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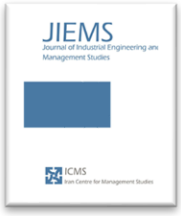

A Conceptual Model for Industry 4.0 Maturity in the Banking Services Supply Chain: Focusing on Financial Technologies and Digital Transformation

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Abstract

Maturity models mostly assess phenomena in each industry or organization and investigate the readiness to accept those phenomenon and paradigms. The Fourth Industrial Revolution has emerged and revealed as a new phenomenon in various industries, whose maturity model has garnered the attention of numerous experts and specialists. Considering that there is no such a model in the banking service supply chain, the present study sought to design a conceptual model for the maturity of Industry 4.0 with a focus on financial technologies and digital transformation. Thus, by conducting interviews with experts, including bank managers, and university professors, basic themes were extracted using a thematic analysis approach, based on which the final model was then designed, including seven organizing themes of managerial factors, infrastructure factors, information technology factors, human resource factors, cultural factors, economic factors, and business factors. The final model, which included seven sub-models, was validated using factor loading analysis, as a result, the findings of which showed that all sub-models were significant at a 95% confidence level; therefore, the designed model was valid enough in the qualitative section.

Keywords: Maturity, Industry 4.0, Banking Services Supply Chain, Financial technologies, Digital Transformation.

Paper Type: Original Research

1. Introduction

Industry 4.0 refers to the fourth industrial revolution representing the information age and digital transformation in production and services. As a matter of fact, any value creation process goes through transformation in this industrial age. The three previous paradigms were mechanical production, mass production, and the digital revolution (Nick et al., 2024). However, the fourth generation of the industrial revolution is not necessarily a complete transition from the previous three generations, but rather a combination of the three mentioned ages. In this age, new production technologies and automated control systems with increased efficiency are introduced as new production processes. Also, the large volume of data and artificial intelligence, which leads to accurate predictions by analyzing this big data, are among the prominent and distinctive features of Industry 4.0 (Iribarren et al., 2024; Tahmasebifard et al. 2018). On the other hand, maturity models are a tool for measuring and assessing the maturity of a phenomenon, such as an organization or a process. Generally, the term maturity is referred to the state of absolute development, readiness to perform specific tasks, and expressing progress in the development of a system. Mature or maturing systems increase their capabilities over time to reach a desired state in the future (Gupta and Jauhar, 2023; Mehrani et al. 2019; Keihani, 2021). Maturity models of an industry show the level of readiness and acceptance of an industry or a phenomenon, which is also plentifully seen in the research literature concerning Industry 4.0 models. Considering the significance of Industry 4.0 in human life, research has been conducted in this context, leading to the design and identification of maturity models for Industry 4.0 (Senna et al., 2023; Delshad et al. 2024). Industry 4.0 has specific applications in every field. For example, the banking industry has undergone profound transformations in Industry 4.0 due to the high volume of data, and for this reason, it needs an accurate review. Therefore, it needs to be reviewed and redesigned as Industry 4.0 has created requirements that every field, including banking, is obliged to consider and face. Hence, designing a maturity model for Industry 4.0 appears to be a necessity in the banking service supply chain taking into account concepts such as new financial technologies (FinTech) and digital transformation. On the other hand, it can be seen that such a model has not been

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presented in the research literature so far, and therefore, a research gap is visible in this field. Therefore, the main issue of the present research is to design a conceptual model for the maturity of Industry 4.0 in the banking services supply chain, which focuses on two new concepts: new financial technologies and digital transformation. For this purpose and based on interviews with experts who are university professors and banking specialists, this model was designed using the thematic analysis method, and then its validity was examined using statistical techniques. In this study, the researcher seeks to answer this fundamental question that "what is the conceptual model for the maturity of Industry 4.0 in the banking services supply chain with a focus on FinTechs and digital transformation?" This paper is structured as follows. In the next section, the literature is reviewed and research gaps are extracted, followed by an introduction to the research methodology. Next, the findings are analyzed, and finally, research suggestions are presented.

