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Digital Transformation: Digital Maturity Model for Turkish Businesses

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Highlights

- This paper focuses on developing a model to determine digital maturity level of businesses.
- A model is proposed using seven dimensions / scales.
- This study has shown the research model is applicable in businesses.

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Abstract

Changing market expectations and the increasing prevalence of the new technological trend in the world force businesses for digital transformation. However, the late realization of transformation opportunities may have devastating effects on businesses. As the first step of digital transformation, it is necessary to determine the status and deficiencies of businesses. Therefore, businesses need to make a comprehensive assessment with the digital maturity model. This study was conducted to provide businesses with an idea about the relevant digital transformation processes, to direct them toward the processes, and to support these activities when they are initiated. In the study, seven scales were developed, and the dimensions of the digital maturity model were formed. The dimensions of model were determined as strategy, customers, employees, process management, technology and data management, organizational culture, and innovation. This study aimed to examine the reliability and validity of the dimensions of the digital maturity model developed. In this context, the developed scales were applied to businesses in Turkey, and explanatory factor analysis (EFA) and validity analysis were performed. The scales were updated according to the analysis results. Moreover, the analysis results of the study were also used to specify the criteria of the model. The findings indicated that the developed scales were usable. It was purposed to provide researchers and businesses with significant opportunities since the model had a wide area of application and included environmental elements.

1. INTRODUCTION

Such factors as technological developments and changes in the economic and social structure necessitate the transition of businesses to digital transformation. Digital transformation is a set of processes enabling the business processes and organizational structure of the business to be more productive, flexible, and agile with the use of information technologies [1]. In a study conducted in 2019, the Boston Group found that the companies integrated with the value chain, which identified their digital maturity and took action by updating their objectives accordingly, had cost savings of up to 30% and increased incomes of up to 20% [2]. Moreover, the ability of businesses to make use of digital transformation opportunities provides such significant advantages as sustainable competition, the higher capability of adaptation and prediction, and having a customer-oriented and fully integrated structure [3–5]. However, the current digital maturity level of the business is determined before the digital transformation process is initiated [6]. Determining the level of digital maturity helps to reveal differences between the digital capacity and the current capabilities of the business, and thus to determine the digital goals in strategic planning [7]. Therefore, the maturity models are considered as important tools for evaluation in strategic management. Parameters are defined for companies to have clarity about the outcome of their efforts to achieve their goals [8].

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Environmental impacts are also among the sustainable metrics of digital transformation. Therefore, the studies indicate that the inclusion of environmentally sustainable practices in business models in use provides significant opportunities [9, 10].

Increasing the digital capabilities of a business has a positive effect on the management of activities that reduce environmental risks [11]. It is also known that corporate environmental management plans are important to create value in businesses. Research demonstrates that corporate environmental management affects the effectiveness of businesses in leadership and strategy implementations and their competitive power. Therefore, it is expected from the environmental activities implemented within the business to provide advantages to businesses in respect of sustainability. It is also known that digital transformation will improve environmental sustainability [12, 13]. Furthermore, it is assumed that new digital technologies may have an effect on the control and management processes of energy resources [14]. In this respect, IBM developed the Climate Impact Rating API technology to investigate the effects of environmental impacts on systems [15]. Owing to these developments in recent years, the effect of energy use and environmental awareness is also important when evaluating the digital maturity of businesses. Therefore, a green digital maturity model, which also assesses environmental impacts, was developed in the study. Afterward, the EFA of the scales in the developed model and the reliability analysis of these factors were carried out. Criteria of the model were also defined based on the factors determined as a result of EFA and other models developed in the literature.

This study consists of five sections. In the first section, the reasons behind and aims of the study are presented. In the second section, studies in the literature related to this study are reviewed and evaluated, and the conceptual structure of the model is established, and its differences are revealed. In the third section, the statistical methods used in the study and the characteristics of the scales are explained. In the fourth section, the classification structure of the scale items and the results of the reliability and validity analysis are presented. In the fifth section, the summary of the research is presented, and the originality and contributions of the study are explained. Future research subjects are also recommended.

