



Paper Type: Research Paper



Identifying Key Indicators for Developing the Use of Blockchain Technology in Financial Systems

Yousef Babazadeh¹, Nasser Fegh-hi Farahmand^{1,*} , Mohammad Pasebani¹, Yaguoob Alavi Matin¹

¹Department of Management, Tabriz Branch, Islamic Azad University, Tabriz, Iran; y.babazadeh@chmail.ir; farahmand@iaut.ac.ir; pasebani@iaut.ac.ir; alavimatin@iaut.ac.ir.

Citation:



Babazadeh, Y., Fegh-hi Farahmand, N., Pasebani, M., & Alavi Matin, Y. (2022). Identifying key indicators for developing the use of blockchain technology in financial systems. *International journal of research in industrial engineering*, 11(3), 244-257.

Received: 28/02/2022

Reviewed: 22/03/2022

Revised: 12/06/2022


Accepted: 19/06/2022

Abstract

Internet-based financial systems and communications have entered a new phase with the advent of blockchain technology and cryptocurrencies. The new economic system with its transparency, privacy, and peer-to-peer networking, has attracted the attention of economists. The advent of cryptocurrencies has brought new blood into the veins of blockchain technology and accelerated its growth. After a decade of cryptocurrency lifetime, it is necessary to identify key components to develop the use of this technology. The aim of this study is to identify the indicators needed to develop the use of blockchain technology and cryptocurrencies in financial systems. A total of six indicator groups were identified including technology, legislation, cybersecurity, regulatory methods, public acceptance, and investment. For this purpose, the three-round Delphi study is used to elicit expert opinions. Calculation of Kendall's W coefficient shows a high degree of concordance of experts' opinions in determining the indicators. The indicators presented in this research can be a helpful guide for governments and economic sections to develop the use of blockchain technology in financial systems.

Keywords: International financial system, Blockchain, Cryptocurrency, Delphi method.

1 | Introduction

 Licensee
International Journal of Research in Industrial Engineering. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0>).

Globalization is commonly defined as the expansion and continuity of the economy, communications, and technology around the world. Globalization over time, with its impact on the industrial, social, and economic areas, has led to fundamental changes in financial systems.

Also, technological advances in computer science and communications have accelerated changes in financial systems [1]. With the development of Internet-related technologies, organizations are adopting e-business and e-commerce technologies to increase productivity and respond more quickly to the needs of their customers [2]. In the field of financial systems and e-commerce, new platforms have emerged that are able to provide products and services with high speed and efficiency [3].

 Corresponding Author: farahmand@iaut.ac.ir

 <http://dx.doi.org/10.22105/riej.2022.331964.1300>

The advent of blockchain technology has made it possible to securely transfer unique value samples (such as money, assets, and contracts) over the Internet without the intermediary approving or reviewing the process [4]. Blockchain technology and cryptocurrencies are expected to quickly become an important aspect of the global financial market and revolutionize financial communications [5]. Blockchain technology and cryptocurrencies in the area of economics have created new challenges in both the field of financial systems and new international currencies [6]. Blockchain technology has received the approval of many technology experts in the financial industry due to its benefits and practical capabilities in the financial system. Several major banks in Europe and the United States have begun testing blockchain technology in their internal systems. Blockchain-based financial technology in banking and payment systems offers new alternative solutions [7]-[9]. Also, over the past decade, the tendency of people and companies to use cryptocurrencies and their growing popularity has led to the increasing importance of cryptocurrencies as an alternative to traditional Fiat currencies [10], [11]. The aim of this study is to identify the indicators needed to develop the use of blockchain technology and cryptocurrencies in financial systems. In fact, this research seeks to answer the question of what actions are needed to be taken to develop the use of blockchain and cryptocurrency in financial systems. This paper is done by eliciting the insights of a group of experts using a three-round Delphi study. The statistical population of the research is comprised of experts in finance, IT, and academic members.

2 | Literature Review

2.1 | Blockchain

Over the past decade, Bitcoin's success as the first cryptocurrency has attracted the attention and interest of economists in blockchain technology. Blockchain is a kind of distributed ledger. The distributed ledger has a broader concept of blockchain technology, and blockchain has a broader concept of cryptocurrency and even financial issues [12]. Blockchain technology provides a distributed shared database and a consensus system. Blockchain, as a distributed shared database, only allows new data to be placed on blocks without updating or deleting existing data. This is to prevent manipulation and review. Blockchain enables information sharing and data transfer on a large network without relying on an integrated central system [13]. Consensus systems are a key element of any blockchain system to reach a consensus on data sharing and distribution of transactions across nodes [14].

The blockchain's integration, flexibility, and transparency features make it an attractive option for companies to revolutionize their business processes and use it to solve the challenges ahead [15]. With development and integration of modern technologies such as business process management, artificial intelligence, cloud computing and the Internet of Things (IoT) with blockchain technology, new opportunities are created for various industries [14]. Blockchain-based financial technology (FinTech) banking companies can offer services such as peer-to-peer lending, capital management and international financial remittances. Blockchain-based FinTech payment companies cover a wide range of personal, commercial, service and international payments [8], [9].

2.2 | Cryptocurrency

Cryptocurrency is a technology artifact and a financial transaction tool. It is predicted that cryptocurrencies will quickly become an important aspect of the global financial industry. Cryptocurrencies have created a new online payment system that offers new features and facilities. This peer-to-peer system enables direct online payment without being connected to a central financial system or financial institution. These distributed systems operate without the need for the control, monitoring and physical center that is common in conventional financial systems. Divided into very small units and transparency of transactions are the characteristics of the cryptocurrencies [16]. In year 2008, for the first time, Satoshi Nakamoto introduced a digital asset with distributed database called Bitcoin. Bitcoin is the most successful decentralized digital currency as the first cryptocurrency, at present. Many programmers began to create

cryptocurrencies with different features and functions, observing the common success of Leadership, Bitcoin [12], [16], [17].