2. Literature Review and Research Background

This section reviews the research carried out on the maturity of Industry 4.0 and explains the resulting theoretical gap based on the research conducted. The research was conducted over the last five years and often addresses the readiness or acceptance and also maturity of the industry, in particular for Industry 4.0. Santos and Martinho (2019) proposed a maturity model for Industry 4.0. Dikhanbayeva et al. (2020) evaluated 4G industry maturity models using design principles. Hizam-Hanafiah et al. (2020) examined readiness models of Industry 4.0 using by reviewing literature of the model dimensions. Aslanova and Kulichkina (2020) discussed digital maturity and its definitions and models. Król and Zdonek (2020) reviewed analytical maturity models. Çınar et al. (2021) provided a framework for the readiness of Industry 4.0 and smart manufacturing enterprises. Stawiarska et al. (2021) tried to identify the maturity level of implementing Industry 4.0 solutions in selected functional areas of Polish automotive companies. Amaral and Peças (2021) provided a framework for evaluating the maturity of Industry 4.0 among small and medium-sized manufacturing enterprises. Mohamed et al. (2022) attended to the role of FinTech for efficiency in production and financial performance in the age of Industry 4.0. Treviño-Elizondo et al. (2023) proposed a model for maturity to become an intelligent organization according to lean and Industry 4.0 Synergy. Gupta and Jauhar (2023) considered and examined digital innovation as an essence for Industry 4.0. Gupta (2023) reviewed the research conducted on the adaptation of Industry 4.0 and the banking sector. Hajoary (2023) considered the readiness and maturity of Industry 4.0 in steel manufacturing organizations. Senna et al. (2023) developed a digital maturity model for Industry 4.0 based on the framework of technology, organization, and environment. Iribarren et al. (2024) reviewed the tools for evaluating Industry 4.0 for digital transformation in their research. Edunjobi (2024) examined financing models in sustainable supply chains and considered the integration of banking and sustainability in these models. Nick et al. (2024) addressed the readiness of Industry 4.0 enriched with AI in production and proposed a model for its maturity.

Table 1. Research background

Researchers	Year	Objective	Maturity model	Industry 4.0	Banking services	Fintech	Digital transformation
Santos & Martinho	2019	Proposing a maturity model of Industry 4.0	✔	✔			
Dikhanbayeva et al.	2020	Evaluating maturity models of Industry 4.0 by design principles	✔	✔			
Hizam-Hanafiah et al.	2020	Examining readiness models of Industry 4.0		✔			
Aslanova & Kulichkina	2020	Discussion on digital maturity and its definitions and models	✔				✔
Król & Zdonek	2020	Review of analytical maturity models	✔				
Çınar et al.	2021	Providing a framework for readiness Industry 4.0 and smart manufacturing enterprises		✔			
Stawiarska et al.	2021	Identifying the maturity level of implementing Industry 4.0 solutions	✔	✔			
Amaral & Peças	2021	Providing a framework for evaluating the maturity of Industry 4.0 among small and medium-sized manufacturing enterprises	✔	✔			
Mohamed et al.	2022	Investigating the role of FinTech for efficiency in production and financial performance in the age of Industry 4.0		✔		✔	
Treviño-Elizondo et al.	2023	Proposing a model for maturity to become a smart organization based on lean and Industry 4.0 synergy	✔	✔			
Gupta and Jauhar	2023	Investigating digital innovation as the essence of Industry 4.0		✔			✔
Gupta	2023	A review of research conducted to adapt Industry 4.0 and banking sector		✔	✔		
Hajoary	2023	Investigating the readiness and maturity of Industry 4.0 in steel manufacturing organizations	✔	✔			

Researchers	Year	Objective	Maturity model	Industry 4.0	Banking services	Fintech	Digital transformation
Senna et al.	2023	Developing a digital maturity model for Industry 4.0 based on the technology-organization-environment framework	✔	✔			
Iribarren et al.	2024	A review of Industry 4.0 assessment tools for digital transformation		✔			✔
Edunjobi	2024	Investigating financing models in sustainable supply chains					
Nick et al.	2024	Investigating the readiness of Industry 4.0 enriched with AI in production		✔			
Present study		Presenting a conceptual model for maturity of Industry 4.0 in banking service supply chain focusing on financial technologies and digital transformation	✔	✔	✔	✔	✔

