1	1.5	0.3	0.6	0.9	0	0	0	2.8	3.1	0	0	0	0	0	0	0
B3	0	0	0	1.2	1.6	2	1.5	2	2.5	2.3	2.8	3.1	1.1	1.6	0	0	0	0	0	0	0
B4	0.5	1	1.5	1.1	1.4	1.7	0	0	0	0	0	0	0.6	1	1.4	0	0.3	0.4	0.5	0	1.3
B5	0	0	0	0	0	0	0	0	0	2	2.5	0.7	1.2	1.7	0	0	0	0	0	0.5	1.3
B6	0.5	1	1.5	1.2	1.6	2	0.5	1	1.5	2.8	3.3	0.7	1.2	1.7	1.3	1.8	0	0	0	0.9	0.5
B7	1.7	2.2	2.7	1.8	2.2	2.6	1.1	1.6	2.1	0	0	0.7	1.2	1.7	0	0	0	0	0	0	0
C1	0	0	0	1.3	1.8	2.3	0.9	1.4	1.9	0.2	0.3	0.1	0.2	0.3	0	0	0.2	0.4	0.6	0	0
C2	3.5	4	4	0	0	0	0.5	1	1.5	1.2	1.7	0	0	0	0	0	1.5	2	2.5	0	0
C3	0.7	1.2	1.7	0.5	0.8	1.1	0	0	0	0	0	2.3	2.8	3.1	1.5	2	0.1	0.2	0.3	0	0.4
C4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	2
D1	0	0	0	2.9	3.4	3.7	1.5	2	2.5	0	0	0.4	0.6	0.8	0	0	0	0	0	0	0.2
D2	0.5	1	1.5	0.3	0.6	0.9	0	0	0	2.8	3.1	0	0	0	0	0	0	0	2	2.5	0.7
D3	1.2	1.6	2	1.5	2	2.5	2.3	2.8	3.1	0	0	0	0	2	2.5	0.7	1.2	1.7	0	0	0

Table 4. Normalized fuzzy matrix

DM	A1			A2			A3			A4			A5			A6			A7		
A1	0	0	0	0.088	0.106	0.120	0.018	0.035	0.053	0.032	0.049	0.067	0.053	0.071	0.088	0.053	0.071	0.088	0.000	0.000	0.000
A2	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.078	0.095	0.025	0.042	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A3	0.028	0.042	0.057	0.067	0.085	0.099	0.000	0.000	0.000	0.117	0.134	0.138	0.067	0.085	0.099	0.046	0.064	0.081	0.032	0.049	0.067
A4	0.032	0.049	0.067	0.000	0.000	0.000	0.053	0.071	0.088	0.000	0.000	0.000	0.018	0.035	0.053	0.018	0.035	0.053	0.046	0.064	0.081
A5	0.000	0.000	0.000	0.000	0.000	0.000	0.124	0.141	0.141	0.018	0.035	0.053	0.000	0.000	0.000	0.046	0.064	0.081	0.000	0.000	0.000
A6	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.078	0.095	0.053	0.071	0.088	0.018	0.035	0.053	0.000	0.000	0.000	0.000	0.000	0.000
A7	0.025	0.042	0.060	0.000	0.000	0.000	0.074	0.092	0.102	0.025	0.042	0.060	0.088	0.106	0.124	0.053	0.071	0.088	0.000	0.000	0.000
B1	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.049	0.067	0.053	0.071	0.088	0.025	0.042	0.060	0.000	0.000	0.000	0.000	0.000	0.000
B2	0.102	0.120	0.131	0.053	0.071	0.088	0.000	0.000	0.000	0.081	0.099	0.117	0.025	0.042	0.060	0.046	0.064	0.081	0.039	0.057	0.074
B3	0.039	0.057	0.074	0.000	0.000	0.000	0.007	0.014	0.021	0.000	0.000	0.000	0.025	0.042	0.060	0.000	0.000	0.000	0.000	0.000	0.000
B4	0.000	0.000	0.000	0.018	0.035	0.053	0.000	0.000	0.000	0.004	0.007	0.011	0.004	0.007	0.011	0.000	0.000	0.000	0.067	0.085	0.102
B5	0.042	0.057	0.071	0.067	0.085	0.102	0.088	0.106	0.124	0.025	0.042	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.071	0.088
B6	0.053	0.071	0.088	0.018	0.035	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.081	0.099	0.110	0.053	0.071	0.088	0.025	0.042	0.060
B7	0.000	0.000	0.000	0.074	0.092	0.106	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C1	0.039	0.057	0.074	0.018	0.035	0.053	0.046	0.064	0.081	0.000	0.000	0.000	0.014	0.021	0.028	0.000	0.000	0.000	0.060	0.078	0.095
C2	0.000	0.000	0.000	0.039	0.057	0.074	0.046	0.064	0.078	0.081	0.099	0.110	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C3	0.018	0.035	0.053	0.102	0.120	0.131	0.018	0.035	0.053	0.000	0.000	0.000	0.110	0.127	0.131	0.102	0.120	0.131	0.046	0.064	0.081
C4	0.000	0.000	0.000	0.000	0.000	0.074	0.092	0.102	0.025	0.042	0.060	0.088	0.106	0.124	0.053	0.071	0.088	0.032	0.049	0.067	0.000
D1	0.028	0.042	0.057	0.000	0.000	0.032	0.049	0.067	0.053	0.071	0.088	0.025	0.042	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D2	0.032	0.049	0.067	0.071	0.088	0.000	0.000	0.000	0.081	0.099	0.117	0.025	0.042	0.060	0.046	0.064	0.081	0.000	0.000	0.000	0.000
D3	0.000	0.000	0.000	0.000	0.000	0.007	0.014	0.021	0.000	0.000	0.000	0.025	0.042	0.060	0.000	0.000	0.000	0.025	0.042	0.060	0.000

