Identifying the Influential Components in the Development Process of Urban Services based on Blockchain Technology

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Abstract:- Purpose: This research aims to identify the influential components in the development process of urban services based on blockchain technology. The present research is applied in terms of purpose and qualitative in terms of method.

Design/methodology/approach: The statistical population of this research includes all managers and urban management experts who have at least a master's degree. To better comprehend the issue of the development of urban services and also to identify its dimensions and components, in-depth and exploratory interviews via the Delphi method were done with 15 key informants of the Municipality and Science and Technology Park of Tehran and academic experts. To guarantee the validity of the qualitative part of the research, valuable opinions of professors familiar with this field and academic experts were used who were knowledgeable and knowledgeable in this field.

Findings: The reliability of the test and the intra-coder agreement method were used to calculate the reliability of the conducted interviews. In the current research, a semi-structured interview was used, and the interpretive analysis method was used to analyze the interview data. It should be mentioned that the coding stages used in the present research comprise open coding regarding the categories extracted from preliminary studies of the theoretical foundations of the research, axial coding, and final coding.

Originality: After the content analysis of the interviews, 21 main components could be identified among the 102 existing categories. The key dimensions of the blockchain technology application model in the growth of urban services comprise the development of urban services, blockchain technology, big data, Internet of Things.

Keywords: Development of urban services, urban management, Blockchain technology, coding method

Introduction

Nowadays, cities have multifaceted challenges to recover their citizens' life quality. Based on the United Nations report in 2014, more than half of the world's population lives in cities and it is predicted that 2.5 billion people will move to cities by 2050. Regarding urban concentration, people's living conditions have been affected by increased traffic, carbon dioxide, greenhouse gas emissions, and waste disposal. The smart city concept is an answer to solving these encounters and problems, which has become very prevalent in the past few years. These smart cities use valuable ground-breaking information and communication technology programs to support citizens. The emerging blockchain technology is significant in the growth and development of cities [1, 2].

Blockchain is a distinct technology for peer-to-peer trading platforms that use decentralized storage to record all transaction data [3]. Nowadays, one of the most prevalent and controversial topics of discussion among technology leaders in financial affairs is blockchain [4, 5]. Consequently, IT associations need to know some things about blockchain [6]. On the other hand, blockchain brings much potential to all the participants in a business network [3, 7]. For instance, the allotment of a registration system, with the repetition of which, the

shared ledger provides an unchangeable and definitive consensus around the transfer of assets in business networks, which, as a result, decreases cost, complexity, time, and risk [8].

Blockchain can attain data compatibility among diverse fields with the basic mechanism. Furthermore, it also guarantees data integrity and security. Blockchain can automatically guarantee the reliable execution of smart contracts based on it and offer the opportunity of automatic control of data transfer [9]. Adopting blockchain technology for digital identity resolutions will help empower citizens and create a digital society. This is one of the key objectives of the smart city, which improves the citizens' life quality via using technology. The significance of using blockchain in digital identity is related to its key features that offer security and integrity of data without the need for a third party. Blockchain is considered an emergent technology and a new tool to communicate the needs of people, technology, and organization. Blockchain research is expected to consider issues of trust, sharing, and ownership as part of human society. Trust has become a very significant feature that blockchain can offer for an exchange. With additional trust mechanisms emerging from blockchain, people may be able to share their properties without concerns about losing ownership.

Lack of centralization, the possibility of entering into smart contracts, along with eliminating the possibility of forgery and fraud, and accordingly, reducing corruption in the areas of urban planning and financial management, and the possibility of using financial tools such as tokens for citizens; are of great importance in the city management and will make the municipal bodies more agile. Likewise, not using blockchain in city management, while not being able to create the necessary trust and transparency, will deprive us of the important features of blockchain stated above. Similarly, blockchain, like other technologies that were born and used in numerous fields and are presently being used, will be used one day, and many whispers of using blockchain in the field of city management can be heard both inside and outside the country.

Preceding studies have focused on the field of urban management, financial resources, banks, traffic, etc. and it intends to use technology for a specific field or to use smart technology. While this research aims to use three technologies in the development of urban services, which are divided into 5 categories. The commonality of the present research with other researchers is that they tried to use new technologies such as the Internet of Things and Blockchain. Nonetheless, the difference is that in this research, to provide a model for the development of urban services, and also by using three big data technologies, the Internet of Things and Blockchain, the main goal is to eliminate shortcomings such as decentralization, distributed processing, focusing on information and knowledge production points, providing a safe platform, processing large amounts of information and knowledge, etc.