According to the above table, it can be seen that despite the wide range of research on the maturity of Industry 4.0, no research has been conducted in the field of banking services and its supply chain, as well as FinTech and digital transformation, and the conducted research often address the maturity of Industry 4.0 in the field of producing tangible goods, this is while banking services are among the service-oriented organizations and no research has been conducted in this field. Therefore, it can be stated that there is a research gap in this field, and the present research sought to fill it. Therefore, the present research is innovative in terms of presenting a conceptual model for the maturity of Industry 4.0 in banking services.

3. Methodology

This research is applied in terms of purpose and descriptive-analytical in terms of data collection. The data analysis procedure is mixed in nature using quantitative and qualitative methods. Thereby at first, the maturity indexes of Industry 4.0 in the financial service supply chain, taking into account new FinTechs and digital transformation, are extracted through the interviews with experts, and then these indexes are converted into a conceptual model using the thematic analysis method. Subsequently, the presented model is also validated using factor loading analysis. In summary, the steps of conducting the research are as follows:

Figure 1. Steps of conducting the research

The statistical population of this study is all managers and financial experts in the banks as well as university professors who are proficient in the concepts of Industry 4.0 and new FinTechs. Given the judgmental nature, the sample of 10 to 20 people results into sample adequacy, which indeed, in the present study, 15 people, i.e., the average of these numbers, are selected as the sample. Moreover, the sampling method is snowball; that is, after interviewing the first person, s/he is asked to introduce another person as a sample, and this process continues

until theoretical saturation is achieved. The data collection tools in this study are an in-depth interview and a Likert-scale questionnaire. The following questions are asked in the in-depth interview:

- What are the components of the conceptual maturity model of Industry 4.0 in the banking service supply chain?
- What is the use of FinTech in the conceptual maturity model of Industry 4.0?
- What is the use of digital transformation in the conceptual maturity model of Industry 4.0?

Also, Cohen's Kappa coefficient is used to measure the validity of the questionnaire. The questionnaire includes indicators extracted from the interviews and the thematic analysis method, which are set on a Likert scale. The validity of the questionnaire is measured using factor loading analysis and its reliability is measured using the Cronbach's alpha test. In this study, information is analyzed using two methods: thematic analysis and factor loading analysis, separated into quantitative and qualitative sections The maturity model of Industry 4.0 is extracted using thematic analysis in three stages of extracting basic themes, pre-organizing themes, and organizing themes, and then the indicators are validated using factor loading analysis. Thematic analysis, similar to content analysis and grounded theory methods, is a qualitative method for data analysis from the interview data. In the first stage, underlying themes are extracted based on the interview text, and then basic themes are formed. In the second stage, basic themes are placed under pre-organizing themes, which are broader themes, and then pre-organizing themes are placed under organizing themes. Therefore, it can be stated that the thematic analysis method is carried out in three stages as grounded theory and content analysis. However, the grounded theory method is carried out in three stages of open, axial, and selective coding, while in the thematic analysis method, these three stages are transformed into the extraction of basic themes, pre-organizing themes, and organizing themes. As for the factor loading analysis, it should be noted that this technical method is a quantitative method for validating indicators based on t-test and is under the structural equation model and is running using AMOS software. Also, based on a 95% confidence level, if the significance level of each factor or indicator is less than 0.05, the validity of each factor is confirmed; otherwise, the validity of the factors is not confirmed.

4. Data Analysis

This section analyzes the findings. First, using the thematic analysis method, basic themes are extracted, then organizing themes and pre-organizing themes are extracted, and by this means, the research model is designed in the qualitative section. Subsequently, using factor loading analysis, the factors are measured and the validity of the model is examined. In addition, in the first step, basic themes are extracted based on the texts of the interviews.