DM	B1			B2			B3			B4			B5			B6			B7		
A1	0.018	0.035	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.102	0.120	0.124	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A2	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.049	0.067	0.000	0.000	0.000	0.011	0.014	0.018	0.000	0.000	0.000	0.004	0.007	0.011
A3	0.095	0.113	0.127	0.032	0.049	0.067	0.088	0.106	0.117	0.018	0.035	0.053	0.000	0.000	0.000	0.018	0.035	0.053	0.000	0.000	0.000
A4	0.000	0.000	0.000	0.032	0.049	0.067	0.000	0.000	0.000	0.046	0.064	0.081	0.000	0.000	0.000	0.032	0.049	0.067	0.000	0.000	0.000
A5	0.053	0.071	0.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A6	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.035	0.049	0.000	0.000	0.000	0.007	0.014	0.021	0.000	0.000	0.000	0.000	0.000	0.000
A7	0.053	0.071	0.088	0.000	0.000	0.000	0.000	0.000	0.000	0.088	0.106	0.124	0.053	0.071	0.088	0.000	0.000	0.000	0.102	0.120	0.131
B1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.007	0.011	0.000	0.000	0.000	0.000	0.000	0.000
B2	0.046	0.064	0.081	0.000	0.000	0.000	0.018	0.035	0.053	0.025	0.042	0.060	0.000	0.000	0.000	0.032	0.049	0.067	0.000	0.000	0.000
B3	0.025	0.042	0.060	0.014	0.028	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B4	0.000	0.000	0.000	0.014	0.021	0.028	0.004	0.007	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B5	0.028	0.042	0.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B6	0.053	0.071	0.088	0.000	0.000	0.000	0.088	0.106	0.113	0.124	0.141	0.141	0.032	0.049	0.067	0.000	0.000	0.000	0.032	0.049	0.067
B7	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.014	0.021	0.060	0.078	0.095	0.035	0.049	0.064	0.007	0.014	0.021	0.000	0.000	0.000
C1	0.000	0.000	0.000	0.014	0.028	0.042	0.000	0.000	0.000	0.018	0.035	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.064	0.081
C2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.085	0.099	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.049	0.067
C3	0.046	0.064	0.081	0.025	0.042	0.060	0.000	0.000	0.000	0.124	0.141	0.141	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.042	0.060
C4	0.032	0.049	0.067	0.000	0.000	0.000	0.046	0.064	0.081	0.000	0.000	0.000	0.032	0.049	0.000	0.000	0.000	0.021	0.035	0.049	0.000
D1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.088
D2	0.000	0.000	0.000	0.021	0.035	0.049	0.000	0.000	0.000	0.007	0.014	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D3	0.000	0.000	0.000	0.000	0.000	0.000	0.088	0.106	0.124	0.053	0.071	0.088	0.000	0.000	0.000	0.000	0.000	0.018	0.035	0.053	0.025