Based on the third paragraph of the 19th article of the third five-year plan for the development of the city of Tehran (2019-2023) in the path of realizing a smart city, Tehran Municipality is obliged to prepare the infrastructure of all types of municipal and urban payment and receiving systems and develop platforms for financial and non-financial exchanges based on modern technologies, blockchain, and cryptocurrencies. Consequently, before using this technology, it is better to offer a framework and a model for use during scientific, technical, and detailed research, while counting the related processes, so that the method, process, and model of using this technology are clear and documented from the beginning. Surely, such a model will prevent trial and error and subsequent costs because of implementation without study, and the failure to implement this research may lead to its application in subjects that are not the priority, need, or issue of the day of urban management, or lead to an increase in processes and a more difficult way of doing things, and as a result create more costs or more dissatisfactions.

Blockchain

Blockchain is generated from two words block and chain. This technology is a chain of blocks that are connected. In a blockchain, information is placed in blocks and linked together in a chain [3]. Blockchain technology is a database that checks and stores transactions. The created database has four characteristics: it is public, it is decentralized, and it is not stored in a single computer, but it is stored in different computers belonging to different people around the world. To keep track of transactions that are synchronized up to the desired date, it is protected using cryptography and weakens hackers [10].

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Presently, blockchain is used as an industrial solution that has significant advantages in the field of asset transfer in business networks. If blockchain technology is used in industries, its good potential can be used, and one of its uses is the development of smart cities. In recent years and after the introduction of blockchain technology, numerous organizations and businesses around the world have started using this useful technology and with the revolutionary slogan of international payment, they have exploited it in the least time and with the least cost. In a permissioned blockchain, anyone can join the network, write, read, and agree. Briefly, in the licensed blockchain, the nodes are known thanks to the authentication mechanisms, and only these nodes can control the blockchain [11, 12]. Some features and features of the technology Blockchain include:

Unlike the centralized data structure architectures, which are in line with numerous issues and problems such as specific breaking points and scalability, the blockchain uses decentralized and distributed ledgers to use the distributed processing capability through all participating users in this communication network, which leads to reducing latency and eliminating breakpoints, eliminating third parties and intermediaries [13]. One of the basic capabilities of the blockchain is the ability to assimilate transactions by unchangeable ledgers. In the traditional centralized architecture, the database can change and there is a need to create a third party (auditor and verifier) to guarantee the integrity of the data. Though in blockchain technology, each block of distributed ledgers has a connection with the preceding block that forms a chain of blocks, blocks are stored permanently and can never be changed as long as participants are present in the network [14].

Blockchain offers a high level of transparency by sharing transaction details between all employees involved in that transaction. This technology guarantees the improvement of trust and reliability in the process because all information is transparently provided to all members of the blockchain [15]. Though security is a main concern for most new technologies, blockchain offers better security than all similar technologies. Because it uses the "public-key" infrastructure that protects the system against malicious actions to manipulate data [16]. Blockchain recovers the traditional data center architecture via distributing database records among different users who are in the blockchain network. Blockchain is more effective than the traditional centralized data structure in terms of cost, agreement speed, and risk management [17].

Urban Services

The growth of urban services is a tool for the development of poor urban areas. This approach is collaborative decision-making for cities that are facing the crisis of urban poverty, increased competition, and putting pressure on environmental and economic sustainability, and it offers an outline for economic growth, sustainability, and equality by implementing strategies and its main goal is providing sustainable urban development by creating social capacity for a cooperative perspective and public action. The principles of urban services development strategy include competitiveness, good governance, bankability, and livability [18].

One of the important constituents in urban development studies and analyses is the analysis of the city's economic competitiveness at the international, national, and regional levels. Put differently, developing a growth strategy and subsequently developing an implementation plan necessitates determining the competitive advantage of cities. Consequently, the analysis of the economic base of the city to assess its strengths and weaknesses in comparison with other cities in the region and the country is aimed at identifying the features in which the city has a competitive advantage and will be able to provide a market for its products and services. Regarding the definition of the World Bank, good governance, implies the inclusion and representation of all groups in the urban society, as it denotes the accountability, integrity, and transparency of the actions of the local government to define and pursue common goals. That is, the governance of a city can be seen in the indicators of the structure and effectiveness of service delivery, the independence of the local government, coordination within the government, and the transparency of the local government.