Table 2. Extraction of basic themes

No.	Basic theme	Text of interview
1	Digital modeling	In my opinion, moving towards a digital model in the banking system is one of the signs of the emergence and indication of maturity of Industry 4.0, because modeling based on digitalization is a feature of Industry 4.0 that should be implemented in the banking system.
2	Strengthening equipment infrastructure	The equipment infrastructure in the banking system is very important. If we want to reach maturity in Industry 4.0and take advantage of new financial technologies, we need to improve the hardware and equipment infrastructure.
3	IT security	Security should not be forgotten since security is an important concern in IT. Although IT helps facilitate matters and processes in the banking system, it brings with it another important challenge which is security.
4	Cloud	Cloud systems and the Internet of Things have shown widespread application in various fields. The banking system has not yet benefited from these systems and technologies, which is considered a shortcoming.
5	Inter-organizational cooperation in the banking system	Cooperation between different organizations and units in the banking system should be in a way that can lead to the maturity of Industry 4.0. In fact, I can say that one of the characteristics of the maturity of Industry 4.0 is the development of inter-sectoral or inter-organizational cooperation in all institutions, of which the banking system is also a part.
6	Data collection and processing in banking services	Industry 4.0 is based on data and big data, so data must be collected carefully and processed in a way that leads to customer service and satisfaction.
7	Service-oriented production planning in banks	The foundation of production in banks is service provision, so we can say that banks are considered service-oriented organizations. However, one point that should not be overlooked is that service-oriented production planning should be done as product-oriented production planning in Industry 4.0. In my opinion, Industry 4.0 is more inclined towards production and service presentation.
8	Acquisition of digital skills for employees	Banking system employees should be equipped with digital skills to keep up with digital transformation. Also, they should acquire the necessary skills to benefit from new FinTech. It seems that in the current situation, digital skills among bank employees are not at a high level.
9	Willingness for change in the banking institution	To achieve digital maturity, the banking system should institutionalize change, of course, the willingness for change is not limited to the banking system, and any institution willing to achieve the maturity of Industry 4.0 should think about change within itself. Therefore, in my opinion, the willingness for change and change management is one of the characteristics of Industry 4.0.
10	Trust in processes and information systems	Processes and information systems must be trustworthy, meaning that they could be trusted. Processes that lack trust are definitely flawed, and untrustworthy processes cannot be considered in the maturity of Industry 4.0.
11	Knowledge creation in banking system	We should pay attention to knowledge creation in the banking system, knowledge creation is one of the important characteristics of the maturity of Industry 4.0.
12	Data storage management & implementation	Data storage and management are important issues that should not be overlooked because the banking system is big data in nature.
13	Banking service connectivity	Banking services must have the feature of connectivity and the possibility of establishing connections between them. Discrete banking services follow the same traditional approach that is distinct from Industry 4.0 and its characteristics.