DM	C1			C2			C3			C4			D1			D2			D3		
A1	0.018	0.035	0.053	0.046	0.064	0.081	0.025	0.042	0.060	0.088	0.106	0.120	0.018	0.035	0.053	0.032	0.049	0.067	0.053	0.071	0.088
A2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.078	0.095	0.025	0.042	0.060	0.000	0.000	0.000
A3	0.081	0.099	0.113	0.018	0.035	0.053	0.000	0.000	0.000	0.067	0.085	0.099	0.000	0.000	0.000	0.117	0.134	0.138	0.067	0.085	0.099
A4	0.032	0.049	0.067	0.039	0.057	0.074	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.071	0.088	0.000	0.000	0.000	0.018	0.035	0.053
A5	0.000	0.000	0.000	0.021	0.035	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.124	0.141	0.141	0.018	0.035	0.053	0.000	0.000	0.000
A6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.078	0.095	0.053	0.071	0.088	0.018	0.035	0.053
A7	0.053	0.071	0.088	0.018	0.035	0.053	0.018	0.035	0.053	0.000	0.000	0.000	0.074	0.092	0.102	0.025	0.042	0.060	0.088	0.106	0.124
B1	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.071	0.088	0.000	0.000	0.000	0.032	0.049	0.067	0.053	0.071	0.088	0.025	0.042	0.060
B2	0.025	0.042	0.060	0.018	0.035	0.053	0.011	0.021	0.032	0.053	0.071	0.088	0.000	0.000	0.000	0.081	0.099	0.117	0.025	0.042	0.060
B3	0.000	0.000	0.000	0.042	0.057	0.071	0.053	0.071	0.088	0.000	0.000	0.000	0.007	0.014	0.021	0.000	0.000	0.000	0.025	0.042	0.060
B4	0.018	0.035	0.053	0.039	0.049	0.060	0.000	0.000	0.000	0.018	0.035	0.053	0.000	0.000	0.000	0.004	0.007	0.011	0.004	0.007	0.011
B5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.085	0.102	0.088	0.106	0.124	0.025	0.042	0.060	0.000	0.000	0.000
B6	0.018	0.035	0.053	0.042	0.057	0.071	0.018	0.035	0.053	0.018	0.035	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.081	0.099	0.110
B7	0.060	0.078	0.095	0.064	0.078	0.092	0.039	0.057	0.074	0.074	0.092	0.106	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C1	0.000	0.000	0.000	0.046	0.064	0.081	0.032	0.049	0.067	0.018	0.035	0.053	0.046	0.064	0.081	0.000	0.000	0.000	0.014	0.021	0.028
C2	0.124	0.141	0.141	0.000	0.000	0.000	0.018	0.035	0.053	0.039	0.057	0.074	0.046	0.064	0.078	0.081	0.099	0.110	0.000	0.000	0.000
C3	0.025	0.042	0.060	0.018	0.028	0.039	0.000	0.000	0.000	0.102	0.120	0.131	0.018	0.035	0.053	0.000	0.000	0.000	0.110	0.127	0.131
C4	0.088	0.106	0.117	0.018	0.035	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.092	0.102	0.025	0.042	0.060	0.088	0.106	0.124	0.053
D1	0.000	0.000	0.000	0.046	0.064	0.081	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.071	0.088	0.025	0.042	0.060	0.000
D2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.071	0.088	0.000	0.000	0.000	0.081	0.000	0.000	0.000	0.042	0.060	0.046
D3	0.021	0.035	0.049	0.000	0.000	0.000	0.007	0.014	0.021	0.000	0.000	0.007	0.014	0.021	0.000	0.000	0.000	0.025	0.000	0.000	0.000