It refers to the financial health of each department of revenue sources and expenses. A bankable city has a transparent and internally compatible local income and expenditure system, transparent and predictable inter-governmental transfers, prudent conditions for the establishment of municipalities, accepted financial accounting techniques, sound asset management standards, transparent methods in the provision of goods and services, and commercial approach (taking into account important social issues). Likewise, a commercial approach is an

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essential condition for the participation of the private sector or the conditional privatization of urban services. The source of the sustainable city concept goes back to the ancient Greek era when people were looking for the ideology and concept of justice and fairness. On the one hand, the concept of livability reveals the attraction and strong influence of the city, but on the other hand, it will intensify the communication and influence of the city via the acquisition of investment, cultural and human resources. The increasing livability of urban areas is a method to stop pollution and protect natural resources in urban areas and their surroundings. Livability in its main and general concept is to attain livability, and in fact, it is to realize the quality of good urban planning and a sustainable place.

Urban services are divided into five categories, which are: health services, welfare, and recreation services, protection and safety services, electronic education services, and public transportation and traffic services [19].

Researchers, in their studies, have offered different dimensions and components regarding the application of blockchain in smart city management. Rot *et al.* (2018) divided blockchain applications into the main areas of the smart health system, smart supply chain and logistics, smart mobility, smart energy management, public service management, electronic voting, smart factory, smart home, and smart education [20].

Regarding the library studies and surveys done in the field of urban management, urban services, and blockchain technology, Table I discloses a summary of the results and the focus of researchers in research.

[Insert Table I near here]

Based on Table I, it can be concluded that the present research has diverse features in the direction of using blockchain technology for the development of urban services; because in this research, the following points are to be paid attention to:

1. Welfare and entertainment services

2. Safety and protection services

3. E-learning services

4. Public transportation and traffic

5. Environmental Health

Method

The present research is applied in terms of purpose and qualitative in terms of method. The statistical population of this research includes all managers and urban management experts who have at least a master's degree. To better comprehend the issue of urban services development and also to identify its dimensions and components, in-depth and exploratory Delphi interviews were conducted with 15 key informants of the Tehran Science and Technology Park and Municipal Organization and academic experts. These people included several experts from the country who were selected purposefully. The sampling method is purposive. First, the essential data and information were collected with the method of documentary and library studies and then using the Delphi method, AS one of the qualitative methods, the dimensions, components, and indicators of the research subject and the methods available in urban services and blockchain technology were discussed.

It must be mentioned that 15 experts in this field were interviewed based on a semi-structured interview with 6 questions. These questions were answered using the Delphi approach and using MAXQDA software. The interview questions are given in Table II.

[Insert Table II near here]

To ensure the validity of the qualitative part of the research, the valuable opinions of professors familiar with this field and academic experts who were experts and knowledgeable in this field were used. The reliability of the test and the intra-coder agreement method were used to calculate the reliability of the conducted interviews. The coding method was used to analyze the data.

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Findings

In open coding, the concepts in the interviews and documents are classified regarding their relationship with similar topics. The result of this step is to refine and summarize the mass of information attained from interviews and documents into concepts and categories. So, in the first step, the semantic units were recognized, of course, the selection of semantic units has been accepted by the supervisors and advisors. After coding the semantic units and getting the saturation limit (when no new categories or codes are obtained from text analysis or new interviews), they were classified based on the similarity of the codes to each other, and lastly, 10 categories appeared from the qualitative data. In the next stage of the coding process of the collected data, the final sorting and clustering of all concepts and core codes were done in multiple layers (Table III).

[Insert Table III near here]

In the last stage of the qualitative analysis process, the findings were centered on the key goal, and by linking the codes (open coding), the concepts (axial coding) were identified. The attained classes around the model can be seen in Table IV.

[Insert Table IV near here]

With the accomplishment of the Delphi method steps, the experts, while approving the dimensions and components extracted from the research, have announced some changes, for instance, the combination of the transportation component with traffic or protection and safety, however, most of the experts' opinions in the Delphi phase included indicators and tips on the application and application of these indicators concerning new technologies, for instance, attention to fraud, patient services, green energy, online services, smart digitalization and automation, urban identity, fair distribution of profits, etc.

