Original Research

Dynamics of the Digital Banking Ecosystem in Iran

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Abstract:
This study examines the digital banking system using a cross-sectional research method that incorporates qualitative and quantitative exploratory data. Fuzzy logic is used to address the complexity and ambiguity of digital banking characteristics, particularly quality indicators and linguistic variables. The successful adoption of new technologies in digital banking depends on continuous use and habit formation. Previous models of electronic and digital banking have their strengths and weaknesses. Therefore, it is important to develop a dynamic model of the D- Banking Ecosystem that aligns with the specific characteristics of the Iranian bank under study. The research aims to analyze existing models and their strengths and weaknesses to present the boundaries, main players, and relationships within the digital banking ecosystem. Proposed models for digital banking were examined, and a new classification of dimensions and components was presented based on a systematic review method and interviews with subject matter experts. A fuzzy Delphi panel of digital banking experts was formed in three stages to determine the components. The developed model for the studied bank was simulated using dynamic analysis. Based on the findings of the simulation and examination of different scenarios, it is concluded that for this bank to enter the digital banking ecosystem, the first step should be an innovative approach to the use of new technologies and their benefits, along with special attention to cooperation and attraction of startups and Fintechs to satisfy and persuade customers and employees. Other important factors in the next stages include banking industry structure, digital transformation infrastructure, security, environmental-social factors, and laws and policies.

Keywords- Ecosystem; Digital Banking; Fintech; Dynamic Simulation; Bibliometrics.

INTRODUCTION

Banks will undergo serious changes in the future, but what kind of process the banks will enjoy is not very conceivable. Because banks act as a legal infrastructure Fintech activities must be based on solid foundations, for which banks are the best option; at the same time, it can be imagined that banking services will be provided separately from the banks themselves and in new formats. In traditional banking institutions, there is a combination of a widespread problem of banking services for innovation with internal resistance to change, in each organization. The result will be a growing gap that newcomers are ready to fill. In the market of banking services, these newcomers have started working. At first glance, it may seem that these organizations are only able to take advantage of the imperfect efficiency in banking processes by providing better services to the final consumer of banking services; but in fact, this is not the whole issue, some people may identify this as the only reason for the formation of this market. Although not completely wrong, this does not completely cover the world of banking technology [1].On the other hand, the ecosystem of digital banking is a valuable opportunity for the future of the financial services industry in Iran if its position is properly understood and recognized, it will have a significant impact on the reconstruction of the ecosystem of banking services, especially the electronic payment industry, and will make the ecosystem of the country's payment industry work efficiently; But at the same time, the complexities of this ecosystem make its future unpredictable. Since the state of the country's commercial banks is not so favorable at the moment, Fintech services may develop well in the

future and become a specific target market for banking service providers in Iran; Therefore, according to the issues raised and according to the theory of Khanna and Palepu (2010), markets do not appear overnight and the formation of the market is by certain trends and processes, as well as due to the lack of a comprehensive research regarding the functioning of the digital banking ecosystem in the country, this research seeks to systematically analyze the theoretical literature and take advantage of the opinions of experts and managers of the banking industry and information and communication technology, professors and specialists in this field to identify and prioritize the factors affecting the ecosystem of digital banking and provide a structured model for Review the performance of this industry in the country. Therefore, it is very important to have a comprehensive model for monitoring and evaluating the establishment of the digital banking ecosystem, which takes into account the unique characteristics of this type of organization. Therefore, in the present study, the main factors of the digital banking ecosystem are analyzed to clarify the path of banks in this field. In general, this analysis has certain characteristics; A. The communication network of the main factors of the digital banking ecosystem is not clear. B. The relationship between the factors in terms of intensity of weakness and strength is not clear. Therefore, in this research, dynamic modeling is used to organize and direct the complexity of the relationships between the main factors of the digital banking ecosystem and also to identify the weaknesses and strengths of the components/indicators.

Some experts believe entering digital banking is an undeniable necessity for transformation in the banking industry. According to the statements of Westerman, Didier & Mcafee (2014), looking at the predictions of the future of banking in the world, it is clear that digital banking will be the dominant business model of the future of banking, especially in the field of retail banking. Today, the banking industry is a dynamic and constantly changing industry, because every day new technologies are launched in this industry. In this dynamic and changing environment, depending on the content, each bank offers different strategies, offers, and services that fit its ecosystem to make its customers loyal create new value for them, and generate income for themselves [2].

On the other hand, due to the focus of banking on providing optimal services to customers and gaining their satisfaction, and the highly competitive environment that governs this environment, digitalization has become one of the most important aspects of banking business [3].

Therefore, this research was considered necessary for banks for the following reasons:

1- Simulating the effect of digital banking entry determinants on outcomes to identify the best political levers.
2- Running "what if" analyses to learn from potential future scenarios and threats.
3- The ability to visually display the connections between the criteria for entering the field of digital banking.
4- Reducing the risk of executive programs, through simulation and checking the results and consequences of different policies before implementation.
5- By benefiting from the digital banking ecosystem, banks will gain the ability to react and respond quickly to the transformation of technological tools as well as changing market and customer needs.
6- The ecosystem of digital banking improves productivity at the same time communicates with customers and provides an overview of all customer banking services.
7- The ecosystem of digital banking creates a 360-degree perspective that uses all multi-dimensional channels to interact with customers and enables ambitious financial organizations to provide impressive products and services to their customers.

THEORETICAL FOUNDATIONS AND RESEARCH BACKGROUND

I. Ecosystem

An ecosystem can be considered a network of organizations, individuals, and other business elements that share and improve their capabilities by focusing on a product or a set of different products [4].

II. Digital Business Model

It is a tool to explain how internet megabrands emerge and expand, as well as how companies are innovative in the digital age [5]. The business model of a truly digital bank means that the bank optimizes its customer interactions, products, processes, etc. about digital technologies [6].

III. Digital Banking

Digital banking refers to the digitization of traditional activities and banking programs that previously required the physical presence of customers in bank branches. These activities include depositing, withdrawing, and transferring money, managing current and savings accounts, and overseeing facilities [7]. Additionally, digital banking involves using technology to streamline the integrated processes related to banking operations and transactions [8]. In scientific research, it is important to consider the opinions and findings of previous researchers. Even though research in the field of digital banking is relatively new, it has significantly expanded. As part of this research, a systematic review was conducted on scientific publications related to the "Digital Banking Ecosystem" using keywords in the Scopus scientific database. To ensure accurate retrieval of research

records, the review was performed in the document search section of the database on August 4, 2023, with a time limit from 1958 to 2023. **Search formula:** Digital AND Banking, **Publication field:** Article title, Abstract, Keywords.
The texts were analyzed using bibliographic analysis to cluster, illustrate, and check the frequency of word occurrences, and to draw knowledge networks of co-authorship and citation analysis. The necessary information was obtained from the Scopus scientific database, and then the analysis was performed using VOSviewer Software version 1.6.19.

IV. Findings of Bibliometric Section

The results of this research section were obtained by examining scientific documents published in the Scopus scientific database in the field of digital banking over the last 66 years. The search formula retrieved 3488 resources. A bibliometric analysis of the retrieved scientific documents shows that 97.16% of them are published in English. Figure 1 illustrates the trend of articles published in the field of digital banking from 1958 to 2023. Since 2000, there has been a significant increase in research interest in digital banking. The number of publications in the Scopus scientific database has been steadily increasing since then, reaching a peak of 638 works in 2022. It's important to note that works related to the year 2023 may not be fully indexed in the Scopus scientific database yet. Table 1 displays the types of texts published in the scientific database within the statistical population of the subject being studied. It indicates that 13 types of texts have been retrieved and categorized, with the highest frequency belonging to original research articles at 44.70%. This confirms the researchers' interest and the applicability of the subject for scientific and scrutinizing analysis.