Palmié et al. [8] reviewed blockchain technology and related FinTech, and analyzed their impact on financial systems. The impact of blockchain on banking, payment systems, crowdfunding, insurance technology (InsurTech), regulatory technology (RegTech) and wealth management has been expressed. They concluded that new innovations have a disruptive effect on traditional and established financial systems, and that disruptive innovation ecosystems need more attention. Nawari and Ravindran [18] believe that the implementation of decentralized technology in any industry will make major changes. The results show that systems based on blockchain technology can be effective and promising due to their flexibility, powerful security, identity features, ease of programming and smart contract technology in the development of security and performance of automation systems. Qiu et al. [9] examined the impact of blockchain technology on changing financial systems in the field of international financial exchanges. They compared the strengths and weaknesses of the old and new systems based on SWOT analysis. They concluded that not in the short term, but in the long run, new technologies such as Ripple will revolutionize financial systems.

FinTech is developing rapidly based on cryptocurrency. Cryptocurrency will have a huge impact on e-business tools, e-commerce and financial systems [19]. At the following, the literature of the cryptocurrency is investigated from various point of views. Bach et al. [20] investigated the technology growth of distributed systems in the field of consensus algorithms. One of the most important issues in developing a consensus system is scalability. The ability of blockchain networks respond to demands on global scale is one power, increased memory, increased storage, and improved consensus mechanisms. Shanaev et al. [21] investigated the consequences of establishing rules and regulation for cryptocurrencies. They believe that strict laws and increased government control over the cryptocurrency market will reduce the price of cryptocurrencies. Allen et al. [19] examined the important points in the design of cryptocurrency rules and regulations. Making rules by increasing trust can lead to the growth of the cryptocurrency market and the growth of innovation. Guo and Yu [22] identified and analyzed the security risks of blockchain and cryptocurrencies by identifying the real hacker attacks and bugs against cryptocurrency-related platforms. Security risks are classified into six groups of high-level risks, including network attacks, endpoint security, intentional misuse, code vulnerabilities, data protection and human negligence.

Chokor and Alfieri [23] studied the long-term and short-term impacts of regulation in the cryptocurrency market. The purpose of developing regulatory methods is divided into three categories: The first purpose is to counteract risks in order to create financial stability. The second goal is to restrict criminal activities and money laundering transactions. The third goal is to generate revenue for the government by implementing appropriate laws and preventing tax evasion. Yeong et al. [24] examined the level of acceptance of cryptocurrencies among Information Technology (IT) enthusiasts in Malaysia. They identified important drivers that predict people's behavior toward accepting digital currency. Factors of performance expectation, facilitating conditions, social influence, and price value significantly influence a person's acceptance behavior. Büyükaslan and Ecer [25] identified the drivers to invest in blockchain technology and cryptocurrencies. Researchers have done a number of activities to prioritize investment drivers in cryptocurrencies. Strong cryptography has been identified as the most important investment driver.

The literature survey demonstrates that despite numerous and scattered researches on the application of cryptocurrencies in financial systems, there is no comprehensive study in identifying and classifying key indicators based on previous research to develop the use of cryptocurrencies in financial systems. The aim of this study is to pay attention to the current knowledge gap by identifying the necessary indicators to develop the use of cryptocurrencies in financial systems.

3 | Methodology

Given that only a decade has passed since the introduction of cryptocurrencies globally and the novelty of the subject, research in this area is very limited. In the lack of sufficient research and scientific experience, the Delphi study was used to derive specialized insights into identifying the indicators needed to develop the use of blockchain technology in financial systems. In addition to being a predictor of the future, the Delphi method has many applications in qualitative research. In this way, a panel of experts is formed. The basis of this approach is to gather feedback and reach a consensus among the panel participants [26]. Since the participants in the subject are knowledgeable and expert, the ideas collected in this way will be very helpful [27]. Since the Delphi technique came into existence in the 1950s, it has been widely used in researches. Some of them can be mentioned as business efficiency enhancements [28], project management [29], supply chain futures [30], (IT) [31]-[33].

Delphi studies may be combined with quantitative data collection (index scoring) and the use of quantitative approaches in data analysis to provide a more accurate and realistic analysis. Triangulation is one of the strategies to increase the validity of qualitative research that can improve the validity of the research which is used in this research [31]. There is no clear agreement on the number of an effective Delphi study rounds, and it should also be noted that adding more steps may result in lower response rates [34]. There are different methods for analyzing the data, but in the Delphi technique, descriptive statistics are usually used to check the data obtained at each round [31], [35]. More complicated techniques such as Kendall's W, used in this study, provide a tool for investigating changes between Delphi rounds [30]. The Delphi technique uses descriptive statistics to evaluate and compare expert responses. The Likert scale was used to quantify responses and the Kendall's W coefficient was used to obtain the concordance of responses and to identify the convergence created in the Delphi rounds. In the Kendall's W, $W = 0$ denotes the level of no conformity and $W = 1$ denotes the level of full conformity. There is no general consensus value for W indicating an "acceptable" value of consistency, but it is used as a comparative indicator between successive stages of the Delphi study [31]. This paper utilizes the three-round Delphi method to gain insights of experts on: What parameters develop the use of blockchain technology and cryptocurrencies in financial systems? In this research, two methods of literature survey and semi-structured interview and questionnaire are used to collect data. After defining the research topic, previous documents and researches in the field of research were reviewed and related parameters were extracted. According to the subject and protocol set for the selection of panel members of experts, Delphi panel members were identified and selected using non-probabilistic sampling methods.

The statistical population of this study, or panel of experts, is comprised of financial experts, (IT) specialists, and academic members in Iran, who work in the field of cryptocurrency. Expert panel members were selected by non-probability sampling and a combination of purposive (judgmental) and snowball (chain-referral) sampling methods. In total, 23 experts from the financial experts, IT specialists and academic members were interviewed. The descriptive characteristics of the panel members are described in *Table 1*.