Table 5. Full fuzzified correlation matrix

DM	*A1*			*A2*			*A3*			*A4*			*A5*			*A6*			*A7*		
A1	0.006	0.022	0.056	0.101	0.142	0.201	0.046	0.098	0.179	0.052	0.100	0.172	0.065	0.107	0.174	0.064	0.100	0.157	0.016	0.037	0.077
A2	0.006	0.016	0.034	0.007	0.017	0.036	0.066	0.096	0.137	0.035	0.064	0.103	0.008	0.020	0.043	0.005	0.014	0.033	0.006	0.014	0.032
A3	0.049	0.093	0.161	0.085	0.135	0.214	0.045	0.097	0.188	0.145	0.206	0.288	0.093	0.152	0.243	0.065	0.114	0.192	0.053	0.099	0.173
A4	0.045	0.083	0.143	0.018	0.046	0.104	0.073	0.126	0.212	0.023	0.056	0.120	0.038	0.085	0.162	0.033	0.075	0.143	0.060	0.100	0.165
A5	0.008	0.019	0.040	0.013	0.027	0.051	0.138	0.176	0.212	0.044	0.084	0.133	0.016	0.035	0.066	0.056	0.087	0.127	0.009	0.022	0.044
A6	0.007	0.017	0.038	0.007	0.018	0.039	0.070	0.104	0.153	0.064	0.096	0.140	0.026	0.058	0.102	0.007	0.019	0.042	0.007	0.018	0.038
A7	0.038	0.079	0.144	0.032	0.071	0.140	0.114	0.178	0.274	0.056	0.115	0.206	0.110	0.163	0.248	0.071	0.117	0.190	0.024	0.054	0.111
B1	0.006	0.017	0.038	0.011	0.024	0.049	0.044	0.080	0.133	0.062	0.094	0.141	0.037	0.070	0.117	0.012	0.026	0.053	0.009	0.021	0.045
B2	0.114	0.154	0.211	0.073	0.120	0.197	0.033	0.079	0.165	0.103	0.157	0.246	0.049	0.103	0.191	0.065	0.111	0.184	0.054	0.096	0.164
B3	0.043	0.071	0.111	0.015	0.033	0.066	0.020	0.049	0.098	0.013	0.033	0.072	0.037	0.073	0.124	0.012	0.028	0.059	0.007	0.018	0.043
B4	0.006	0.016	0.037	0.024	0.053	0.095	0.014	0.032	0.067	0.014	0.032	0.065	0.013	0.029	0.059	0.007	0.017	0.038	0.072	0.099	0.137
B5	0.051	0.079	0.121	0.082	0.117	0.168	0.108	0.151	0.218	0.047	0.090	0.152	0.019	0.042	0.085	0.014	0.032	0.067	0.062	0.093	0.141
B6	0.064	0.102	0.162	0.041	0.092	0.171	0.036	0.083	0.164	0.025	0.062	0.131	0.102	0.153	0.226	0.069	0.112	0.178	0.043	0.085	0.149
B7	0.008	0.022	0.049	0.090	0.129	0.182	0.021	0.045	0.091	0.014	0.033	0.069	0.011	0.028	0.061	0.008	0.021	0.047	0.015	0.033	0.066
C1	0.047	0.082	0.137	0.040	0.087	0.159	0.066	0.116	0.196	0.021	0.052	0.109	0.034	0.068	0.128	0.016	0.039	0.084	0.071	0.108	0.166
C2	0.013	0.031	0.064	0.056	0.100	0.162	0.067	0.113	0.178	0.096	0.135	0.187	0.015	0.039	0.081	0.011	0.029	0.064	0.023	0.046	0.084
C3	0.028	0.066	0.125	0.120	0.168	0.237	0.061	0.123	0.215	0.031	0.073	0.144	0.129	0.179	0.244	0.119	0.162	0.222	0.064	0.105	0.169
C4	0.044	0.080	0.133	0.062	0.094	0.141	0.037	0.070	0.117	0.012	0.026	0.053	0.009	0.007	0.017	0.038	0.007	0.018	0.039	0.070	0.104
D1	0.033	0.079	0.165	0.103	0.157	0.246	0.049	0.103	0.191	0.065	0.111	0.184	0.054	0.038	0.079	0.144	0.032	0.071	0.140	0.114	0.178
D2	0.020	0.049	0.098	0.013	0.033	0.072	0.037	0.073	0.124	0.012	0.028	0.059	0.007	0.006	0.017	0.038	0.011	0.024	0.049	0.044	0.080
D3	0.014	0.032	0.067	0.014	0.032	0.065	0.013	0.029	0.059	0.007	0.017	0.038	0.072	0.114	0.154	0.211	0.073	0.120	0.197	0.033	0.079