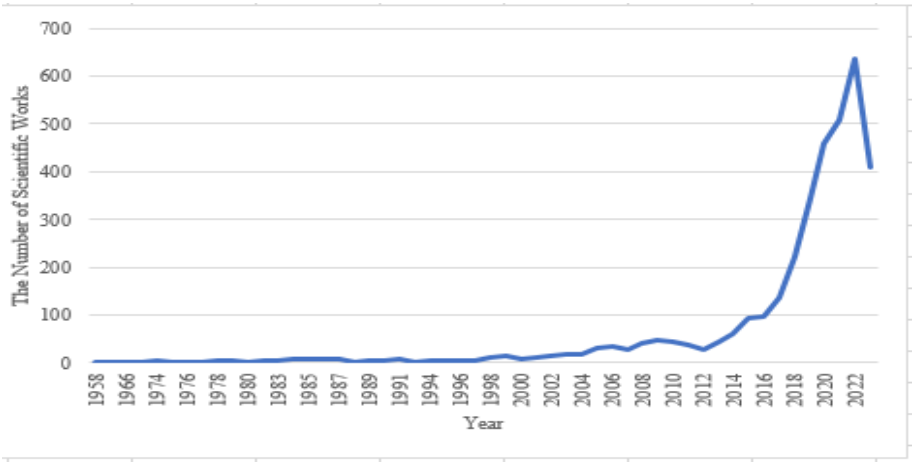

FIGURE 1
CHART OF THE ANNUAL TREND OF PUBLICATION OF SCIENTIFIC WORKS

TABLE 1
THE TYPE OF PUBLISHED SCIENTIFIC WORKS

Document Type	Frequency	Percent
Article	1559	44.70
Conference Paper	1223	35.06
Book Chapter	390	11.18
Review	140	4.01
Conference Review	91	2.61
Book	66	1.89
Note	9	0.26
Editorial	3	0.09
Letter	2	0.06
Short Survey	2	0.06
Erratum	2	0.06
Retracted	1	0.03

Table 2 shows the top ten most cited articles, two of which were published in the International Journal of Information Management.

TABLE 2

HIGHLY CITED ARTICLES IN THE FIELD OF D- BANKING

Author/ Authors	Title	Year	Source title	Citations
Barnes S.J.	The mobile commerce value chain: Analysis and future developments	2002	International Journal of Information Management	369
Peters G.W.; Panayi E.	Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the internet of money	2016	New Economic Windows	351
Laukkanen T.; Lauronen J.	Consumer value creation in mobile banking services	2005	International Journal of Mobile Communications	229
Lehrer C.; Wieneke A.; vom Brocke J.; Jung R.; Seidel S.	How Big Data Analytics Enables Service Innovation: Materiality, Affordance, and the Individualization of Service	2018	Journal of Management Information Systems	203
Ailisto H.; Lindholm M.; Mäntyjärvi J.; Vildjiounaite E.; Mäkelä S.-M.	Identifying people from gait pattern with accelerometers	2005	Proceedings of SPIE - The International Society for Optical Engineering	192
Anagnostopoulos I.	Fintech and regtech: Impact on regulators and banks	2018	Journal of Economics and Business	180
Liu D.-Y.; Chen S.-W.; Chou T.-C.	Resource fit in digital transformation: Lessons learned from the CBC Bank global e-banking project	2011	Management Decision	173
Li P.; Li J.; Huang Z.; Gao C.-Z.; Chen W.-B.; Chen K.	Privacy-preserving outsourced classification in cloud computing	2018	Cluster Computing	166
Yip A.W.H.; Bocken N.M.P.	Sustainable business model archetypes for the banking industry	2018	Journal of Cleaner Production	163
Parise S.; Guinan P.J.; Kafka R.	Solving the crisis of immediacy: How digital technology can transform the customer experience	2016	Business Horizons	163
Karjaluoto H.; Shaikh A.A.; Saarijärvi H.; Saraniemi S.	How perceived value drives the use of mobile financial services apps	2019	International Journal of Information Management	162

Figure 2 illustrates the knowledge map of global cooperation in digital banking. Out of the 185 countries studied, 78 countries are connected based on at least 5 joint scientific works between them. The map displays these connections in 11 clusters, each represented by a different color, making it easy to categorize and visualize the data.

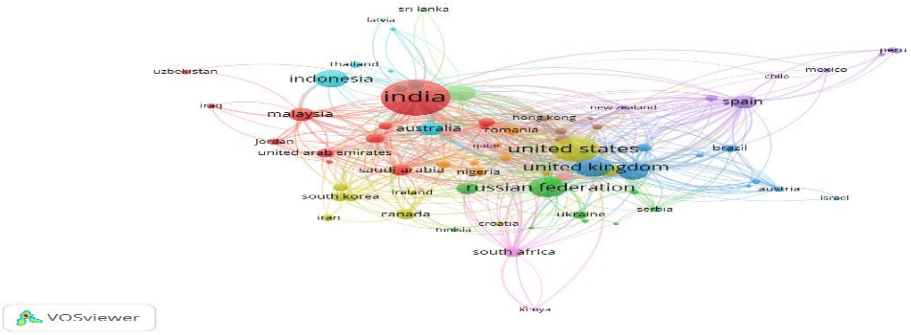

FIGURE 2
SOCIAL NETWORK OF PARTNER COUNTRIES IN THE FIELD OF D- BANKING.

In Figure 3, you can see a knowledge map that illustrates the co-occurrence of keywords in articles and scientific documents related to digital banking. The analysis was conducted using a minimum frequency of 20 words. A total of 197 words with

7986 links were retrieved from the Scopus scientific database, and they are grouped into 6 clusters, each represented by a different color. The first cluster contains 70 keywords, with the keyword "banking" having the highest link strength (1510) and appearing in red. The second cluster consists of 55 keywords, with the highest link strength (907) associated with the keyword "e-commerce" in green. The third cluster, visible in blue, comprises 33 keywords, with the keyword "digital storage" having the highest link strength (1024). The fourth cluster, represented in olive color, contains 26 keywords, with the keyword "Blockchain" having the highest link strength (1060). The fifth cluster, in purple, includes 11 keywords, and the keyword "human" has the highest link strength (309). Lastly, the sixth cluster, visible in turquoise, consists of 2 keywords, with the highest link strength (309) associated with the "information system".

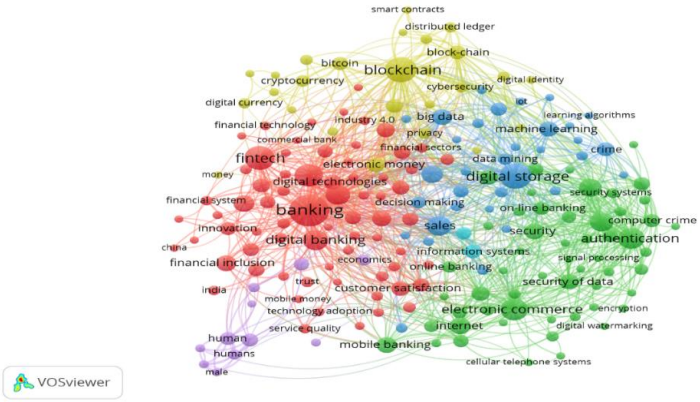

FIGURE 3
SOCIAL NETWORK OF PARTNER COUNTRIES IN THE FIELD OF D- BANKING

In the diagram, the size of the nodes represents the frequency of words, the distance between nodes indicates the repetition of words in a document, and the thickness of the lines between the nodes indicates the strength of simultaneous word occurrence.

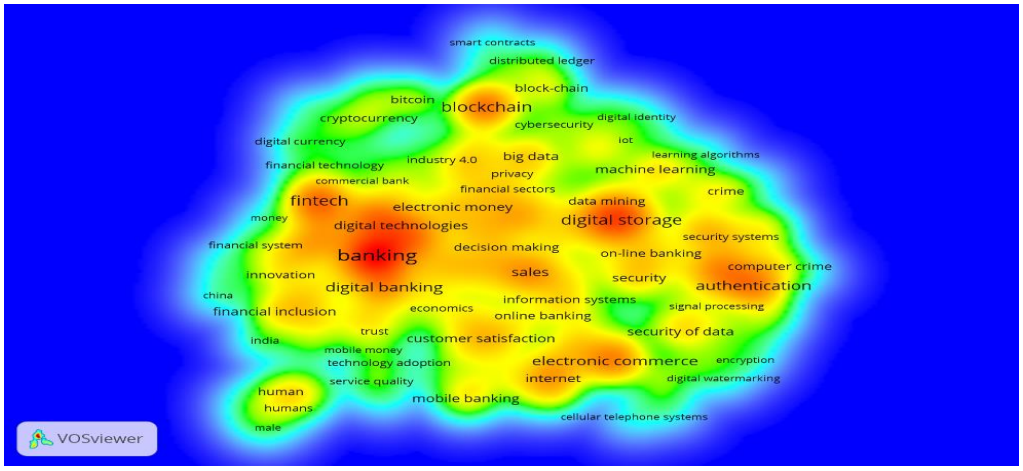

FIGURE 4
VISUALIZATION MAP OF THE CO-OCCURRENCE DENSITY OF KEYWORDS IN THE FIELD OF D- BANKING

V. Summary of Findings

The primary objective of this research was to create and present a knowledge map of the current state of scientific documents in the digital banking field. In scientometric research, it is crucial to consider quantitative and qualitative information about the studied subject. Such studies reveal hidden realities in every scientific field. Remote research points may pose significant