Purposive and snowball sampling method is used in this study. In this method, after identifying or selecting the first group of experts (Purposive), they are used to identify and select the next group (snowball). Interviews begin with the first expert and during the interview they are asked to introduce new experts to the interview. Similarly, other sample units are identified and selected. Interviews continue until the information received is saturated, incremental learning is very low and no new parameters are introduced.

Table 1. Descriptive characteristics of panel members.

Property	Specification	Relative Frequency	Relative Frequency Percentage
Job	Academic member	3	13%
	financial experts	8	35%
	IT specialists	12	52%
Education	B.Sc.	6	26%
	M.Sc.	12	52%
	PH.D	5	22%
Age	20-29	9	39%
	30-39	10	43%
	40-49	4	18%
Work experience	Up to 10 years	5	22%
	10 to 15 years	11	48%
	More than 15 years	7	30%
Gender	Female	3	13%
	Male	20	87%

Round one. The first questionnaire is sent as an open-ended question that acts as a strategy for generating ideas and its purpose is to reveal all issues related to the title under study [36]. Interviews are useful and enlightening when gathering information [37]. After collecting the questionnaires, responses are organized, comments similar to composition, grouping and repetitive and marginal themes are eliminated as short as possible [38]. In the first Delphi round, the results of previous studies and the list of extracted parameters was presented to the panel members. The questionnaire was provided to the experts and a semi-structured interview was conducted with them. The experts were asked to express their views, parameters and factors that are not listed and are important to them.

The questionnaire consists of four parts: first part provides some explanations about the blockchain technology, cryptocurrency and as well as parameters extracted from previous studies. Second part identifies respondent's area of expertise. And third part is an open ended question in which experts are asked to explain parameters that lead to the development of the use of blockchain technology and cryptocurrencies in financial systems. Each respondent was interviewed for more details [37].

After preparing the data, it was coded in two steps to structure the data and organize them. With the identification of codes in the first step (parameters) and pattern codes in the second step (indicators), they were used to create a structured questionnaire as a tool in the second round. The validity of the indicators extracted from the Delphi first round and the related questions were confirmed by a number of experts.

Round two. From the second round onwards, most of the structured questionnaires are used, and similar individuals in the first round are asked to rank each indicator using the Likert scale. Here, cases of agreement and disagreement are identified and a space is created for identifying new ideas, correcting, interpreting, deleting and explaining their strengths and weaknesses [39]. In the second round, a questionnaire consisting of the factors extracted from the Delphi first round was developed and re-sent to the panel members to evaluate the indicators. The questionnaire was structured and similar people were asked in the first round to quantify each indicator using the Likert scale while expressing their opinions about the parameters and indicators. The third section was used to evaluate the indicators using a 5-point Likert scale, in which the "least agreement" is indicated by the number one and the "most agreement" by the number five. Using descriptive statistics, the score of each indicator was calculated and ranked based on the score. Kendall's W concordance coefficient was calculated to determine the degree of consensus of experts.

Round three. At this round, the panel members, taking into account the average scores of the indicators, prioritized them according to their importance. The experts were also asked to state their reasons for disagreement if necessary. Kendall's W concordance coefficient was calculated to determine the degree of consensus of experts.

At this round, through a semi-structured interview method, the research question was asked to determine the parameters that cause the development of the use of blockchain technology and cryptocurrencies in financial systems. Twenty-three experts answered questions. After receiving the answers and reviewing the views of experts, the researchers prepared the data with the information obtained from studying the literature and accompanied by two experts. After preparing the data, it was coded in two steps to structure the data and organize them. In the first step of coding, parameters and in the second step of coding, indicators were extracted. At this round, the validity of the extracted indicators was confirmed by two experts.

Based on the findings, 60 parameters were extracted. The parameters were classified into 6 indicator groups. Factors derived from the first round are listed in *Table 2*.

Table 2. Developing indicator of using blockchain technology and cryptocurrencies in financial systems.

1. Technology Growth
Technology growth of platforms (software and hardware)
Development of Blockchain-based software
Development of innovation in blockchain and cryptocurrency
Installation of cryptocurrency ATMs around the world
Using cryptocurrency POSs in service centers around the world
Creating different cryptocurrency for different purposes
Increasing efficiency and speed in consensus systems
Development of technology in cryptocurrency wallets and exchanges
Development of technology in smart contracts
Production of cryptocurrency high-performance mining device
Increase the speed of transaction network of blockchain (TPS)
Achieving global scalability
Development of ICT infrastructure
2. Legislation (Rule and Regulation)
Enacting international regulation agreed by countries in the field of blockchain and cryptocurrency
National legislation of countries in the field of blockchain and cryptocurrency
Making appropriate regulations by international financial systems
Establishing regulation by the World Bank
Establishing regulation by the International Monetary Fund (IMF)
Establishing regulation by the FATF
Making appropriate rules for international exchanges
Enacting property laws and dispute resolution rules
Enacting tax laws
Making investment rules
3. Development of Cybersecurity
Increasing cybersecurity of blockchain network
Development of proper cybersecurity for cryptocurrencies
Development of cybersecurity in the field of blockchain-based software
Development of cybersecurity in the field of IoT
Increasing cybersecurity of cryptocurrency wallet
Increasing cybersecurity by hardware upgrades
Increasing cybersecurity of exchanges
Development of cybersecurity to prevent infiltration of hackers
Development of cybersecurity to prevent cyber spying

Table 2. Continued.