Based on the results, the most probable context of change at the end of the Delphi method was on the conceptual model in recognizing and finding the opinions of experts in the field of procedures and indicators of the development of urban services regarding the application of big data technologies, Internet of Things and Blockchain. Likewise, finding the role of these technologies in urban services and paying attention to significant points in the progress of urban services, some of them are given below:

- The smart city should be prioritized by city development managers.

- Business is done electronically.

- Ownership and registration of land become online.

- Production should be managed in a decentralized manner.

- Transportation system must be electronic and online.

- Predict the reliable and more accurate capacity of energy.

- Improve mass data analysis.

- The cost of urban development services should be reduced.

- Municipal services should be carried out based on Internet technology.

- Management of public services should be based on urban development.

- Track passengers and vehicles.

- Create sensors and autonomous systems in production.

- Public security is established.

- Urban identity must be formed.

- Urban architecture should be derived from urban development criteria.

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- Insurance services must be online.

Conclusions

One of the significant fields in which blockchain has received attention is the development of urban services and smart cities. The development of urban services has diverse social, economic, and environmental effects and consequences, including the role of these activities in existing industries in countries. Likewise, the preferment of urban services is the most important prerequisite for a smart city, and what moves a city towards smartness is not just the use of electronic tools and communication systems of that city; rather, the use of these tools to improve the quality of life of the citizens of a city is the focal point. The results revealed that after analyzing the content of the interviews, among the 102 existing categories, 21 main components could be identified.

The key dimensions of the application model of blockchain technology in the development of urban services comprise the growth of urban services, blockchain technology, big data, and the Internet of Things. The chief components in the development of urban services include recreational welfare services, protection and safety services, electronic education services, public transportation, and traffic services, and environmental health services and in the blockchain technology dimension include decentralization, immutability (permanence), transparency and trust, data and information security and data storage and in the Internet of Things technology dimension, data interoperability between devices process management, improving cooperation and transfer, tracking devices, the possibility of collecting data online and in the dimension of big data (big data), including reducing costs, making quick and better decisions, detecting fraud in data and processes and data analysis and visualization.

In urban planning, achievement of the citizens' trust and increasing administrative health, and decreasing corruption are one of the most important issues of urban management, so transparency is one of the most important issues of urban management that can lead to mutual trust between citizens and city management. In the field of transportation and traffic, as well as the way of receiving and paying tolls, topics such as data and information management, data sensitivity of traffic control and air pollution control, systems of projects such as the traffic plan and My Tehran system in Tehran Municipality are among the most important urban management issues in the field of smart city, which try to integrate urban services electronically. Lack of concentration is another issue of urban management facing citizens, particularly in issues related to urban planning, urban services, and traffic transportation. The recognized indicators lead to the growth of the city of Tehran using big data platforms, and the Internet of Things by implementing supply chain management in the field of urban development. Consequently, the findings of the current research are consistent with the results and findings of the studies done by Badii (2017); Baklanov _et al._ (2016); Baklanov _et al._ (2018); Basole _et al._ (2017); and Florea (2018) [21-25].

In preceding researches, the expansion of urban services and blockchain technology has been addressed in a one-dimensional and partial manner. Consequently, up till now, the development system of urban services regarding blockchain technology has not been designed for the organization of municipalities. Likewise, so far, there has not been independent and comprehensive research that deals with the design of urban services development models based on blockchain technology in Tehran, and in this sense, the current research is pioneering.

The present research was done in 2021 in Iran and Tehran province. If this research was implemented in all municipalities across Iran due to the wide range of factors affecting the research topic, it could have used the opinions of experts, university professors, and more specialists in the field of the research topic. Consequently, space and time limit is one of the main problems of this research.

Regarding the components and dimensions of the development of urban services, the indicators debated in the Delphi method in the architecture and development of urban services should be given special attention. For instance, considering the management of energy consumption and making their management smarter. In line with the factors affecting the progress of urban services, the variables of environmental health services and transportation and traffic services have received the most commentaries. Consequently, for the development of urban services, it is recommended that the trustees of municipal organizations consider these variables in planning and policy-making. To upsurge the quality and recover the development of urban services, it is recommended to

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the trustees of this field (Tehran Municipal Organization) to alter the employment of these programs from the command, order, and relational mode and to create the necessary fields for applying blockchain technology to use its capabilities in offering services and creating the necessary platforms for a smart and developed city.

Conflict of interest: There is no conflict to declare.