challenges in the future or present promising opportunities for further research and narrowing study gaps. The outcomes of these research efforts aim to facilitate the development of a clear and logical path for guiding future research and avoiding duplication of work. The research findings indicate that most of the scientific documents related to this field in the Scopus scientific database consist of original scientific and research articles published in prestigious journals and conferences. According to the survey, India, England, and the United States have the highest number of scientific documents in comparison to other countries. Additionally, scientific centers in Singapore, Russia, and India are the most productive. Continuing the work, a knowledge map related to the social network of partner countries and the co-occurrence of keywords was designed and visualized using VOSviewer scientometric software. The findings of the research indicate that Iranian researchers are entering this issue and also actively cooperating with other countries, but this issue should be pursued with more speed.

STEPS TO SOLVE THE PROBLEM

In this research, the bank is considered a system with its own input, output, and feedback parameters, used to assess its readiness for the digital banking ecosystem. We conducted a systematic review of the research literature using VOSviewer software to determine the basic situation, focal boundaries, and key factors influencing the research. The fuzzy Delphi method, along with expert interviews, was used to confirm and categorize the extracted variables from the literature review. Finally, we completed the necessary analyses with the estimation of the designed model. To select experts, we employed the judgmental sampling method. Initially, 8 individuals, including faculty members in the field of management or information technology, directors/senior consultants of information technology projects, and managers/senior specialists of the studied bank involved in the application of information and communication technology were selected. We then utilized the snowball method to introduce additional members to the fuzzy Delphi panel. In total, 15 people participated in this research, and their composition, based on the mentioned criteria, can be seen in Figure 5. Table 3 presents the panel members' work experience categorized by type, number, and range of years.

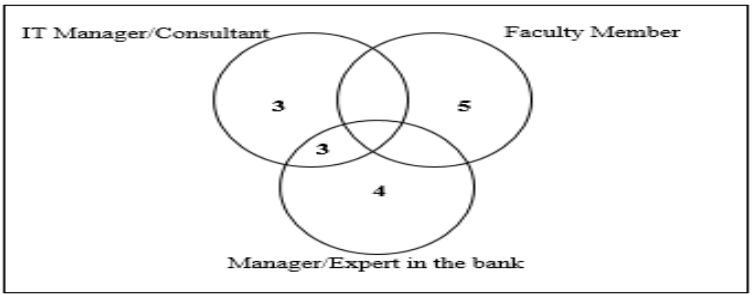

FIGURE 5
FUZZY DELPHI PANEL COMPOSITION

TABLE 3
WORK HISTORY OF DELPHI PANEL MEMBERS

Type of work	Number	Service Record (Years)	
		Min	Max
University Faculty in the field of ICT	5	3	17
Bank's ICT Projects Manager	3	4	13
Bank's ICT Projects Executive	3	3	11
Bank Consultant in the field of ICT	3	4	14
Member of the Bank's policy-making councils in the field of ICT	1	5	5

٤٠ ٦٥ ٤ ١٥
٣ ٢٥ ٣ ١٥

I. "Consensus" criterion in fuzzy Delphi method

The level of agreement among the panel members is determined by comparing the acquired value of each index with a threshold value of 0.7, which was decided after consulting experts and conducting background checks. To do this, first, we need to

calculate the triangular fuzzy values of the experts' opinions, and then find their arithmetic mean to determine the average of the respondents' opinions. After that, we convert it into a specific number using a defined relationship.

$$ffuzzy = (l, m, u) \quad (1)$$

$$fcrisp = (l + ۲m + u)/4 \quad (2)$$

Consensus stage and completion of fuzzy Delphi: Consensus means that the respondents have reached a general decision about the factors and nothing special happens in the criteria after that. If the average difference of experts' opinions (converted to crisp numbers) in two consecutive stages for all criteria is less than 0.1, the consensus has been reached.

II. Fuzzy Delphi Panel Findings

TABLE 4
SUMMARY OF FUZZY DELPHI PANEL STEPS

Step	Distribution of questionnaires		Compilation of questionnaires		Average number of follow-ups	Factors investigated	Finalized factors
	Number	Date of distribution	Number	Last date			
First	20	2023.08.30 2023.09.02	15	2023.09.20	7	20+40	5+60
Second	15	2023.10.04 2023.10.07	15	2023.10.22	4	65	40
Third	15	2023.11.08 2023.11.13	15	2023.12.10	3	25	3
Finalized Factors						65	43=18+25

In the first part of the first round of the fuzzy Delphi questionnaire, the effective factors in the digital banking ecosystem in the studied Iranian bank, which were extracted from previous researches and thematic analysis with subject matter experts, were presented. In this section, the respondent should express his opinion about the impact of each of them by choosing one of the options available in front of them ["Very unimportant = VU", "Unimportant = U", "Moderate = MI", "Important = I", "very important = VI" (Table No. 5).

TABLE 5
EFFECTIVE FACTORS IN THE DIGITAL BANKING ECOSYSTEM, USING THEORETICAL FOUNDATIONS AND EXPERTS' VIEWS

Row	Dimensions	Mark	Indicator	Mark	Source
1	The Structure of the Banking Industry	*A*	*Change and flexibility of the organizational structure of the bank*	A_1	*Harward Business Review Press (2014)*
2			*Supporting employees in the bank's digital transformations*	A_2	Anbumalar et al. (2020)
3			*Bank's partnership with startups and new businesses*	A_3	Christoph & Winnefeld Permantier (2017), Leonga et al. (2017)
4			*Developing and expanding innovation and updating the bank's operational processes*	A_4	*Capgemini Consulting (2016)*

Row	Dimensions	Mark	Indicator	Mark	Source
5			*The compatibility of the bank with the modern economy*	A_5	*(2021)Dubyna et al.*
6			*The course of transformation and innovation in bank services*	A_6	*Bandara et al. (2019)*
7			*Applying digital penetration strategies in the bank*	A_7	*Anbumalar et al. (2020)*
8			*Changing the attitude of managers towards the digitalization of bank services*	A_8	I_1, I_3, I_4, I_5, I_7
9			*Aligning employees to establish digital banking*	A_9	$I_2, I_3, I_4, I_5, I_6, I_7$
10			*Using the experience and expectations of customers in providing digital banking services*	A_{10}	I_1, I_2, I_3, I_6, I_7
11			*Relying on the comprehensive digital profile of citizens in the bank*	A_{11}	I_1, I_3, I_4, I_5, I_6
12	Environmental-Social Factors	B	*Preventing damage to society in digital banking*	B_1	*Saeednia et al. (2021)*
13			*Protecting the environment in digital banking*	B_2	*(2021)Dubyna et al.*
14			*Economic stability of the banking system*	B_3	*Khosroanjom et al. (2020)*
15			*Customer loyalty in digital banking*	B_4	Chauhan et al. (2022)
16			*Welfare and development of the social life of customers with banking services*	B_5	Kearney (2013)
17			*Acceptance of new bank services in the community*	B_6	*Alkhowaiter et al. (2020), (2020) .Anbumalar et al*
18			*The approach of bank customers to digital channels*	B_7	*Anbumalar et al. (2020)*
19			*Fields of production and employment growth with digital banking*	B_8	*Gunawan & Rustiadi (2021)*
20			*Satisfying the bank's customers*	B_9	Chauhan et al. (2022)
21			*Expansion of digital banking services such as Mobile Bank*	B_{10}	Christoph & Winnefeld Permantier (2017), Leonga and et al. (2017)
22			*Promoting the culture of using digital banking services*	B_{11}	$I_2, I_3, I_4, I_5, I_6, I_7$
23			*Attention to norms and values in creating digital banking products and services*	B_{12}	I_3, I_4, I_5, I_7
24			*Strengthening the organizational culture in accepting the digital banking approach*	B_{13}	I_1, I_2, I_5, I_7