4. Development of Regulatory Methods
Development of RegTech for blockchain-based software
Achieving proper monitoring technology for cryptocurrencies
Development of surveillance technology to prevent cybercrime
Improvement of monitoring and controlling systems to prevent tax evasion
Improving Know Your Customer (KYC) and identification methods
Development of Anti-Money Laundering (AML) methods
Development of Combating Financing of Terrorism (CFT) methods
Making regulatory frameworks for cryptocurrency transfer
Establishing distributed regulatory
5. Public Acceptance
Increasing public trust in the cryptocurrency and blockchain-based softwares
Increasing desire of people to use cryptocurrency and blockchain-based softwares
Increasing interest of financial systems to use cryptocurrency and blockchain-based FinTech
Increasing interest of governments to use cryptocurrency and blockchain-based softwares
Using in financial systems, banking and payment
Creating and using national stablecoin by governments in domestic financial transactions
Promoting the use of cryptocurrency as a medium of exchange
Public awareness of the advantages of using cryptocurrency and blockchain
Using cryptocurrencies in international trade by merchants and companies
Acceptance of Initial Coin Offering (ICO)
Acceptance and use of cryptocurrency by service centers
6. Increasing Investment
Increasing investment in blockchain technology
Increasing investment in blockchain-based applications
Increasing the total market capitalization of cryptocurrencies
Increasing investment in the cryptocurrency platforms and tools
Increasing the turnover of cryptocurrencies
Increasing the turnover of cryptocurrencies to an appropriate percentage of the turnover of global trade
Public participation in the initial investment of projects by purchasing ICOs
Using national stablecoin to increase total market capitalization

4.2 | Round Two of Delphi

The second round of Delphi consisted of a structured questionnaire and similar people in the first round were asked to quantify each indicator using the Likert scale while expressing their views on the parameters and indicators. In the second round, the panel members agreed to group the parameters and scored the obtained indicators. Ranking results of the indicators are presented in *Table 3*. Expert responses have a concordance degree of 0.27 according to Kendall's W coefficient of concordance ($W = 0.27$).

Table 3. Ranking of extracted indicators in Delphi round two.

Indicators	Mean	Std. Deviation	Ranking
Technology growth	4.56	0.66	1
legislation (Rule and Regulation)	4.47	0.79	2
Development of cybersecurity	4.17	0.93	3
Development of regulatory methods	4.13	0.54	4
Public acceptance	4.08	0.51	5
Increasing investment	3.39	0.89	6

4.3 | Round Three of Delphi

In the third round, another questionnaire was provided to the participating experts in the previous stage. They were requested to prioritize indicators based on importance while viewing the ranking obtained

from round 2 based on average scores given to each indicator. Then, they comment on ranking and prioritize the results. According to the experts' prioritization of six indicators at this round, the highest priority was assigned 6 and the lowest priority 1 to allow calculating the average and Kendall's W coefficient of concordance. At this round, a higher value of Kendall's W coefficient of concordance ($W = 0.54$) was obtained. The results of prioritization of indicators are presented in *Table 4*.

Table 4. Prioritizing the importance of indicators in Delphi round three.

Indicators	Mean	Std. Deviation	Prioritizing
legislation (Rule and Regulation)	5.26	0.61	1
Technology growth	4.78	1.31	2
Development of cybersecurity	3.82	1.37	3
Development of regulatory methods	3.17	1.19	4
Public acceptance	2.26	1.32	5
Increasing investment	1.78	1.12	6

4.4 | Discussion

Blockchain and cryptocurrencies have created a new paradigm in financial systems and financial transactions. These phenomena have opportunities and threats that need to be identified in order to take advantage of those opportunities and repel their threats, tactfully. In the first round of Delphi, by coding the first and second steps and approval by experts, the initial model of the research is obtained. By creating pattern codes in the second step, the researcher can use approaches such as tabular representation (*Table 2*) or visual representation (*Fig. 2*) for analysis. *Fig. 2* shows the model of indicators needed to "develop the use of blockchain technology and cryptocurrencies in financial systems".

This study describes the indicators that need to be realized in order to create the conditions for developing the use of blockchain and cryptocurrencies in financial systems. The six indicators based on pattern codes include technology growth, legislation (Rule and Regulation), development of cybersecurity, development of regulatory methods, public acceptance, and increasing investment.

Technology growth

The growth of the technology is important in both hardware and software platforms [40]. Production of servers and mining devices with higher efficiency, global expansion of cryptocurrency ATMs, and expansion of cryptocurrency Point of Sales (POSs) in stores and service centers are examples of the growth of technology [41]. Also, due to the advantages of cryptocurrencies, various application software is being developed based on them, which will increase the public use of this technology [42]. One of the important parameters in the growth of blockchain technology is the growth of consensus systems in this technology. As a result, the possibility of developing consensus systems with high efficiency and speed and optimal consumption of energy is very important [14]. A panel member stated:

One of the most important issues in the development of cryptocurrencies is the scalability or ability of the network to respond to the demand of the network. The ability of cryptocurrencies to respond to global demand is one of the challenges of this technology for its ambitious goals in the future, which can be solved by the growth of technology and innovation.

Legislation (Rule and Regulation). Leading countries in the field of cryptocurrencies have developed an initial support framework for companies operating in the field of cryptocurrencies [21], [43]. The existence of international law will provide a good framework for national legislation so that governments can provide the right legal framework to support cryptocurrencies [19]. Establish laws to protect private companies, making regulations to provide the documents required for accounting and taxation, developing

identification regulations, and determining the ways to comply with anti-money laundering regulation, are very important in the development of cryptocurrencies [7]. A panel member stated:

To develop the use of cryptocurrencies, it is necessary to compile the required laws in the areas of cryptocurrency mining, taxation, ownership, investment, and exchange. In all economic activities, rules and regulations protect the rights of both parties.

Development of cybersecurity

High security is one of the key features of cryptocurrencies. However, there have been criticisms of security problems in this system by critics that need to be clarified [44]. As now, the cryptocurrencies themselves have not been hacked, but that some ancillary services such as wallets created for support have had security problems [22]. In cryptocurrency systems, there are risks such as stealing private key of cryptocurrency from wallets, hacking exchanges, hacking applications of cryptocurrency and blockchain due to program design flaws, phishing attacks, using cryptocurrencies as payment methods in ransomware, using power of hacked computers to mine cryptocurrencies, and vulnerability of smart contracts due to design flaws [45], [46]. Development and increase of cybersecurity will be possible with the coordinated development of hardwares and softwares [8]. A panel member stated:

The importance of developing appropriate cybersecurity for applications of cryptocurrency in areas such as the IoT, cryptocurrency wallets, cryptocurrency exchanges, and smart contracts to prevent the infiltration of hackers and intelligence services is increasing day by day.