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Tables

Table I. Summary of results and patterns in the field of development of urban services based on blockchain technology

Researcher (year)	Research components												Research processes			
	Municipal services	Smart City	Urban architecture	Urban identity	Security	Electronic	Electronic citizen	Energy Management	Transportation	Blockchain	Digital currencies	E-commerce	Delphi panel	Structural equation	Dimetal technique	Research Validation
Abdali (2015)	*	-	*	*	-	-	-	-	-	-	-	-	-	-	-	-
Zahedi *et al.* (2019)	-	-	-	-	-	-	-	-	-	*	-	-	-	-	-	*
Azarakhshi and Azmi (2019) [26]	-	-	-	-	-	-	-	-	-	*	-	-	-	-	-	-
Rashidi (2019)	*	*	*	-	-	-	-	-	-	*	-	-	-	-	-	-

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Table II. Interview Questions.

Row	Question
1	What is your definition of the development model of urban services based on blockchain technology?
2	What is your opinion about the role of blockchain technology in the development of municipal services, and what are the characteristics of municipal services?
3	In your opinion, what are the problems and shortcomings of blockchain technology in the development of urban services?
4	What are the main dimensions of the blockchain technology application model in the development of urban services?
5	What are the main components of the blockchain technology application model in the development of urban services?
6	What are the relationships between the components and dimensions of using blockchain technology in the development of urban services?

Table III. Sorting and clustering of all concepts and codes extracted from the interview.

Row	Basic extractive concepts	Coding
1	Facilitate interaction between smart homes.	A1
2	Smart city should be the priority of city development managers.	A2
3	Flexible insurance premiums should be paid based on driver behavior data (speed, accuracy, etc.).	A3
4	Business is done electronically.	A4
5	Access to medical reports and documents is necessary for patients and doctors in emergency cases.	B1
6	Prevent manipulation of voting data.	B2
7	the quality of proceedings in insurance claims must be improved.	B3
8	Land ownership and registration must be online.	B3
9	Energy trading activities are done automatically in smart homes.	B5
10	Communication and information exchange among processes of supply chain partners is simplified.	B6
11	A flexible environment is created for the entire energy industry.	B7
12	Promotion of clinical research and earning money from data should be considered.	C1
13	Production should be managed in a decentralized manner	C2
14	Optimizing and making independent decisions to produce products is one of the benefits of networking.	C3
15	All business transactions in the supply chain are tracked.	C4
16	Smart charging and car-sharing services must become online.	D1
17	Transportation system must be electronic and online.	D2

Row	Basic extractive concepts	Coding
18	Reliable and more accurate capacity of energy must be predicted.	D3
19	Forecasting and tracking of forecasted materials are done for clearer and more accurate production.	D4
20	Integrity of supply chain processes is tracked.	D5
21	Electronic voting is established.	D6
22	Distribute data and secure industrial automation quickly.	E1
23	Smart mobility takes place.	E2
24	University's decentralized and secure management system is supported.	E3
25	Geographic information system patient tracking should be done in the conditions of epidemics.	F1
26	Driver's shifts should be determined electronically.	F2
27	Passenger demand must be anticipated.	F3
28	Product tracking is adapted through production and consumption cycles.	F4
29	Smart homes are developed with energy consumption.	F5
30	Excess energy trading is done at a low cost.	F6
31	Use the electronic wallet to use public transportation.	F7
32	Electronic signature can be used to identify suspicious activities and secure the assignment of any smart device at home	F8
33	Provide electronic services in different areas of the city.	G1
34	Factory and production become smart.	G2
35	Digital currencies are becoming popular.	G3
36	Improve massive data analysis.	H1
37	In communication and information exchange, data should be illustrated and simplified.	H2
38	Mass analysis of data can be retrieved and tracked.	H3
39	All decisions should be made faster using big data results.	H4
40	Cost of urban development services should be reduced.	H5
41	Fraud detection management becomes intelligent in data transmission and analysis.	H6
42	Expanding the range of public service systems should be prioritized.	I1
43	Different services must be shared between industrial equipment.	I2
44	Urban services should be done based on Internet technology.	I3
45	Digital certificates should be issued.	I4
46	Individuals' academic records and students' valid credits are automatically confirmed when using the curriculum.	I5
47	Create innovative service delivery channels.	J1