DM	*B1*			*B2*			*B3*			*B4*			*B5*			*B6*			*B7*		
A1	0.029	0.064	0.119	0.006	0.019	0.044	0.009	0.024	0.050	0.117	0.160	0.212	0.003	0.008	0.019	0.003	0.010	0.025	0.006	0.018	0.043
A2	0.009	0.019	0.038	0.004	0.011	0.024	0.038	0.062	0.091	0.006	0.017	0.039	0.011	0.017	0.025	0.002	0.007	0.016	0.005	0.012	0.024
A3	0.115	0.163	0.236	0.042	0.077	0.128	0.100	0.137	0.183	0.047	0.107	0.200	0.006	0.016	0.036	0.025	0.053	0.092	0.013	0.032	0.069
A4	0.017	0.042	0.091	0.037	0.066	0.109	0.012	0.028	0.059	0.070	0.121	0.202	0.005	0.013	0.031	0.035	0.060	0.095	0.012	0.028	0.059
A5	0.069	0.099	0.137	0.007	0.016	0.031	0.014	0.025	0.040	0.010	0.027	0.057	0.001	0.005	0.012	0.004	0.011	0.023	0.003	0.009	0.022
A6	0.010	0.023	0.046	0.005	0.013	0.028	0.028	0.050	0.076	0.007	0.020	0.045	0.008	0.017	0.029	0.003	0.009	0.020	0.002	0.005	0.015
A7	0.076	0.121	0.192	0.009	0.026	0.060	0.014	0.032	0.065	0.115	0.172	0.261	0.059	0.086	0.121	0.005	0.015	0.036	0.111	0.144	0.187
B1	0.010	0.023	0.049	0.005	0.014	0.030	0.005	0.012	0.026	0.013	0.029	0.058	0.004	0.010	0.020	0.003	0.008	0.019	0.003	0.009	0.022
B2	0.061	0.104	0.175	0.007	0.021	0.052	0.028	0.062	0.112	0.058	0.114	0.200	0.006	0.015	0.034	0.036	0.061	0.097	0.011	0.028	0.062
B3	0.033	0.066	0.112	0.017	0.038	0.067	0.003	0.010	0.025	0.017	0.037	0.072	0.001	0.003	0.010	0.001	0.005	0.015	0.004	0.012	0.028
B4	0.007	0.017	0.038	0.016	0.028	0.047	0.006	0.016	0.032	0.013	0.029	0.059	0.005	0.009	0.018	0.001	0.004	0.012	0.010	0.020	0.037
B5	0.045	0.076	0.123	0.006	0.015	0.035	0.013	0.025	0.046	0.018	0.040	0.082	0.005	0.011	0.022	0.004	0.011	0.025	0.008	0.017	0.035
B6	0.071	0.115	0.183	0.007	0.021	0.049	0.095	0.127	0.163	0.148	0.200	0.263	0.037	0.063	0.099	0.002	0.008	0.023	0.041	0.075	0.124
B7	0.008	0.021	0.048	0.005	0.013	0.032	0.013	0.030	0.055	0.077	0.116	0.171	0.038	0.056	0.079	0.008	0.018	0.034	0.009	0.021	0.043
C1	0.016	0.038	0.082	0.019	0.044	0.082	0.009	0.023	0.050	0.045	0.095	0.172	0.006	0.015	0.030	0.003	0.010	0.026	0.057	0.089	0.135
C2	0.011	0.027	0.059	0.009	0.023	0.048	0.009	0.022	0.045	0.087	0.133	0.195	0.004	0.010	0.021	0.005	0.013	0.028	0.042	0.073	0.112
C3	0.065	0.109	0.175	0.031	0.061	0.106	0.013	0.033	0.066	0.142	0.193	0.256	0.007	0.017	0.035	0.003	0.012	0.031	0.035	0.068	0.115
C4	0.064	0.056	0.100	0.162	0.067	0.113	0.178	0.096	0.135	0.187	0.015	0.039	0.081	0.011	0.029	0.005	0.013	0.032	0.013	0.030	0.055
D1	0.125	0.120	0.168	0.237	0.061	0.123	0.215	0.031	0.073	0.144	0.129	0.179	0.244	0.119	0.162	0.019	0.044	0.082	0.009	0.023	0.050
D2	0.133	0.062	0.094	0.141	0.037	0.070	0.117	0.012	0.026	0.053	0.009	0.007	0.017	0.038	0.007	0.009	0.023	0.048	0.009	0.022	0.045
D3	0.165	0.103	0.157	0.246	0.049	0.103	0.191	0.065	0.111	0.184	0.054	0.038	0.079	0.144	0.032	0.031	0.061	0.106	0.013	0.033	0.066