Development of regulatory methods

Developing regulatory methods based on RegTech helps governments and regulatory centers monitor the implementation of rules by companies and individuals [47]. Cryptocurrency is one of the main areas considered in the development of regulatory methods. Like any other tool, cryptocurrencies can have dual function, meaning that in addition to their widespread use in legal activities, they can also be used in criminal activities [23]. Regulatory systems and RegTech companies are trying to develop identification methods and KYC. Another important issue in the development of regulatory methods is tax management and trade monitoring [8]. A panel member stated:

Development of regulatory methods in financial systems and the possibility of monitoring trade and preventing tax evasion, is very effective in increasing government support for cryptocurrencies and the use of cryptocurrency-based financial systems in the world.

Public acceptance

Potential applications and features of cryptocurrency in various fields have created hope for solving various challenges [48]. This gradually increases the desire of people, government and organizations for this technology. The use of cryptocurrency in business processes, property management and FinTech is expanding [8]. Also, cryptocurrencies are proposed as alternatives to Fiat currencies for use in payments and financial transactions [11]. Public awareness of the advantages of cryptocurrencies, increasing the use of cryptocurrencies in peer-to-peer payments, and acceptance of cryptocurrencies by service and shopping centers will build public acceptance [24]. Establishing trust in online relationships is essential [49]. By achieving an appropriate percentage of trust and acceptance in the global level, we can expect this technology to gain an appropriate percentage of global turnover [19]. A panel member stated:

Proper understanding of investors and users about the uncertainty of financial asset markets and cryptocurrencies, and the future value of the cryptocurrency market can be effective in controlling fear and uncertainty and increasing their trust.

Increasing investment

Policies adopted on investment and the use of cryptocurrency vary across countries. The developed countries support private companies and government organizations to invest in cryptocurrency market, platforms and applications in order to take advantage of opportunities [8], [50]. One of the most interesting and challenging phenomena created by cryptocurrency is the ICO. Entrepreneurs and development teams use ICOs to raise capital without applying the usual business rules [51]. Increasing total market capitalization of cryptocurrencies will expand the use of cryptocurrency in international financial exchanges, as well as have a direct impact on the development and increase of investment in this technology [52]. A panel member stated:

- I. Sustainable investment in research and development of any new technology, especially cryptocurrencies, is of particular importance. Also, increasing the total capital of the cryptocurrency market will have a direct impact on the development of investment in this field.
- II. In the second round, the developing indicators of the use of blockchain technology and cryptocurrencies in financial systems were ranked.
- III. In the third round, the experts have arranged the importance of the indicators according to the results of the second round. *Table 5* shows the comparison of rankings based on the average score of round 2 and prioritization based on importance score in round 3. The results in this table show the high consensus in the opinions of experts.

Table 5. Comparison of the indicators group rank based on second and third round of Delphi.

Round 3	Rank	Round 2	
Prioritize Indicators	Mean	Mean	Ranking Indicators (Likert Points)
legislation (Rule and Regulation)	5.26	Top	4.56
Technology growth	4.78		4.47
Development of cybersecurity	3.82		4.17
Development of regulatory methods	3.17		4.13
Public acceptance	2.26		4.08
Increasing investment	1.78	Down	3.39

The difference between the two rounds is the "technology growth" and "legislation" indicators. In the second round, the "technology growth" indicator has the highest agreement among experts as the first indicator. This shows that there is the most consensus on "technology growth" or, in other words, on "necessity of the growth of blockchain technology and cryptocurrencies to develop their use in financial systems ". The "legislation" indicator replaces the "technology growth" indicator in the third round and is the first priority in the third round. At present, during this period of blockchain and cryptocurrency development, the importance of "legislation" is the first priority, which is logical. Because any technology requires rules and appropriate legal infrastructure for further development. After a period of growth in technology and limited use in the world, Blockchain needs legislation to continue its growth process. During this period of development of blockchain and cryptocurrencies, which has been met with initial acceptance in countries, the need for "legislation" has become more important. This is a continuous process. With the growth of technology, the related rules will gradually be completed, and the growth process in the growth cycle of blockchain technology will continue.

5 | Conclusion

This article provides a framework for "indicators needed to develop the use of blockchain technology and cryptocurrencies in financial systems" and provides an understanding by extracting insights of the panel of experts through the use of Delphi study. Given limited literature in this field, this study states parameters needed to develop the use of blockchain technology and cryptocurrencies, also examines the priority of their importance. The indicators for expanding the use of cryptocurrencies and blockchain in international financial exchanges have been expressed in order to effectively use advantages of this new technology. The

main indicators include technology growth, legislation, development of cybersecurity, development of regulatory methods, public acceptance, and increasing investment. The indicators are presented in Fig. 1.