Row	Dimensions	Mark	Indicator	Mark	Source
25	Infrastructures of Digital Transformation	C	Continuity of digital innovation	C_1	Mekinjić (2019), Khosroanjom et al. (2020), Naimi-Sadigh et al. (2019)
26			A technology-based approach	C_2	Mekinjić (2019)
27			Comprehensive and centralization of technologies in banking services	C_3	Christoph & Winnefeld Permantier (2017), Naimi-Sadigh et al. (2019)
28			New banking portals for remote services	C_4	, Khosroanjom (2013) Kearney et al. (2020), Ghaemi et al. (2017)
29			The emergence of revolutionary technologies and technologies such as networks and social media, computers, and mobile	C_5	Capgemini Consulting (2016), Leonga and et al. (2017), (2013) Kearney
30			Mobile technology is the main driver of the development and realization of digital transformation	C_6	Capgemini Consulting (2016), (2013) Kearney
31			Evolution in the technological needs of the bank	C_7	Harward Business Review Press (2014)
32			Interaction of bank customers through social networks	C_8	Capgemini Consulting (2016)
33			Providing basic banking services on the digital platform	C_9	Mekinjić (2019)
34			Using blockchain, cryptocurrencies, etc. to provide digital banking services	C_{10}	I_3, I_5, I_6, I_7
35			Providing new hardware and software technologies through outsourcing	C_{11}	I_2, I_4, I_6, I_7
36			Valuing data and information in the bank	C_{12}	I_1, I_3, I_4, I_5, I_7
37			Strengthening the processing speed of transactions and bank data	C_{13}	I_2, I_3, I_4, I_6, I_7
38	Innovative Approach	D	Value creation approach in digital banking	D_1	Kearney (2013)
39			Opportunities and threats of the bank with the growth of technology	D_2	Bandara et al. (2019), Khosroanjom et al. (2020), Leonga and et al. (2017)
40			The approach of maintaining and promoting the bank brand	D_3	Naimi-Sadigh et al. (2019)
41			Simplifying banking operations	D_4	Aghaei et al. (2022), Ghaemi et al. (2017)
42			Defining new business models in the bank	D_5	Harward Business Review Press (2014), Aghaei et al. (2022)

Row	Dimensions	Mark	Indicator	Mark	Source
43			Innovation and creation of new banking services	D_6	Ghaemi et al. (2017)
44			Social responsibility is an opportunity for bank innovation	D_7	Soltani et al. (2021)
45			Innovation in providing new banking services	D_8	Bandara et al. (2019), Naimi-Sadigh et al. (2019)
46			Attracting startups and fintech aligned with digital banking concepts	D_9	I_1, I_2, I_3, I_4, I_5, I_6, I_7
47			Increasing the bank's risk tolerance to provide new digital banking services	D_{10}	I_2, I_4, I_5, I_7
48			Increasing the speed of converting an idea into a product in the bank	D_{11}	I_3, I_4, I_5, I_7
49			Removing legal restrictions in the banking system	E_1	Soltani et al. (2021)
50			Compliance with the laws of the country's regulators	E_2	Soltani et al. (2021), Aghaei et al. (2022)
51	Laws and Policies	E	Optimum use of internal regulations of organizations	E_3	Soltani et al. (2021)
52			Legalizing the conclusion of smart contracts with customers in digital banking	E_4	I_1, I_2, I_3, I_4, I_6
53			Clarification of data governance in the bank	E_5	I_1, I_2, I_3, I_4, I_5, I_7
54			Sanctions management for the provision of equipment and the entry of new knowledge	E_6	I_1, I_2, I_3, I_4, I_5, I_6, I_7
55			Considering cyber risks in remote bank services	F_1	(2021)Dubyna et al.
56			The approach of information security in serving the bank	F_2	Naimi-Sadigh et al. (2019)
57			Increasing the bank's operational risk with digitalization and using digital innovations	F_3	Alkhowaiter et al. (2020)
58	Security	F	Establishment of incident recording and quick response security centers in the bank	F4	I_3, I_5, I_6, I_7
59			Maintaining and improving the job security of bank employees and managers	F_5	I_2, I_3, I_4, I_5, I_6
60			Keeping the organization's trends and information confidential in the field of digital banking services	F_6	I_1, I_2, I_4, I_5, I_7

The second part of the questionnaire is dedicated to providing effective factors that are not on the list of the first part. But they are important from the respondent's point of view. In this section, the respondents were asked to present the other factors that they consider important, along with a short explanation. In this section, they raised a total of 5 factors (Table 6) and in total, the number of factors reached 65.

TABLE 6
NEW FACTORS PROPOSED BY FUZZY DELPHI PANEL MEMBERS

Row	Dimension	Indicator
1	The structure of the banking industry	Recruitment of specialists by the bank in the field of new technologies
2	Infrastructures of digital transformation	Adaptability of digital banking services with existing technological platforms
3	Innovative approach	Modeling the successful process of innovation in the world
4		Evaluation of the innovation process in certain time frames
5	Security	Establishment of insurance and risk coverage systems to compensate customers' financial damages

After three rounds of Delphi, the panel members identified 43 indicators, forming 6 effective components in the digital banking ecosystem of the bank under study. Out of these, 25 factors were researched and 18 were suggested by the panel members themselves during the Delphi process.

III. Determining Causal Relationships

According to the factors calculated from the fuzzy Delphi panel, cause-effect relationships were formed between them. This diagram was reviewed and modified through interviews and discussions with experts and experts, and finally, the relationships described in Figure 6 were used as a basis for conducting other stages of the research.

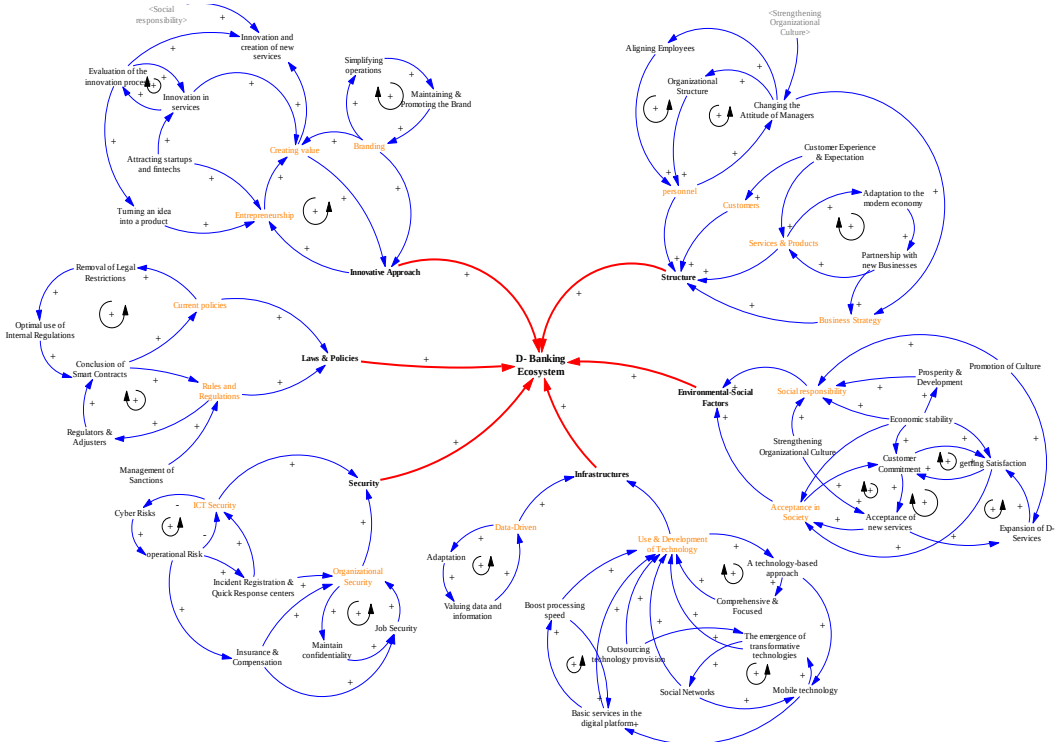

FIGURE 6
CAUSAL DIAGRAM

IV. Rate-flow model

According to the Causal Diagram of the research as well as the techniques and methods available in the topics of systems dynamics, the related Rate-Flow model was designed and created in the Vensim software according to Figure 7. The reason for using this software to perform simulation tasks is to facilitate the understanding of the model and to write its equations, as well as the researchers' complete understanding of it.