No.	Basic theme	Text of interview
14	Moving towards service customization	Banking services should be customized according to the needs and demands of customers. So, one of the important principles in Industry 4.0 banking is to pay attention to the needs and demands of customers, and their demands should not be ignored.
15	Creating network coordination	In the service network and supply chain of banking services, coordination is a principle. All components should be in harmony with each other and service delivery should be facilitated through coordination.
16	Organizational leadership style in banking system	Of course, macro management issues are also important in realizing Industry 4.0. Naturally, with the new paradigm, management and leadership cannot be done in the traditional and old way.
17	Providing digitalization-based measurement models in Banking system	If models for measuring digitalization can be presented in the banking system, then we can say that we are close to Industry 4.0. In the current situation, we see a long distance from this system.
18	Developing digitalization strategies in banking system	Regarding digitalization in the banking system, strategies must be developed, which of course cannot be seen in the research or practice yet. In any case, if we want to reach enough maturity in Industry 4.0 in banking, it is needed to develop these strategies.
19	Adapting to the business model	The maturity model of Industry 4.0 should be consistent with the business model of banks. In other words, the connection between the business model and the maturity model is a necessary condition for achieving the maturity of Industry 4.0.
20	Managing and encouraging innovation	A digital society or community needs to think about innovation. The death of an organization in Industry 4.0 happens due to lack of innovation, and the banking system is no exception to this rule.
21	Encouraging investment	Investment is the cornerstone of achieving business maturity and the maturity of Industry 4.0.
22	Commitment of senior management	Senior management must believe in and of course be committed to achieving the maturity of Industry 4.0. Without the commitment of senior management, nothing can be achieved. Therefore, senior management must be diligent in this regard.
23	Development & design of virtual processes	Given the nature of digitalization and digital transformation in the banking system, virtual processes must be properly designed by experts and specialists, of which there are many, and as a result, with these processes, an appropriate and correct outcome can be achieved.
24	Comprehensive understanding of the banking value chain	The banking value chain must be understood by all components of the banking service chain and implemented in line with digital transformation and the use of new FinTechs.
25	Inter-sectoral digitalization	The digitalization process should be institutionalized among sectors. In the banking system, this is considered inevitable and mandatory.
26	Changing organizational culture in banking system	In order to achieve digital maturity, the banking organizational culture must also undergo change so that the organizational culture does not change. In my opinion, digital maturity cannot be expected because digital maturity requires the development of organizational culture and its improvement in various areas and fields.
27	IoT infrastructure in banks	IoT is an important issue that is being pursued intensively, but its infrastructure is not evident in any system in my country, including the banking system. For example, we want to achieve digital transformation, but we see that its infrastructure is not available, then how can we expect improvement in digitalization performance without a proper IoT infrastructure?
28	Big data management	The high volume of data in the banking system requires a strong big data management system that can help improve the situation. Overall, Industry 4.0 has the characteristics of big data and this issue should be taken seriously.
29	Real-time tracking	Real-time tracking of processes must be done in the banking system. Of course, some efforts have been made in this area, but we cannot say that we have achieved this goal by simply programming a few applications. As a result, it requires practice and effort, and if necessary, modeling.
30	Moving towards Industry 4.0 workforce	Industry 4.0 human resources must be in line with the characteristics of Industry 4.0. On the other hand, Industry 4.0 human capital management is another concept that, in line with Industry 4.0 human resources, creates conditions that can lead to a maturity model for Industry 4.0.
31	Encouraging employee participation	Employees should participate in various areas and demonstrate their performance, especially in achieving the maturity of Industry 4.0. The maturity of Industry 4.0 is impossible without employee participation.
32	Continuous performance evaluation	Employee performance should be continuously evaluated to see how close they are to the processes and requirements of Industry 4.0 in the banking system.
33	Improving R&D in the banking system	R&D has not been taken seriously in our country in general, even many large companies lack an institution for R&D in its desired and modern form. Of course, this is not limited to banks, but if we want to institutionalize Industry 4.0 in the banking system, we need to institutionalize R&D in the banking system.
34	Institutionalizing the use of FinTech	FinTech must be used since new FinTechs have shown their success in financing, but we are currently lagging behind the plan.

As can be seen in Table 2, 34 basic themes were extracted based on the interviews conducted. Therefore, using the basic themes in the thematic analysis method, pre-organizing themes and then organizing themes can be extracted, which is summarized in Table 3.

Table 3. Extraction of pre-organizing and organizing themes based on basic themes

Organizing themes	Pre-organizing themes	Basic themes
Managerial factors	Change management	Willingness for change in the banking institution
	Collaboration	Inter-organizational cooperation in the banking system
		Coordination in the network
		Inter-sectoral digitalization
	Senior management leadership	Organizational leadership style in the banking system
		Commitment of senior management
	Knowledge management	Knowledge creation in the banking system
Infrastructure factors	Infrastructure	Strengthening of equipment infrastructure
		IoT infrastructure in banks
	R&D[1]	Improving R&D in the banking system
	Use of technology	Using the cloud
Cultural factors	Trust	Trust in processes and information systems
	Change of organizational culture	Changing organizational culture in the banking system
Human resource factors	Monitoring & control	Real-time tracking
	Skill acquisition	Acquisition of digital skills for employees