DM	C1			C2			C3			C4			D1			D2			D3		
A1	0.035	0.078	0.143	0.058	0.098	0.161	0.030	0.060	0.106	0.007	0.018	0.039	0.070	0.104	0.153	0.064	0.096	0.140	0.026	0.058	0.102
A2	0.008	0.019	0.041	0.006	0.017	0.039	0.003	0.010	0.023	0.032	0.071	0.140	0.114	0.178	0.274	0.056	0.115	0.206	0.110	0.163	0.248
A3	0.102	0.156	0.239	0.043	0.098	0.186	0.019	0.045	0.096	0.011	0.024	0.049	0.044	0.080	0.133	0.062	0.094	0.141	0.037	0.070	0.117
A4	0.053	0.101	0.178	0.054	0.099	0.174	0.008	0.026	0.065	0.073	0.120	0.197	0.033	0.079	0.165	0.103	0.157	0.246	0.049	0.103	0.191
A5	0.017	0.035	0.063	0.029	0.057	0.097	0.006	0.015	0.034	0.015	0.033	0.066	0.020	0.049	0.098	0.013	0.033	0.072	0.037	0.073	0.124
A6	0.010	0.022	0.047	0.007	0.020	0.046	0.003	0.009	0.024	0.024	0.053	0.095	0.014	0.032	0.067	0.014	0.032	0.065	0.013	0.029	0.059
A7	0.081	0.136	0.221	0.043	0.095	0.179	0.032	0.071	0.132	0.082	0.117	0.168	0.108	0.151	0.218	0.047	0.090	0.152	0.019	0.042	0.085
B1	0.009	0.023	0.052	0.007	0.020	0.047	0.055	0.078	0.109	0.041	0.092	0.171	0.036	0.083	0.164	0.025	0.062	0.131	0.102	0.153	0.226
B2	0.043	0.094	0.176	0.038	0.087	0.169	0.022	0.055	0.111	0.090	0.129	0.182	0.021	0.045	0.091	0.014	0.033	0.069	0.011	0.028	0.061
B3	0.012	0.029	0.062	0.049	0.077	0.122	0.058	0.086	0.125	0.040	0.087	0.159	0.066	0.116	0.196	0.021	0.052	0.109	0.034	0.068	0.128
B4	0.030	0.062	0.106	0.045	0.067	0.104	0.004	0.014	0.033	0.056	0.100	0.162	0.067	0.113	0.178	0.096	0.135	0.187	0.015	0.039	0.081
B5	0.017	0.037	0.077	0.010	0.029	0.067	0.007	0.018	0.044	0.120	0.168	0.237	0.061	0.123	0.215	0.031	0.073	0.144	0.129	0.179	0.244
B6	0.039	0.089	0.166	0.065	0.110	0.183	0.033	0.073	0.134	0.062	0.094	0.141	0.037	0.070	0.117	0.012	0.026	0.053	0.009	0.007	0.017
B7	0.076	0.112	0.164	0.074	0.104	0.152	0.045	0.074	0.115	0.103	0.157	0.246	0.049	0.103	0.191	0.065	0.111	0.184	0.054	0.038	0.079
C1	0.024	0.055	0.112	0.060	0.103	0.172	0.040	0.074	0.126	0.010	0.022	0.047	0.007	0.020	0.046	0.003	0.009	0.024	0.024	0.053	0.095
C2	0.141	0.184	0.229	0.020	0.045	0.089	0.026	0.058	0.102	0.081	0.136	0.221	0.043	0.095	0.179	0.032	0.071	0.132	0.082	0.117	0.168
C3	0.045	0.095	0.173	0.036	0.077	0.147	0.010	0.030	0.071	0.009	0.023	0.052	0.007	0.020	0.047	0.055	0.078	0.109	0.041	0.092	0.171
C4	0.103	0.157	0.246	0.049	0.103	0.191	0.065	0.111	0.184	0.002	0.008	0.023	0.028	0.062	0.112	0.058	0.114	0.200	0.017	0.037	0.077
D1	0.011	0.024	0.049	0.044	0.080	0.133	0.062	0.094	0.141	0.037	0.070	0.117	0.003	0.010	0.025	0.017	0.037	0.072	0.039	0.089	0.166
D2	0.073	0.120	0.197	0.033	0.079	0.165	0.103	0.157	0.246	0.049	0.103	0.191	0.006	0.016	0.032	0.013	0.029	0.059	0.076	0.112	0.164
D3	0.015	0.033	0.066	0.020	0.049	0.098	0.013	0.033	0.072	0.037	0.073	0.124	0.013	0.025	0.046	0.018	0.040	0.082	0.024	0.055	0.112