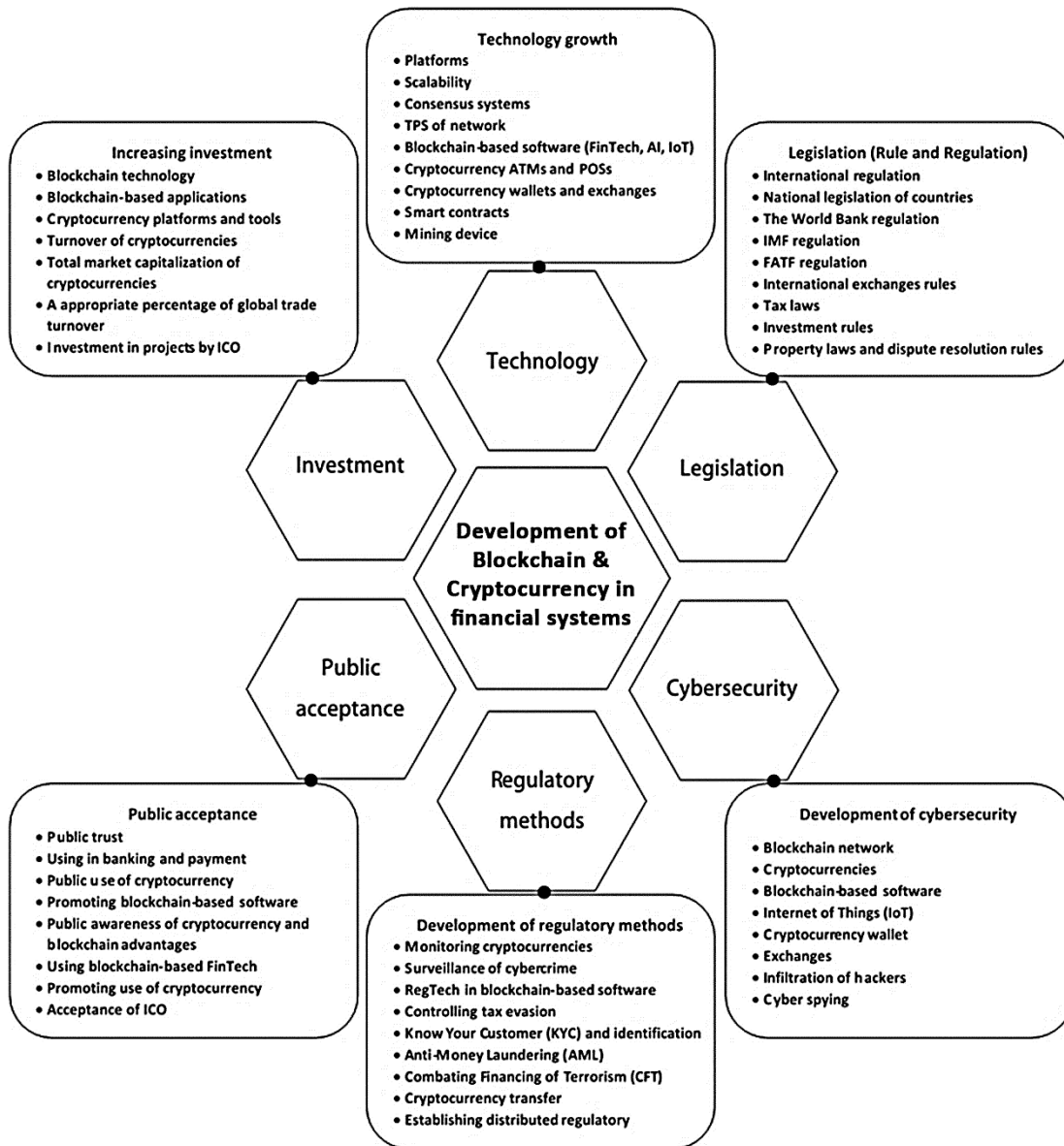


Fig. 1. The indicators needed to develop the use of blockchain and cryptocurrencies in financial systems.

The existence of international and national rules and regulations in the field of blockchain and cryptocurrencies in order to create formal and legal frameworks for the development and action of financial systems is an undeniable requirement. Technology growth in hardware/software platform has an important impact on the stability, proper performance, efficiency and energy consumption of blockchain systems. The development of blockchain technology in the field of consensus system, scalability and support for the number of Transactions per Second (TPS) is great importance in the global application of this technology.

In addition to legislation, another important parameter in technology development and building public trust is appropriate cybersecurity. Cybersecurity is an important component of online financial systems. Legislation and cybersecurity require development of appropriate regulatory methods to monitor the implementation of blockchain and cryptocurrencies regulations. Regulatory systems are trying to establish customer monitoring and identification systems in the field of blockchain technology. It should be noted that the development of appropriate regulatory methods in the field of money laundering,

terrorist financing, tax collection and trade monitoring is very important for governments and will have important effects on the development of this technology in the future. Awareness of people and organizations with the advantages of blockchain technology and cryptocurrencies, and promoting the use of cryptocurrencies in payment and financial systems will gradually build trust and public acceptance. With increasing public acceptance and the use of technology by the people, governments and organizations, investment in blockchain technology will also be increased.

It should be noted that due to face-to-face interview we were geographically limited to utilize more experts' opinions. Maybe, the indicators and related elements of each indicator are changed when more experts are used in the Delphi study.

In future research, each of the obtained indicators, including technology growth, legislation, development of cybersecurity, development of regulatory methods, public acceptance, and increasing investment, should be investigated to determine the technical and specialized dimensions and their development models in financial systems should be presented. Using the expertise of different countries in future research, the comprehensiveness of the results in identifying the indicators affecting the expansion of blockchain use in financial systems will increase. Research on the requirements for developing trade relations with other countries based on blockchain technology will help to develop the use of e-commerce in international trade.