[1] Research and development

Organizing themes	Pre-organizing themes	Basic themes
	Assessment & evaluation	Providing digitalization-based measurement models in the banking system
	Human resource management	Moving towards Industry 4.0 workforce
		Continuous performance evaluation
	Employee participation	Encouraging employee participation
	Value chain	Comprehensive understanding of the banking value chain
Economic factors	Using FinTech	Institutionalizing the use of FinTech
	Investment	Encouraging investment
		Service-oriented production planning in banks
	Service-oriented approach	Connectivity of banking services
Business factors		Movement towards service customization
	Business model	Adaptation to the business model
	Innovation management	Managing and encouraging innovation
		Data storage management and implementation
	Data management	Data collection and processing in banking services
		Big data management
IT factors	Security	Creating IT security
		Digital modeling
	Digitalization	Developing digitalization strategies in the banking system
		Developing and designing virtual processes

According to Table 3, it can be seen that 34 basic themes, 23 pre-organizing themes, and seven organizing themes, encapsulating the components of the conceptual model of the maturity of Industry 4.0, were extracted. This model was extracted based on the supply chain of banking services and new FinTech as well as digital transformation. Therefore, if we want to draw the final model based on the organizing themes including the dimensions of the model, the following figure would be achieved:

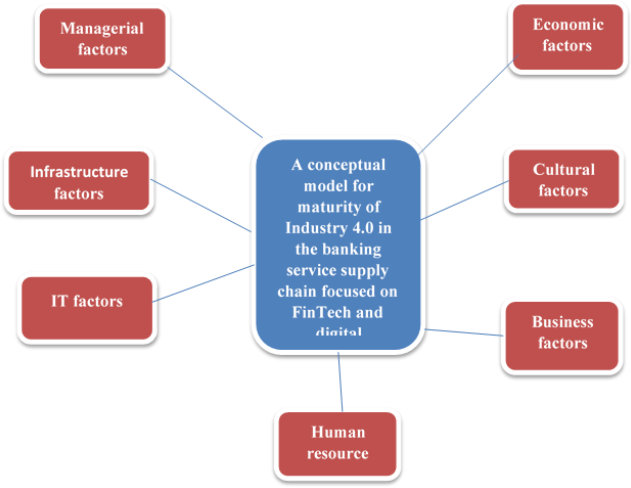

Figure 2. Conceptual model of maturity of Industry 4.0 in the banking service supply chain

As can be seen in Fig. 2, the conceptual maturity model of Industry 4.0 in the banking service supply chain includes seven main dimensions or factors. Economic factors mainly include the economic characteristics of this model, namely investment and FinTech. Cultural factors include trust and organizational culture. Business factors focus on specific areas of the banking business. Human factors include all factors faced by employees and human resources of banks. Factors such as digitization and digital transformation fall under information technology (IT) factors, and infrastructure factors are those facing equipment and infrastructure of the Internet of Things (IoT) and cloud computing. Managerial factors also include all factors from the top of the banking organization to the bottom and middle and line managers. In addition, the cases, such as organizational transformation management and collaboration fall under managerial factors. Hence, the proposed model has factors, each of which has specific effects and characteristics and can lead to the maturity of Industry 4.0 with a focus on digitization and digital transformation, as well as new FinTech. In fact, in order for the banking system to reach the maturity of Industry 4.0, it must define and institutionalize the above dimensions and factors in itself. Having been designed, the above mode is then statistically validated. Factor loading analysis is used to validate the model, and each of the organizing themes is validated based on the pre-organizing themes or their sub-themes, which are defined as indicators. The results are presented below:

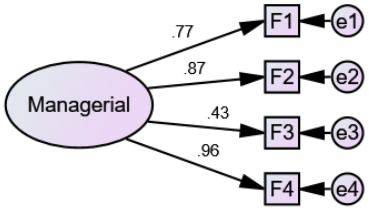

Figure 3. Model of managerial factors

Table 4. Model of managerial factors

Variables	Statistic	Standard error	Sig. level
Change management	3.241	.220	***
Collaboration	3.276	.262	***
Senior management leadership	3.069	.280	***
Knowledge management	3.621	.235	***

Figure. 3 exhibits the model of managerial factors along with its sub-factors. As can be seen, the significance level for all the sub-factors of managerial factors is significant at the 95% confidence level, and Fig. 3 also displays the effectiveness level of each factor. Therefore, it can be said that the model of managerial factors has the necessary validity.