Row	Basic extractive concepts	Coding
48	Increase the transparency of elections.	J2
49	Avoid possible human errors or frauds inherent in manual and centralized computer systems.	J3
50	Supervision and management of government records should coincide.	J4
51	Energy consumption of security measures and human physiological data should be analyzed.	J5
52	Urban governance becomes possible in a decentralized manner.	J6
53	Prevent medical fraud.	K1
54	Save the microdata related to the driver and vehicle specifications.	K2
55	Management of public services should be based on urban development.	K3
56	Smartphone applications should be established.	K4
57	Sensors of the Internet of Things are done by measuring the environment.	K5
58	Passengers and vehicles can be tracked.	L1
59	Innovative and sustainable transportation should be considered.	L2
60	Identity management is created on the platform of big data.	L3
61	Government transparency and service quality are in the context of the Internet of Things.	L4
62	Financial transactions must be done safely.	M1
63	Simplify the process of collecting, validating, and delivering energy capacity data.	M2
64	Increased monitoring is more accurate in the networking context.	M3
65	Smart supply chain and logistics are improved.	M4
66	Smart contracts should be concluded in connection with public services.	N1
67	It is possible to track all devices and sensors used to achieve context-aware service delivery.	N2
68	Read the complete and unalterable maintenance history.	O1
69	E-government should be prioritized.	O2
70	E-citizen is one of the main factors of urban development.	O3
71	Internet voting systems reduce complexity.	O4
72	Sensors and autonomous systems should be established in production.	O5
73	Public security is established.	O6
74	Data-driven healthcare drives urban development.	P1
75	Data, transparency, and access are important in the health sector.	P2
76	Blockchain economic data management support blockchain is important for managing, exchanging, and sharing dispersed patient data.	P3
77	Votes must be stored safely.	P4

Row	Basic extractive concepts	Coding
78	An urban identity should be formed.	P5
79	Educational records must be digitized.	P6
80	Distribution of profits should be fair and online.	P7
81	Activities of Internet users should be supported.	P8
82	Prevents cyber-attacks.	P9
83	Urban architecture should be derived from urban development criteria.	Q1
84	Maintenance of vehicles based on software to be controlled remotely.	Q2
85	History of accidents and transfers should be studied.	Q3
86	Insurance services must be online.	Q4
87	Optimize routing strategies.	Q5
88	Education is done intelligently.	Q6
89	It becomes possible to distribute subsidies and give tax discounts to green energy suppliers.	Q7
90	Information exchange with smart homes.	S1
91	Charging time will be automatically paid through basic cryptocurrencies.	S2
92	Non-cooperation between objects is resolved.	S3
93	Fault and predictive maintenance are automatically detected.	S4
94	Use of green energy increases.	S5
95	Changing energy in the environment through blocking the market with increasing momentum for sustainability in cities.	S6
96	Governance and tracking of any production equipment become possible.	S7
97	Patient-centered services are a factor in urban development.	T1
98	Develop high authentication in electronic voting.	T2
99	Learning analytics and big data are important in higher education.	T3
100	It becomes easy to operate and maintain industrial facilities.	T4
101	Green energy trading and allowing smart citizens to sell their excess green energy reliably will increase.	T5
102	Public security is established in society.	T6

Table IV. Final coding resulting from interview and Delphi technique with experts.

Final coding of constructs	Concepts extracted from the final round of Delphi	Code
Development of urban services	Recreational welfare services	J1-J6
		K1-K5
		L1-L5
		M1-M4
		N1-N2
		O1-O6
Development of urban services	Protection and safety services	P1-P9
		Q1-Q7
Development of urban services	Electronic training services	S1-S7
		T1-T6
Development of urban services	Public transportation and traffic services	C4
		D1-D6
		E1-E3
		F1-F7
		H1
Development of urban services	Environmental health services	A1-A4
		B1-B7
		C1-C4
		D1-D6
		E1-E3
		F1-F7
		H1-H6
		I1-14
Blockchain technology	Decentralization (decentralized)	J1-J6
	Immutability	K1-K5
	Transparency and trust	L1-L5
	Data and information security	M1-M4
	Durability and data storage	N1-N2
		O1-O6
Internet of Things technology	Interactivity between data and devices	
	Process management	
	Improved cooperation and transfer	P1-P9

Final coding of constructs	Concepts extracted from the final round of Delphi	Code
	Device tracking	Q1-Q7
	The possibility of collecting data	
Big data	Reducing costs	A1-A4
	Quick and better decision making	B1-B7
	Detection of fraud in data and processes	C1-C4
	Data and information recovery	D1-D6
	Data analysis and visualization	E1-E3
		F1-F7
		H1-H6
		I1-14