References

- [1] Savrul, M., Incekara, A., & Sener, S. (2014). The potential of e-commerce for SMEs in a globalizing business environment. *Procedia-social and behavioral sciences*, 150, 35-45. <https://doi.org/10.1016/j.sbspro.2014.09.005>
- [2] Popa, S., Soto-Acosta, P., & Perez-Gonzalez, D. (2018). An investigation of the effect of electronic business on financial performance of Spanish manufacturing SMEs. *Technological forecasting and social change*, 136, 355-362. <https://doi.org/10.1016/j.techfore.2016.08.012>
- [3] Catalini, C. (2018). Blockchain technology and cryptocurrencies: Implications for the digital economy, cybersecurity, and government. *Georgetown journal of international affairs*, 19, 36-42. <https://www.jstor.org/stable/26567525>
- [4] Swan, M. (2018). Blockchain for business: Next-generation enterprise artificial intelligence systems. In *Advances in computers* (Vol. 111, pp. 121-162). Elsevier. <https://doi.org/10.1016/bs.adcom.2018.03.013>
- [5] Lee, J. Y. (2019). A decentralized token economy: how blockchain and cryptocurrency can revolutionize business. *Business horizons*, 62(6), 773-784. <https://doi.org/10.1016/j.bushor.2019.08.003>
- [6] Zachariadis, M., Hileman, G., & Scott, S. V. (2019). Governance and control in distributed ledgers: understanding the challenges facing blockchain technology in financial services. *Information and organization*, 29(2), 105-117. <https://doi.org/10.1016/j.infoandorg.2019.03.001>
- [7] Morse, E. A. (2018). From Rai stones to Blockchains: the transformation of payments. *Computer law & security review*, 34(4), 946-953. <https://doi.org/10.1016/j.clsr.2018.05.035>
- [8] Palmié, M., Wincent, J., Parida, V., & Caglar, U. (2020). The evolution of the financial technology ecosystem: an introduction and agenda for future research on disruptive innovations in ecosystems. *Technological forecasting and social change*, 151, 119779. <https://doi.org/10.1016/j.techfore.2019.119779>
- [9] Qiu, T., Zhang, R., & Gao, Y. (2019). Ripple vs. SWIFT: transforming cross border remittance using blockchain technology. *Procedia computer science*, 147, 428-434. <https://doi.org/10.1016/j.procs.2019.01.260>
- [10] Dibrova, A. (2016). Virtual currency: new step in monetary development. *Procedia-social and behavioral sciences*, 229, 42-49. <https://doi.org/10.1016/j.sbspro.2016.07.112>
- [11] Chu, J., Chan, S., & Zhang, Y. (2020). High frequency momentum trading with cryptocurrencies. *Research in international business and finance*, 52, 101176. <https://doi.org/10.1016/j.ribaf.2019.101176>
- [12] Best, J. (2018). *Breaking digital gridlock+ website: improving your bank's digital future by making technology changes now*. John Wiley & Sons.

- [13] Xu, X., Lu, Q., Liu, Y., Zhu, L., Yao, H., & Vasilakos, A. V. (2019). Designing blockchain-based applications a case study for imported product traceability. *Future generation computer systems*, 92, 399-406. <https://doi.org/10.1016/j.future.2018.10.010>
- [14] Viriyasitavat, W., & Hoonsopon, D. (2019). Blockchain characteristics and consensus in modern business processes. *Journal of industrial information integration*, 13, 32-39. <https://doi.org/10.1016/j.jii.2018.07.004>
- [15] Cao, Y. (2019). Energy Internet blockchain technology. In *The energy internet* (pp. 45-64). Woodhead Publishing. <https://doi.org/10.1016/B978-0-08-1022207-8.00003-5>
- [16] Corbet, S., Lucey, B., Urquhart, A., & Yarovaya, L. (2019). Cryptocurrencies as a financial asset: a systematic analysis. *International review of financial analysis*, 62, 182-199. <https://doi.org/10.1016/j.irfa.2018.09.003>
- [17] Ammous, S. (2018). Can cryptocurrencies fulfil the functions of money? *The quarterly review of economics and finance*, 70, 38-51. <https://doi.org/10.1016/j.qref.2018.05.010>
- [18] Nawari, N. O., & Ravindran, S. (2019). Blockchain and the built environment: potentials and limitations. *Journal of building engineering*, 25, 100832. <https://doi.org/10.1016/j.job.2019.100832>
- [19] Allen, F., Gu, X., & Jagtiani, J. (2022). Fintech, cryptocurrencies, and CBDC: financial structural transformation in China. *Journal of international money and finance*, 124, 102625. <https://doi.org/10.1016/j.jimonfin.2022.102625>
- [20] Bach, L. M., Mihaljevic, B., & Zagar, M. (2018). Comparative analysis of blockchain consensus algorithms. *2018 41st international convention on information and communication technology, electronics and microelectronics (MIPRO)* (pp. 1545-1550). IEEE. DOI: [10.23919/MIPRO.2018.8400278](https://doi.org/10.23919/MIPRO.2018.8400278)
- [21] Shanaev, S., Sharma, S., Ghimire, B., & Shuraeva, A. (2020). Taming the blockchain beast? regulatory implications for the cryptocurrency Market. *Research in international business and finance*, 51, 101080. <https://doi.org/10.1016/j.ribaf.2019.101080>
- [22] Guo, H., & Yu, X. (2022). A survey on blockchain technology and its security. *Blockchain: research and applications*, 3(2), 100067. <https://doi.org/10.1016/j.bcra.2022.100067>
- [23] Chokor, A., & Alfieri, E. (2021). Long and short-term impacts of regulation in the cryptocurrency market. *The quarterly review of economics and finance*, 81, 157-173. <https://doi.org/10.1016/j.qref.2021.05.005>
- [24] Yeong, Y. C., Kalid, K. S., Savita, K. S., Ahmad, M. N., & Zaffar, M. (2022). Sustainable cryptocurrency adoption assessment among IT enthusiasts and cryptocurrency social communities. *Sustainable energy technologies and assessments*, 52, 102085. <https://doi.org/10.1016/j.seta.2022.102085>
- [25] Böyükaslan, A., & Ecer, F. (2021). Determination of drivers for investing in cryptocurrencies through a fuzzy full consistency method-Bonferroni (FUCOM-F'B) framework. *Technology in society*, 67, 101745. <https://doi.org/10.1016/j.techsoc.2021.101745>
- [26] Holotiuk, F., Pisani, F., & Moormann, J. (2019). Radicalness of blockchain: an assessment based on its impact on the payments industry. *Technology analysis & strategic management*, 31(8), 915-928. <https://doi.org/10.1080/09537325.2019.1574341>
- [27] Nikkhah, M., Nikkhah, A., & Afsahi, A. (2017). Evaluating the implementation of strategies in plants using balanced scorecard (BSC): a case study. *International journal of research in industrial engineering*, 6(1), 39-50.
- [28] Harer, J. B. (2003). Performance measures of quality for academic libraries implementing continuous improvement projects: a Delphi study. In *Advances in library administration and organization* (Vol. 20, pp. 229-296). Emerald Group Publishing Limited. [https://doi.org/10.1016/S0732-0671\(02\)20011-5](https://doi.org/10.1016/S0732-0671(02)20011-5)
- [29] Brill, J. M., Bishop, M. J., & Walker, A. E. (2006). The competencies and characteristics required of an effective project manager: a web-based Delphi study. *Educational technology research and development*, 54(2), 115-140. <https://doi.org/10.1007/s11423-006-8251-y>
- [30] Melnyk, S. A., Lummus, R. R., Vokurka, R. J., Burns, L. J., & Sandor, J. (2009). Mapping the future of supply chain management: a Delphi study. *International journal of production research*, 47(16), 4629-4653. <https://doi.org/10.1080/00207540802014700>
- [31] White, G. R. (2017). Future applications of blockchain in business and management: a Delphi study. *Strategic change*, 26(5), 439-451. <https://doi.org/10.1002/jsc.2144>