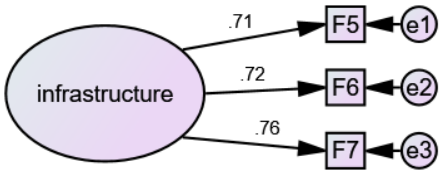

Figure 4. Model of infrastructure factors

Table 5. Model of infrastructure factors

Variables	Statistic	Standard error	Sig. level
Infrastructure	2.897	.260	***
R&D	3.276	.221	***
Use of technology	3.034	.274	***

According to Figure. 4 and Table 5, it can be seen that the significance level for all factors at the 95% confidence level is less than 0.05; therefore, the validity of each factor under the sub-factor model can be confirmed, while the coefficients shown in Fig. 4 indicate the intensity of the relationship or effectiveness of each sub-factor.

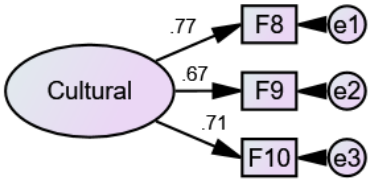

Figure 5. Model of cultural factors

Table 6. Model of cultural factors

Variables	Statistic	Standard error	Sig. level
Trust	3.241	.236	***
Changing organizational culture	3.276	.285	***
Monitoring and control	2.966	.260	***

Figure. 5 and also Table 6 illustrate the results on the validation of the cultural model. The results show that all sub-factors are significant at the 95% confidence level, as the significance level of all of them is less than 0.05. Therefore, the validity of the cultural sub-model can also be confirmed.

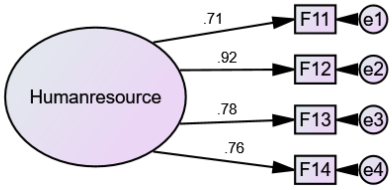

Figure 6. Model of human resource factors

Table 7. Model of human resource factors

Variables	Statistic	Standard error	Sig. level
Skill acquisition	2.517	.231	***
Assessment and evaluation	3.034	.260	***
Human resource management	2.690	.306	***
Employee participation	2.862	.292	***

It can be seen in the table above that all the indicators of the human resources model are significant at the 95% confidence level, as they are less than the threshold of 0.05; hence, all four indicators and ultimately the human resources model can be confirmed.

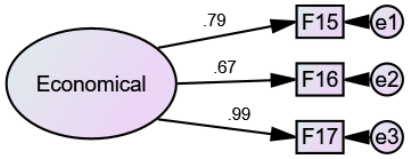

Figure 7. Model of economic factors

Table 8. Model of economic factors

Variables	Statistic	Standard error	Sig. level
Value chain	3.552	.256	***
Using FinTech	3.207	.260	***
Investment	3.276	.237	***

As can be seen, all criteria of the economic model are significant at the 95% confidence level and less than 0.05. Thus, it can be said that the economic model is valid considering the variables of the value chain, the use of FinTech, and investment.

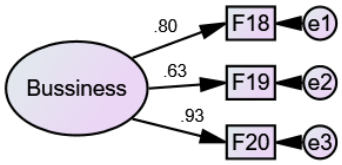

Figure 8. Model of business factors

Table 9. Model of business factors

Variables	Statistic	Standard error	Sig. level
Service-oriented approach	2.862	.252	***
Business model	3.724	.221	***
Innovation management	2.862	.266	***

The model of business factors is examined in Table 9. The results indicate that all three indicators of service-oriented approach, business model, and innovation management are significant at the 95% confidence level, as their significance level is less than 0.05. Therefore, the validity of the business factor sub-model can also be confirmed.