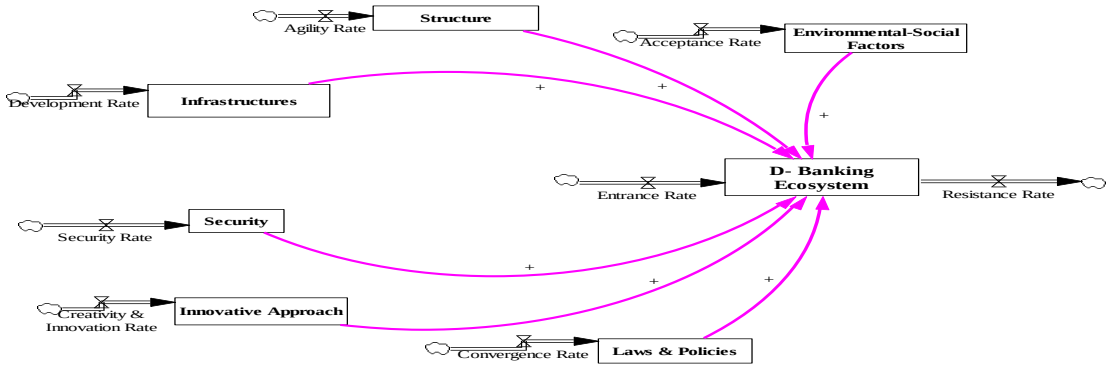

FIGURE 7
RATE - FLOW DIAGRAM

In this research, to complete the simulation process and conduct model tests, as well as add the equations of each factor, va methods have been used.

As Forrester states, there are 5 different ways to find the equations in a system dynamics problem:

1) The use of physical principles and theories among factors,
2) Using data and statistical relationships between model factors,
3) Using the opinions of subject matter experts,
4) Using the general opinions of the studied society,
5) Using the opinion of the model designer.

According to his emphasis in his book, the modeler is obliged to investigate the possibility of applying each of the above cases according to the conditions under study, and finally, if none of the above 4 cases is possible, according to his point of view define the equations [12]. Of course, it should be mentioned that in the end, by performing the defined tests for the designed dynamic models, we try to prevent their differences from reality. In determining the equations of the model of this research, in addition to the available statistical information about studies, the opinions of experts and modelers have also been used. Some of the coefficients of the equations have been estimated by them according to the experience and opinion of the researchers, because they are considered part of the confidential information under study, and other relations have been determined according to the statistical information and interviews with subject experts.

V. Model Equations

The equations used in the model of this research are explained in Table 7.

TABLE 7
THE MAIN EQUATIONS OF THE MODEL

Row	Variable	variable Equation	Description
1	D- Banking Ecosystem	INTEG (Entrance Rate - Resistance Rate, 5*F)	Storage
2	Entrance Rate	0.05*Security+ 0.15*Innovative Approach+0.3* Infrastructures+ 0.05*D- Banking Ecosystem+ 0.1*Structure+ 0.1*Environmental-Social Factors+ 0.25*Laws & Policies	Rate
3	Structure	INTEG (Agility Rate, F)	Storage
4	Agility Rate	0.15*Business Strategy+ 0.45*Services & Products+ 0.2*Customers+ 0.2*Personnel	Rate
5	Innovative Approach	INTEG (Creativity & Innovation Rate, 0.115)	Storage
6	Creativity & Innovation Rate	Branding* Creating Value	Rate
7	Security	INTEG (Security Rate, 0.652)	Storage

Row	Variable	variable Equation	Description
8	Security Rate	0.65*Organizational Security + 0.35*IT Security	Rate
9	Infrastructures	INTEG (Development Rate, 0.2)	Storage
10	Development Rate	(Connectivity/Consumer)*Effect of Connectivity on Consumer	Auxiliary
11	Consumer Rate	0.5*Data-Driven+ 0.5*Application & Development of Technology	Rate
12	Environmental-Social Factors	INTEG (Acceptance Rate, 0.135)	Storage
13	Acceptance Rate	0.75* (Social Responsibility + Acceptance in Society)	Rate
14	Laws & Policies	INTEG (Convergence Rate, 0.063)	Storage
15	Convergence Rate	0.65* (Current Policies* Laws & Regulations)	Rate

VI. Model Validation & Accreditation

- **Qualitative Section**

In this research, the validity of the questionnaire was confirmed by the content validity method. Thus, by studying the research literature and related articles, effective and relevant indicators in the digital banking ecosystem have been identified, and based on the opinions of the group's experts, they have been screened. In the continuation, the questions were designed based on the indicators approved by the researcher and with the cooperation of respected professors, advisors, managers, and related experts of the bank. Therefore, the fact that the questions have been approved by experts indicates the validity or validity of the content of the questionnaire. To check the reliability, Cronbach's alpha value of the first round questionnaire was calculated according to Table 8.

TABLE 8
CRONBACH'S ALPHA REPORT OF THE QUESTIONNAIRE

Reliability Statistics	
Cronbach's Alpha	*N of Items*
0.835	*66*

The ultimate goal of validating dynamic systems models is to ensure that the structural behavior of the model and the modeling process are appropriate to the real and considered conditions. Generally, the validation of systems dynamics models is based on the following two assumptions:
- Dynamic system models are designed for a specific purpose.
- The structural validity of the model precedes its behavioral validity and only when the structure of the model is confirmed, its behavioral validity can be examined [29].

MODEL TEST

Extreme Test: In this test, the behavior of the main variables of the model in the limit states (very high and very low values) is examined and the sensitivity of the model to these changes is studied. For this purpose, limit values were checked in each equation. Here, the test answer to the final limit of the inputs regarding the digital banking ecosystem, the structure of the banking industry, and the digital transformation infrastructure are shown in Figures 8 to 10 respectively.

The tests show that the system has not deviated from its normal state and has a relatively stable behavior. In high-limit conditions, it approaches the desired level, and in low-limit conditions, the minimum amount is created for the system.
Surprise Behavior Test: Is the model successful in predicting the system's response to new conditions or not? This test was done by consciously changing some input data and model parameters; which has been fully investigated in the section of shock (momentum) to the variables.

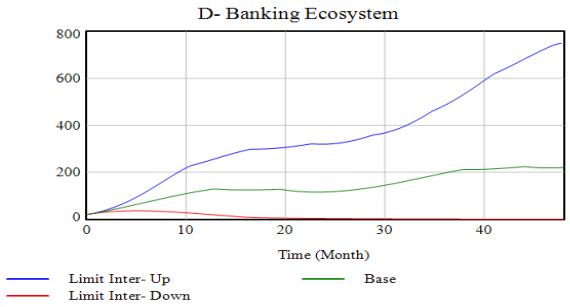

FIGURE 8
THE RATE OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN MINIMUM CONDITIONS (BLUE LINE) AND MAXIMUM CONDITIONS (RED LINE)

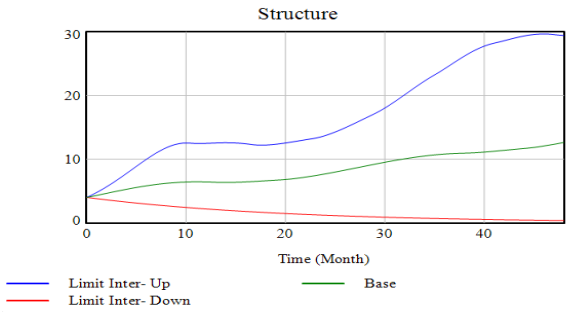

FIGURE 9
THE RATE OF AGILITY OF BANKING INDUSTRY STRUCTURE IN MINIMUM CONDITIONS (BLUE LINE) AND MAXIMUM CONDITIONS (RED LINE)

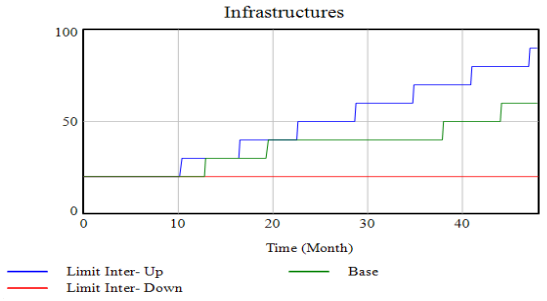

FIGURE 10
THE RATE OF DEVELOPMENT OF DIGITAL TRANSFORMATION INFRASTRUCTURE IN MINIMUM CONDITIONS (BLUE LINE) AND MAXIMUM CONDITIONS (RED LINE)

In this research, the behavior surprise test has been used to validate the model, in which by adding impulse to some variabl of the model, the effect of the impulse on the behavior of the system and other variables can be observed and this behavior can be compared with what was expected to happen.