For this purpose, the sum of the elements of each row (Di) and the sum of the elements of each column (Ri) was calculated from the fuzzy matrix. The sum of the elements of each row (D) for each factor indicates the influence of that factor on other factors. The sum of column elements (R) for each factor indicates that factor's degree of influence on other system factors. Then the D+R and D-R values were calculated and defuzzied. Factor ranking results and final ranking of components were shown in Table 6 and Table 7 respectively.

8. Discussion and Conclusion

The use of blockchain technology in any company and industries, including Iran's automobile industry, like any other technology, needs to identify the obstacles and challenges to its progress so that by solving them, it is possible to create the basic and appropriate platforms for its implementation. The rush to apply this technology in all industries and organizations, especially the automobile industry, regardless of the obstacles ahead, and knowing them exactly and not trying to remove these obstacles, besides leading to spending large amounts of money, will not bring the expected results. Therefore, the first step is to identify the obstacles to using this technology and try to solve them so that after removing them, this technology can be used properly, and the automobile industry can benefit from its significant advantages and benefits.

This research showed that organizations and industries, especially the automobile industry, should first believe that this technology can play a significant role in improving their performance. For this belief to form in them, it is necessary for the knowledge body of these industries to transfer what they have learned about this technology to their managerial and executive bodies and show them practical examples of using it and its role in improving the performance of the organization. Since the application of this technology creates significant changes in the processes, structures, and in general, in the set of activities of the organization, usually, organizations deal with the issue with a defensive approach, and resistance to change will act as a critical obstacle to using this technology. On the other hand, because this technology is based on information technology and needs to interact with other existing software of organizations, such as organizational resource management software, financial, production, purchasing, so on, the lack of knowledge about how these technologies interact and communicate with other existing software of the organization is also a major obstacle in its application. Based on their organizational structure, the organization's employees are engaged in the organization's current activities, and there are often no experts who have the role and task of identifying interdisciplinary technologies such as blockchain in organizations. In other words, they are more involved in their executive work in organizations. On the other hand, due to the newness of this technology and its lack of significant appearance in the set of activities that can be seen, it has led to the fact that organizations consider the cost of using it to be high and do not find a desire to use it. These are known as intra-organizational obstacles to applying blockchain technology in Iran's automobile industry. Also, this research showed that this category of obstacles is considered the most important and priority obstacle. In other words, even the industries have not ensured the believability of its effect on the chain's performance. If senior managers do not seriously support its application, it will be impossible to implement it in Iran's Automobile Industry.

Smart contracts are one of the most significant achievements of using blockchain technology in the supply

Table 6. Factor ranking results

	D	*R*	*D+R*	*D-R*	*W*	*Wj*	*Rank*
A1	1.342	1.221	2.255	0.180	2.262	0.057	10
A2	0.532	1.348	1.927	-0.994	2.168	0.055	11
A3	1.648	1.866	3.732	0.033	3.732	0.094	1
A4	1.265	1.652	2.825	-0.318	2.843	0.072	3
A5	0.861	1.344	2.274	-0.709	2.382	0.060	7
A6	0.645	1.333	1.738	-0.622	1.846	0.047	14
A7	1.823	1.247	2.900	0.655	2.973	0.075	2
B1	0.722	1.336	1.808	-0.598	1.905	0.048	13
B2	1.663	0.645	2.120	1.015	2.350	0.059	8
B3	0.777	0.741	1.481	-0.035	1.481	0.037	18
B4	0.599	1.711	2.279	-1.097	2.529	0.064	5
B5	0.784	0.433	1.345	0.551	1.453	0.037	18
B6	1.665	0.459	2.005	1.308	2.394	0.060	7
B7	0.899	0.719	1.638	0.225	1.653	0.042	16
C1	1.233	1.389	2.595	-0.227	2.605	0.066	4
C2	1.303	1.308	2.432	-0.160	2.437	0.061	6
C3	1.568	0.917	2.511	0.794	2.633	0.066	4
D1	1.237	1.651	2.825	-0.318	2.843	0.058	9
D2	0.796	1.312	1.808	-0.598	1.904	0.039	17
D3	1.775	0.431	2.005	1.308	2.394	0.049	12
D4	0.532	1.505	1.927	-0.994	2.168	0.044	15