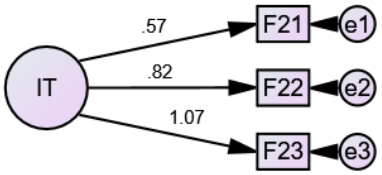

Figure 9. Model of IT factors

Table 10. Model of IT factors

Variables	Statistic	Standard error	Sig. level
Data management	3.034	.246	***
Security	2.828	.248	***
Digitalization	3.138	.280	***

Based on the above model, it is seen that data management, security, and digitalization are significant at the 95% confidence level; therefore, the sub-model of IT factors is considered as a significant sub-model. Next, the reliability of the questionnaire is measured based on the Cronbach's alpha test. This test is implemented based on the basic themes, the results of which are presented in Table 11.

Table 11. Reliability of the questionnaire

Organizing themes	Pre-organizing themes	Basic themes	Cronbach's alpha statistic
Managerial factors	Change management	Willingness for change in the banking institution	0.702
	Collaboration	Inter-organizational cooperation in the banking system	0.757
		Coordination in the network	0.758
		Inter-sectoral digitalization	0.799
	Senior management leadership	Organizational leadership style in the banking system	0.893
		Commitment of senior management	0.881
	Knowledge management	Knowledge creation in the banking system	0.748
Infrastructure factors	Infrastructure	Strengthening of equipment infrastructure	0.863
		IoT infrastructure in banks	0.810
	R&D	Improving R&D in the banking system	0.727
	Use of technology	Using the cloud	0.821
Cultural factors	Trust	Trust in processes and information systems	0.738
	Change of organizational culture	Changing organizational culture in the banking system	0.723
Human resource factors	Monitoring & control	Real-time tracking	0.886
	Skill acquisition	Acquisition of digital skills for employees	0.783
	Assessment & evaluation	Providing digitalization-based measurement models in the banking system	0.774
	Human resource management	Moving towards Industry 4.0 workforce	0.872
		Continuous performance evaluation	0.794
	Employee participation	Encouraging employee participation	0.705
Economic factors	Value chain	Comprehensive understanding of the banking value chain	0.792
	Using FinTech	Institutionalizing the use of FinTech	0.824
	Investment	Encouraging investment	0.739
Business factors	Service-oriented approach	Service-oriented production planning in banks	0.713
		Connectivity of banking services	0.780
		Movement towards service customization	0.741
	Business model	Adaptation to the business model	0.820
	Innovation management	Managing and encouraging innovation	0.727
IT factors	Data management	Data storage management and implementation	0.740
		Data collection and processing in banking services	0.876
		Big data management	0.717
	Security	Creating IT security	0.775
	Digitalization	Digital modeling	0.827
		Developing digitalization strategies in the banking system	0.800
		Developing and designing virtual processes	0.856

As can be seen, the basic themes in all factors have desirable reliability based on the Cronbach's alpha test, because the Cronbach's alpha statistic for all of them is over 0.7, indicating desirable reliability of the questionnaire.

5. Discussion and Conclusion

This paper proposed a conceptual model for the maturity of Industry 4.0 in the banking supply chain focused on FinTech and digital transformation. The basic, pre-organizing, and organizing themes were extracted using the thematic analysis approach, and then the above model was validated. The conceptual maturity model of Industry 4.0 in the banking sector shows that in order for a bank or a banking system to reach maturity, it requires seven main factors including the following:

- Managerial factors
- Infrastructure factors
- Economic factors
- Cultural factors
- Human resource factors
- Business factors
- IT factors

Managerial factors are mostly associated with the function and performance of bank managers, whether at the senior level or at the middle and lower levels. Infrastructure factors are about infrastructure and equipment of the banking system. Economic factors include investment and new FinTech. Cultural factors often deal with organizational culture of banks, and human resource factors refer to the management of employees and their reward system and skills. Business factors attend to the business model of banking and banking services, and IT factors also focus on IT infrastructure and especially digitalization. Therefore, in order to reach the maturity level of Industry 4.0, the banking system need to institutionalize and strengthen these seven dimensions. Moreover, each dimension has specific functions and characteristics in which by ignoring each of them, there is a possibility of not realizing the maturity of Industry 4.0 in the banking system and the banking service supply chain. Future studies could design the maturity of Industry 4.0 in other industries, especially service-based industries, and subsequently rank the effective factors.

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