- [32] Hong, S. G., Trimi, S., Kim, D. W., & Hyun, J. H. (2015). A Delphi study of factors hindering web accessibility for persons with disabilities. *Journal of computer information systems*, 55(4), 28-34. <https://doi.org/10.1080/08874417.2015.11645784>
- [33] Huang, S. J., Wu, M. S., & Chen, L. W. (2013). Critical success factors in aligning IT and business objectives: a Delphi study. *Total quality management & business excellence*, 24(9-10), 1219-1240. <https://doi.org/10.1080/14783363.2011.637785>
- [34] Gary, J. E., & Heiko, A. (2015). The future of foresight professionals: results from a global Delphi study. *Futures*, 71, 132-145. <https://doi.org/10.1016/j.futures.2015.03.005>
- [35] Watson, T. (2008). Public relations research priorities: a Delphi study. *Journal of communication management*, 12(2), 104-123. <https://doi.org/10.1108/13632540810881938>
- [36] Windle, P. E. (2004). Delphi technique: assessing component needs. *Journal of perianesthesia nursing*, 19(1), 46-47. <https://doi.org/10.1016/j.jopan.2003.11.005>
- [37] Denscombe, M. (2017). *The good research guide: for small-scale social research projects*. McGraw-Hill Education (UK).
- [38] Farley, C. L. (2005). Midwifery's research heritage: a Delphi survey of midwife scholars. *Journal of midwifery & women's health*, 50(2), 122-128. <https://doi.org/10.1016/j.jmwh.2004.11.004>
- [39] Landeta, J. (2006). Current validity of the Delphi method in social sciences. *Technological forecasting and social change*, 73(5), 467-482. <https://doi.org/10.1016/j.techfore.2005.09.002>
- [40] Nasir, M. H., Arshad, J., Khan, M. M., Fatima, M., Salah, K., & Jayaraman, R. (2022). Scalable blockchains—a systematic review. *Future generation computer systems*, 126, 136-162. <https://doi.org/10.1016/j.future.2021.07.035>
- [41] Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). A systematic literature review of blockchain-based applications: current status, classification and open issues. *Telematics and informatics*, 36, 55-81. <https://doi.org/10.1016/j.tele.2018.11.006>
- [42] Ashoor, A., & Sandhu, K. (2021). Framework and model for cryptocurrency innovation and its impact on economic transformation. In *Research anthology on blockchain technology in business, healthcare, education, and government* (pp. 217-229). IGI Global. DOI: 10.4018/978-1-7998-5351-0.ch012
- [43] Borri, N., & Shakhnov, K. (2020). Regulation spillovers across cryptocurrency markets. *Finance research letters*, 36, 101333. <https://doi.org/10.1016/j.frl.2019.101333>
- [44] Taylor, P. J., Dargahi, T., Dehghantanha, A., Parizi, R. M., & Choo, K. K. R. (2020). A systematic literature review of blockchain cyber security. *Digital communications and networks*, 6(2), 147-156. <https://doi.org/10.1016/j.dcan.2019.01.005>
- [45] Li, X., Jiang, P., Chen, T., Luo, X., & Wen, Q. (2020). A survey on the security of blockchain systems. *Future generation computer systems*, 107, 841-853. <https://doi.org/10.1016/j.future.2017.08.020>
- [46] Schlatt, V., Guggenberger, T., Schmid, J., & Urbach, N. (2022). Attacking the trust machine: developing an information systems research agenda for blockchain cybersecurity. *International journal of information management*, 102470. <https://doi.org/10.1016/j.ijinfomgt.2022.102470>
- [47] Grobys, K., Dufitinema, J., Sapkota, N., & Kolari, J. W. (2022). What's the expected loss when Bitcoin is under cyberattack? a fractal process analysis. *Journal of international financial markets, institutions and money*, 77, 101534. <https://doi.org/10.1016/j.intfin.2022.101534>
- [48] Koroma, J., Rongting, Z., Muhideen, S., Akintunde, T. Y., Amosun, T. S., Dauda, S. J., & Sawaneh, I. A. (2022). Assessing citizens' behavior towards blockchain cryptocurrency adoption in the Mano River Union States: mediation, moderation role of trust and ethical issues. *Technology in society*, 68, 101885. <https://doi.org/10.1016/j.techsoc.2022.101885>
- [49] Stouthuysen, K. (2020). A 2020 perspective on “the building of online trust in e-business relationships”. *Electronic commerce research and applications*, 40, 100929. <https://doi.org/10.1016/j.elerap.2020.100929>
- [50] Yan, L., Mirza, N., & Umar, M. (2022). The cryptocurrency uncertainties and investment transitions: evidence from high and low carbon energy funds in China. *Technological forecasting and social change*, 175, 121326. <https://doi.org/10.1016/j.techfore.2021.121326>
- [51] Adhami, S., Giudici, G., & Martinazzi, S. (2018). Why do businesses go crypto? an empirical analysis of initial coin offerings. *Journal of economics and business*, 100, 64-75. <https://doi.org/10.1016/j.jeconbus.2018.04.001>
- [52] De Andrés, P., Arroyo, D., Correia, R., & Rezola, A. (2022). Challenges of the market for initial coin offerings. *International review of financial analysis*, 79, 101966. <https://doi.org/10.1016/j.irfa.2021.101966>