A) It is assumed that the level of agility of the studied bank structure will be greatly reduced due to various reasons, which may be due to the lack of a suitable business strategy, weakness in providing new services and products, dissatisfaction of customers, and employees with the system, etc. It is predicted that the rate of entering the digital banking ecosystem by the studied bank branches will decrease significantly. As can be seen from Figure 11, if this shock is applied from the very beginning of the simulation year (2021), the declining trend of entering the digital banking ecosystem will decrease due to the decrease in the agility of the studied bank structure.

B) If it is assumed that based on the country's economic conditions (sanctions), laws, and policies, as well as environmental and social factors, the resistance rate of banks towards digital development is higher than the rate of entry of these companies into the digital banking ecosystem. In this case, the rate of creativity and innovation, and the development of the infrastructure of digital transformation has decreased and it is expected that the entry of the studied bank branches into the digital banking ecosystem will decrease.

As it can be seen, based on theoretical foundations, with the net negative entry rate, the bank's acceptance of the digital ecosystem decreases, except for the periods that can be seen in the diagram, which is also due to the element of habituation to the conditions, so it can be concluded that the model of conditions governing It accurately simulates the real world.

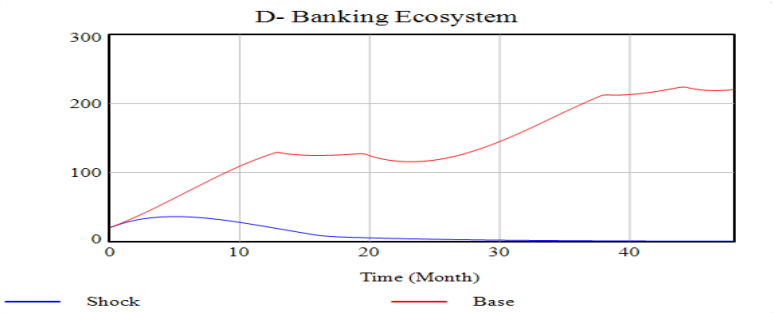

FIGURE 11
The results of the model validation test-A.

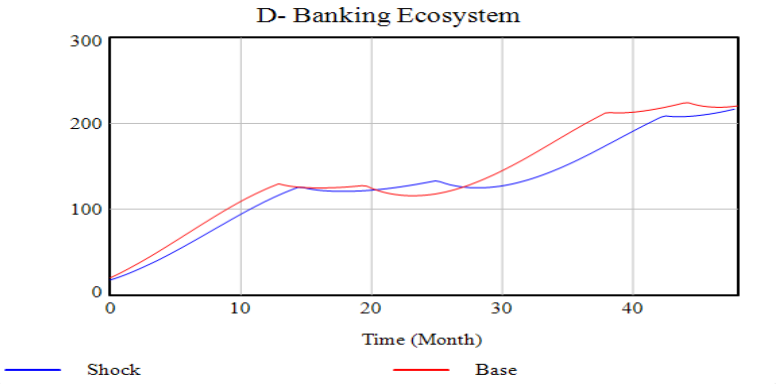

FIGURE 12
THE RESULTS OF THE MODEL VALIDATION TEST-B

MODEL EXECUTION

After ensuring the correctness of the model, the model is implemented. Regarding the initial conditions of the model, the execution time and the number of executions are explained in the next sections.

- **Policy Analysis**

Simulation is the process of designing a model of the real system and conducting experiments with this model with the aim of understanding the behavior of the system or evaluating various strategies for system operation [28].
Below are some of the assumptions considered in the simulation of the preparedness of the studied bank to enter the field of digital banking:

1. The time period of simulation is 48 months
2. The time step and storage in this model are considered equal to 0.125 (the subject of integrating the model equations).
3. The type of integration in this simulation is Euler integration and the time for simulation is considered monthly.
4. All statistics and information used in this simulation are taken from reliable sources and authorities.
5. In this simulation, for the simplicity of the model, all the functions have been considered as simple as possible, and functions such as log-arc sin-tan, etc. have been avoided.

The following graphs show the state of model execution in the state where the data and equations are completed:

As can be seen in Figure 13, the rate of entering the digital banking ecosystem by the studied bank in the base year of the simulation (2021) was 20, and if the current situation continues, the rate of this variable will reach 220,724 in 2025 and the reason This increase is also the development of digital business during these years and the development of technology over time.

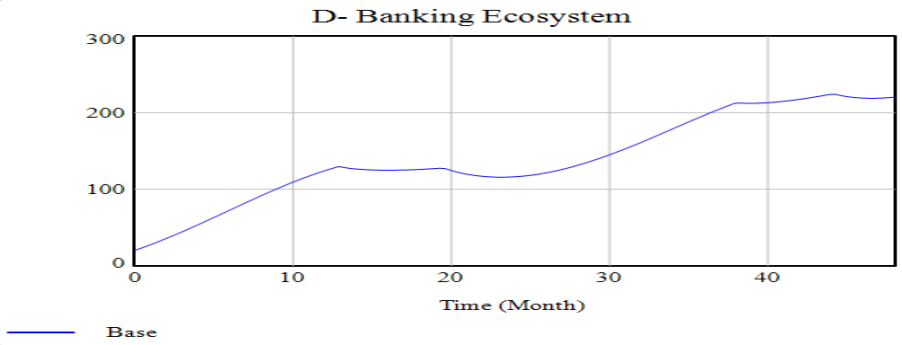

FIGURE 13
BASE MODEL SIMULATION RESULTS

I. Scenarios

In the following, we will examine the changes in the results of the model, according to the changes in the values of the variables under control, to finally determine under what conditions the desired goals can be achieved. Based on the available information, it has been tried to design the maximum attainable values or the maximum change of variables in the form of scenarios.

- **Scenario 1: Increasing the Agility Rate (improving the bank's structure)**

If the agility rate of the bank under study, which is affected by the business strategy, services and products, customers, and employees of the bank and is calculated based on the opinion of experts in the base state of 0.4, increases to 0.5, in this case, as seen in Figure 14 If this scenario is implemented, the amount of change in entering the digital banking ecosystem will

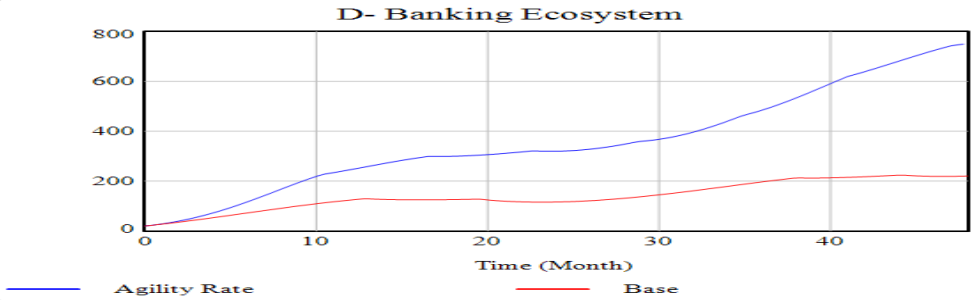

FIGURE 14
THE RESULTS OF THE VARIABLE SIMULATION OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN THE FIRST SCENARIO.

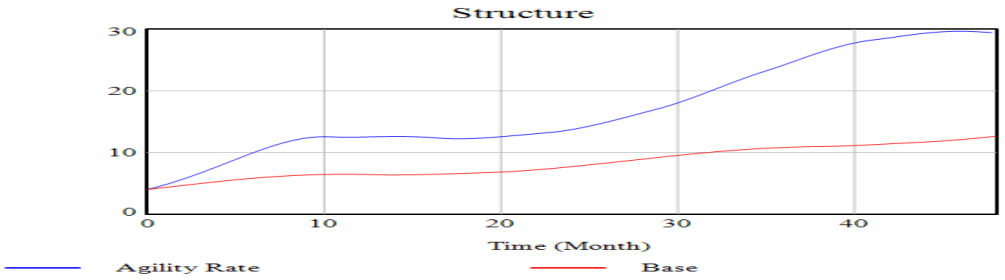

FIGURE 15
THE RESULTS OF THE VARIABLE SIMULATION OF THE STRUCTURE OF THE BANKING INDUSTRY IN THE FIRST SCENARIO.

increase from 20 units in the base year of the simulation to 752,282 units in the final year of the simulation. Also, with the application of this scenario (increasing the agility rate), the variable status of the studied bank structure finds an upward trend so that in the final year of the simulation, it shows a trend of 42.92% in the base state compared to the time of applying the scenario.