Table 7. Final ranking of components

Main component	*Sub-component*	*Symbol*	*Rank*
Technical and technological	Not having the necessary security against cyber attacks...	A3	1
Technical and technological	Data saving problem...	A7	2
Technical and technological	Lack of standardization in different blockchain systems and...	A4	3
Interorganizational Interorganizational	Lack of necessary and specific laws for legal support of...	C1 C3	4
within the organization	There is no specific law for tax and insurance in the context of this...	B4	5
Interorganizational	Creating a fundamental and fundamental change in the current structures and processes...	C2	6
Technical and technological	The absence of a clear law for financial and cybercrimes in the context of...	A5	7
within the organization	Lack of RFID and IoT infrastructure...	B2	8
Interorganizational	Lack of proper knowledge and understanding of blockchain technology and its impact on...	D1	9
Technical and technological	Lack of data security and privacy...	A1	10
Technical and technological	Slow processing and transactions and lack of scalability...	A2	11
Terms and Conditions	Lack of suitable financial resources of supply and supply chain partners...	D3	12
within the organization	Lack of proper estimation of the cost of implementing blockchain technology...	B1	13
Technical and technological	It is not possible to include all transactional aspects in the contracts....	A6	14
Terms and Conditions	Confusion about how to combine blockchain technology with...	D4	15
within the organization	Lack of access to all supply chain partners and organizations...	B7	16
Terms and Conditions	Lack of commitment and desire of senior managers to improve and make changes...	D2	17
within the organization within the organization	Unbelievability of the need to use blockchain technology...	B3 B5	18

chain; until binding and specific laws for legal support of smart contracts are compiled and approved, it is impossible to use this technology in the real industrial environment. The absence of a clear law for financial and cyber crimes in the context of blockchain technology, as well as the absence of a clear law on insurance and taxes related to transactions in the context of this technology, are among other legal obstacles that are included in the category of legal and regulatory obstacles.

Although blockchain technology claims data security through the lack of concentration in the database, the risk of fraud continues to plague this technology, and there is still no solution. Respecting the privacy of organizations and doubting the theft and manipulation of information, lack of access to the required IT technology and suitable IOT infrastructure and excessive transaction processing time if the entire chain is involved in the blockchain technology platform are among the obstacles that fall into the category of technical and technological obstacles to the use of blockchain technology in the automobile industry.

Due to the extent of Iran's automobile industry, this industry is in touch with many diverse organizations and industries, many of which are new and do not have significant financial and structural facilities. It is also impossible to use electronic equipment to exchange information, use information technology, develop transparency and visibility, the flow of information, and share it with suppliers. In some cases, the small number of suppliers in the specific fields required by the automobile industry leads to the lack of access to organizations that can use blockchain technology. In some cases, the amount of parts and materials needed from suppliers is insufficient for the defense industry to be considered their key customers and to form long-term relationships based on trust and cooperative interaction. In this situation, it cannot be expected that blockchain technology will be a crucial necessity for the suppliers of the chain, and they will be forced to carry out their interactions on its platform. The other most significant barriers include differences in how chain partners approach information sharing, a lack of proper understanding of blockchain technology among network members, a lack of trust in information disclosure among network members, a lack of understanding of how smart contracts function, and financial interactions in the chain.

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Authors' contributions
MZJ: Study design, acquisition of data, interpretation of the results, statistical analysis, supervision, drafting and revision of manuscript; MF: Study design, acquisition of data, interpretation of the results, statistical analysis; HHNM: Acquisition of data, interpretation of the results; MSRZ: acquisition of data, interpretation of the results.

Conflict of interest
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