- **Scenario 2: Increasing the Rate of Creativity and Innovation**

In this scenario, it is assumed that the coefficients of the following sections of the innovative approach such as branding, value creation, and entrepreneurship will increase based on the opinion of experts, and in this case, it can be seen that the upward trend of entering the digital banking ecosystem by the studied bank has increased its slope and the ratio In the final year of the simulation, it will increase by 617.766 and reach 838.49.

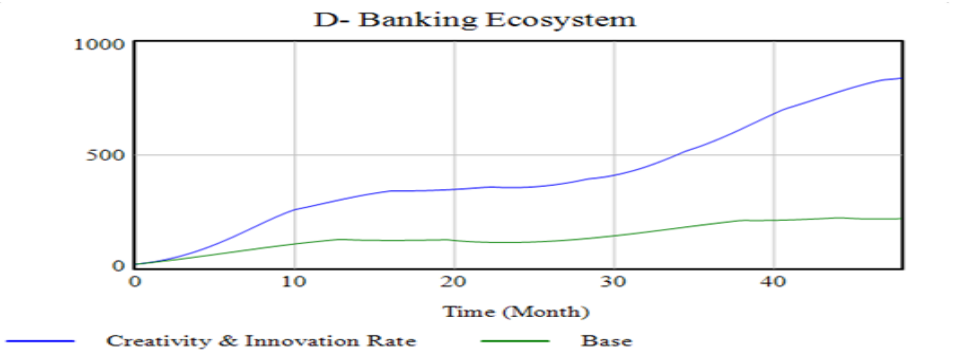

FIGURE 16
THE RESULTS OF THE VARIABLE SIMULATION OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN THE SECOND SCENARIO

- **Scenario 3: Improving the Security Situation**

In this scenario, it is assumed that the coefficients of system security variables, such as organizational security and ICT security, will increase by 60%, in this case, the rate of entering the digital banking ecosystem based on the theoretical foundations of the model will increase and move away from the base state, and will have an upward trend. So that in the last year of the simulation, its amount shows an increase of 72.28% compared to the base situation by applying this scenario.

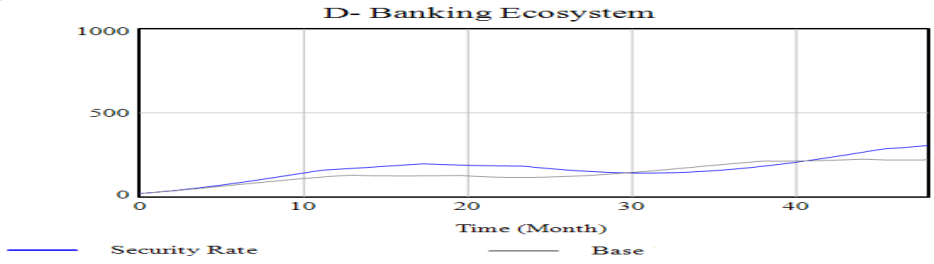

FIGURE 17
THE RESULTS OF THE VARIABLE SIMULATION OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN THE THIRD SCENARIO.

- **Scenario 4: Infrastructure Development**

In this scenario, it is assumed that the coefficients of the influencing variables on the development rate of digital transformation infrastructure, such as the use and expansion of technology and data-oriented in the studied bank, will increase by 50%, in this case, the rate of entering the digital banking ecosystem based on the theoretical foundations of the model, will increase and compared to The base state has moved away and finds an upward trend so that in the final year of the simulation, its amount shows an increase of 120.686 units, which is equivalent to 64.65%, compared to the base state by applying this scenario.

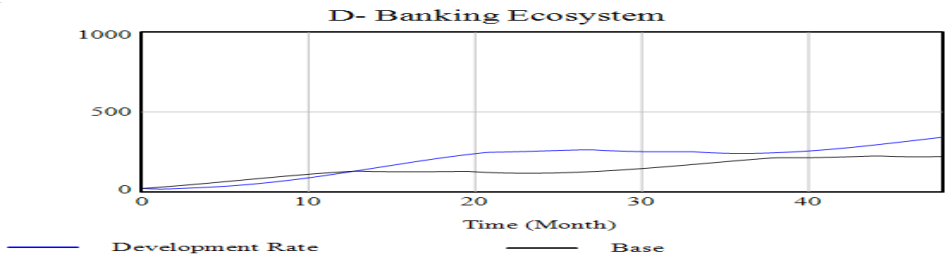

FIGURE 18
THE RESULTS OF THE VARIABLE SIMULATION OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN THE FOURTH SCENARIO.

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٣ ٢٥

- **Scenario 5: Increasing Acceptance Rate by Society**

If the society's acceptance rate, which is affected by the variables of social responsibility and acceptability in the society of the bank under study and is calculated based on the opinion of experts in the basic state of 0.4, increases to 0.8, in this case, as seen in Figure 19, if this scenario increases the amount of change in entering the digital banking ecosystem from 40 units in the base year of the simulation to 294,308 units in the final year of the simulation. Also, with the application of this scenario (increasing the acceptance rate), the status of the value creation variable finds an upward trend, so that in the final year of the simulation, it shows an increase of 42.92% in the base state compared to the time of application of this scenario.

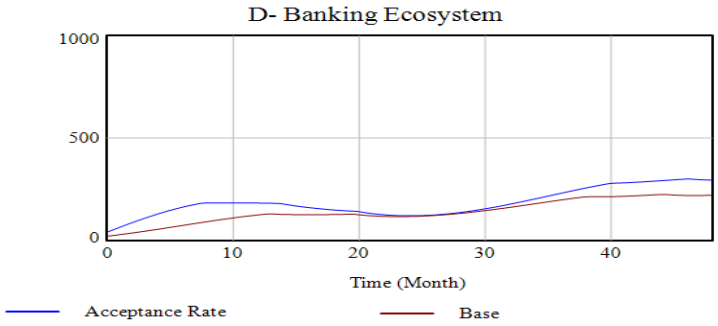

FIGURE 19
THE RESULTS OF THE VARIABLE SIMULATION OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN THE FIFTH SCENARIO.

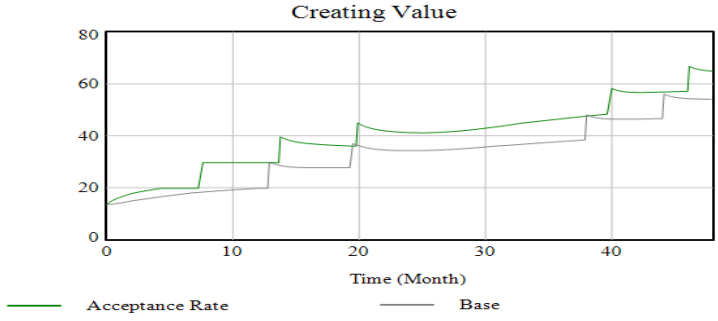

FIGURE 20
THE RESULTS OF THE SIMULATION OF THE AMOUNT OF VALUE CREATION IN THE FIFTH SCENARIO.

- **Scenario 6: Increasing the Convergence Rate of Laws and Policies**

In this scenario, it is assumed that the coefficients of the sub-sections of laws and policies such as current policies and laws and regulations will increase based on the opinion of experts, in this case it can be seen that the upward trend of entering the digital banking ecosystem by the studied bank has increased its slope and Compared to the base state, it will increase by 26,364 and reach 247,088 in the final year of the simulation.

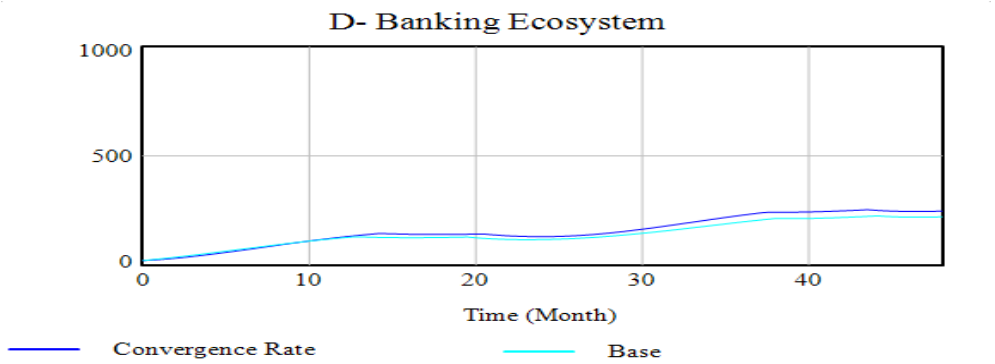

FIGURE 21
THE RESULTS OF THE VARIABLE SIMULATION OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN THE SIXTH SCENARIO.

- ***Comparison of Scenarios***

In Figure 22, the scenarios (agility rate increase, creativity and innovation rate, security, infrastructure development, acceptance rate by society, rate of convergence of laws and policies) compared to the base situation are compared in the form of a graph.

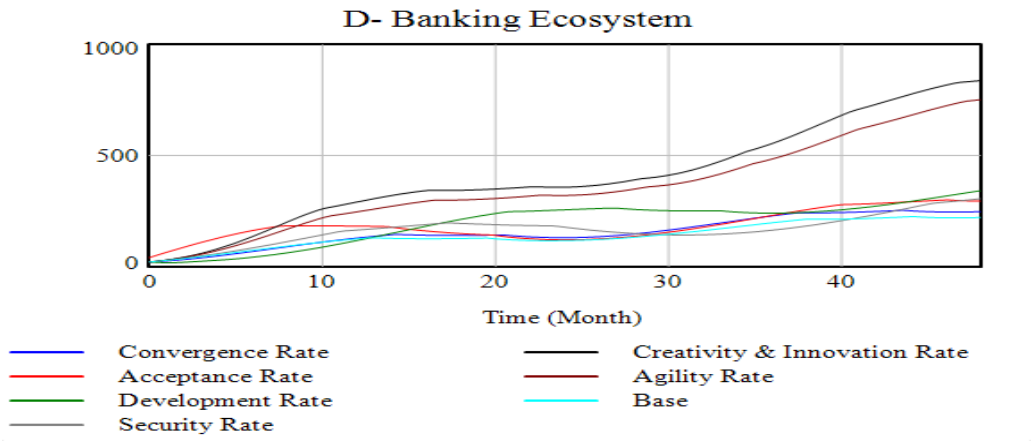

FIGURE 22
COMPARISON OF SCENARIOS

- **Scenario 7: Simultaneous Application of all Scenarios (Combined Scenario)**

If all the scenarios mentioned above, i.e. increase in agility rate, creativity and innovation rate, security, infrastructure development, acceptance rate by society, and rate of convergence of laws and policies are applied simultaneously, as seen in Figure 23. It is possible, that the amount of entering the digital banking ecosystem by applying this scenario will reach 841,898 in the final year of the simulation, which shows an increase of 621,174 units compared to the base situation.

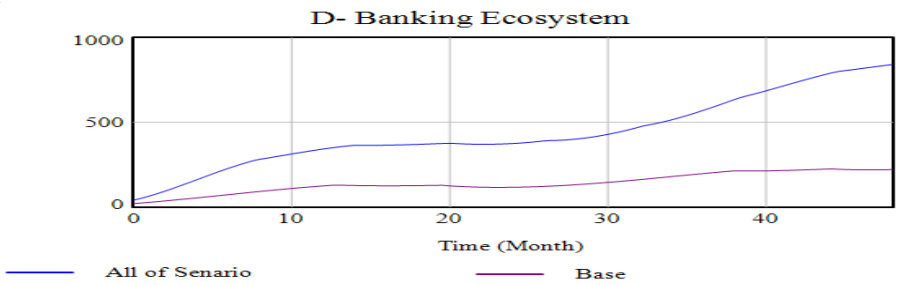

FIGURE 23
THE RESULTS OF THE VARIABLE SIMULATION OF ENTERING THE DIGITAL BANKING ECOSYSTEM IN THE SEVENTH SCENARIO

DISCUSSION

Identifying key factors (actors) and future trends is the concern of most businesses, governments, and decision-making and strategic decision-making centers, and it is one of the most important stages of scenario-based planning, in different scenario formulation methods. Actors are the elements based on which a scenario is designed. Therefore, comprehensive identification and prevention are of great importance [22]. Based on this, in this research, 6 factors were identified as the most influential factors by the experts through a systematic study of the research background, interviews, and information collected from the questionnaire, which include: the structure of the banking industry, environmental-social factors, digital transformation infrastructure, approach Innovative, laws and policies are security. The studies showed that all the identified dimensions and components have a significant impact on the digital banking ecosystem. This means that these factors and their dimensions can lead to the implementation and strengthening of the digital banking ecosystem in the studied bank.

The results of the examination of the importance of the components also showed that the dimensions of the innovative approach are the most important and effective components in the digital banking ecosystem. After that, the structure of the banking industry and digital transformation infrastructure had the most impact on the output, and then the security dimension ranked fourth. Also, the components of social-environmental factors and laws and policies took the last two ranks respectively. Based on the results obtained from this section, it can be said that the most important factor in the successful implementation of digital banking in the banking system is having the spirit of creativity and innovation and its support by the top managers of the bank. Factors that prevent the expansion and optimal use of technology can cause problems in the banking system. With the formation of digital culture in society and organizations, we need to create ideas and innovations in services that can use the maximum potential of technology in the field of satisfaction of customers and employees of the banking system. Considering that Bandra et al. (2019), Leonga et al. (2017), and also Kearney (2013) in their research addressed the approach of creativity and innovation and its dimensions as the main factor of creating digital transformation in the banking system, this result is consistent with the research He is aligned. Also, Bandra et al. (2019) also emphasized the structure of the banking industry as another important factor in their research, which is in line with this research.

SUGGESTIONS

I. Practical Suggestions

In the end, suggestions including practical suggestions for the country's banking system and suggestions for future research are presented as follows:

Considering that the innovative approach is the priority of the current research, therefore, in this regard, it is suggested that the bank under study, rely on the creation of a strong expert group, during brainstorming sessions, the opportunities available in the environment, and the organization for the effective use of emerging technologies review and analyze the situation and provide appropriate solutions to take advantage of opportunities and innovative approaches during brainstorming sessions. Since the provision of technology-oriented and innovative services plays an essential role in digital banking, and on the other hand, the emergence of Fintech start-ups is a threat to banks, banks can get out of being a victim by establishing innovation centers and turning this threat into an opportunity. The creation of an innovation center will help the bank to evaluate and adapt to emerging technologies, and create a culture of innovation and digital strategies. These activities provide the conditions for the bank to be a leader in the growing Fintech world and create a potential to meet and react to innovations. It is suggested that the organizational structure of the studied bank should be flexible for the deployment of technology. Traditional and old structures are not responsive to the deployment of emerging technologies, as a result, necessary changes must be made to align the organizational structure with technology by top managers.

The mental patterns and dominant traditional thinking of senior managers and their previous experiences and attitudes are considered to be one of the main obstacles to the implementation of innovation and new business models in the banking industry. By forming training courses, participating in conferences and seminars, and cultural programs, the studied bank can direct these dominant and institutionalized thoughts in the right direction so that such changes are met with the luck and commitment of the managers. It is suggested that technology should be considered as a potential and important ability and be used continuously in the bank, and it is emphasized that the positive capabilities of technology should be in line with the social and business goals of the bank. Improving the quality and security of Fintech services is to gain the trust of customers. Because Fintechs have entered financial areas that have high risk and sensitivity. Therefore, gaining the trust of customers in this field is associated with special difficulties compared to other fields such as retail or transportation.

II. Suggestions for Future Research

It is suggested to future researchers that the pattern of variables and actors affecting the ecosystem of digital banking should be regularly and continuously monitored and evaluated to ensure its successful implementation. In this regard, goals and actions for its future should be identified and reviewed, and to evaluate and create the necessary adjustments and reviews, appropriate indicators and mechanisms should be designed so that the effects of the implementation of the relevant model can be measured in certain periods, as well as be examined the obstacles to the successful entry of banks into the digital banking ecosystem.

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