2. LITERATURE REVIEW

2.1. Developing a Digitalization Scale

The increasing importance of digital transformation has caused the development of different scales with digitalization. There are also studies measuring the effect of digitalization on finance, leadership, employees, and business models in addition to measuring how the use of new technologies is perceived.

It has been realized that the spread of digital technologies affects not only producers but also consumers. Therefore, sustainable consumption intentions of consumers and the factors affecting this behavior [16] and the reactions of consumers to new technologies have been measured. Studies have shown that consumers respond less to digital assistant technology resembling them [17], the use of social media in electronic commerce positively affects purchase intention and brand value [18], and consumer loyalty in social commerce differs according to consumer preferences, interaction, and disclosure of personal information [19]. In SMEs, assessment of goals for the dynamics of advanced businesses [20]; which are of great importance for manufacturers, the criteria of security and privacy, corporate risk, sharing and cooperation have been found to be significant in adopting cloud computing, one of the first steps of digitalization [21].

As the successful realization of digital transformation cannot be possible only with technological development, the effects of digitalization on leadership, organizational culture and employees have also been measured. Studies have revealed that digitalization positively affects career success and job satisfaction of employees [22], digital awareness [23], and development of emotional intelligence has impacts on performance [24], and digitalization enables managers to be more adaptive and affects management implementations positively [25]. It has been found that the business models used in the management of processes have a positive effect on the developments of strategies, technologies, communication and innovation economy [26], and digital innovation is associated with Organizational Culture, digital competence, and organizational readiness of the business [27].

2.2. Digital Maturity Model

Digital maturity models developed in the manufacturing sector have assessed digitalization only within the scope of in-house activities. It has been observed that most of these activities do not address connections with customers and suppliers, those who address them only focus on the distribution function, a maturity model is generally used for logistics processes, and none of the activities deal with resource recovery [28]. While there are a few models that review the entire supply chain in manufacturing, address all dimensions of digitalization (business, organization, process & methods, technology), and provide a detailed description of the assessment levels and dimensions, no models combining all these aspects have been found [29, 30]

When determining the digital maturity readiness of businesses, grouping according to the total score of the questions [31], z-score [32] statistical path analysis [33], Singular Value Modularity Index [34] methods were utilized. In addition to these methods, in the assessment of the goals of successful family businesses in Poland by Janka et. al., application of grey clustering evaluation models [20] were used.

Within the scope of the study, research was conducted using the keywords “digital maturity”, “digital maturity model”, “smart industry readiness”, “digitalization readiness”, and “digital transformation assessment” in databases. Studies have shown that businesses have developed many maturity models to determine only their technological infrastructure and architecture [5, 35–42]. However, over the years, it has been understood that the digital maturity of the business does not depend only on technological competence but it also relies on factors such as the corporate structure, strategy, and stakeholders of the business [39, 41–70]. It is observed in most of the studies that such subjects as the importance of data in managing processes; the level of cooperation with stakeholders; the technologies used or the level of technology use; employee skills; horizontal-vertical integration within and outside the system; customer orientation and information technologies; and data security are included [4, 43–45, 71–76]. Apart from these, it is also seen that factors such as internal communication, understanding the value of mistakes, and information sharing are also included in the evaluations made by large consultancy firms. In recent studies, the importance of quality [57, 62, 65, 77] and innovative features [27, 42, 66, 68] has also been emphasized. In addition, the use of renewable energy has been evaluated [62]. However, there is no study in the literature that includes all of them in its dimensions or criteria by handling the quality assurance systems of the enterprise; energy management; recycling activities; social environmental responsibility; and innovation level. In this study, while evaluating the model, all these factors (quality management system, energy management, environmental social responsibility, and innovation activities) are also considered as separate criteria.

In the studies, models were developed by using contextual environment analysis, interviews and workshops, exploratory research, and collection of critical information through the literature reviews. Furthermore, the models were mostly confirmed with case studies, observational studies, action research, or comparative analyses through interviews with experts [8].

3. MATERIAL METHOD

Within the scope of the study, a conceptual structure was created for the digital maturity model by examining the studies conducted by consulting firms, public businesses, and academicians. In the research, Science Direct, Web of Science, Google Scholar databases, public studies and websites of consulting companies were reviewed. The conceptual framework of the study is given in Figure 1.

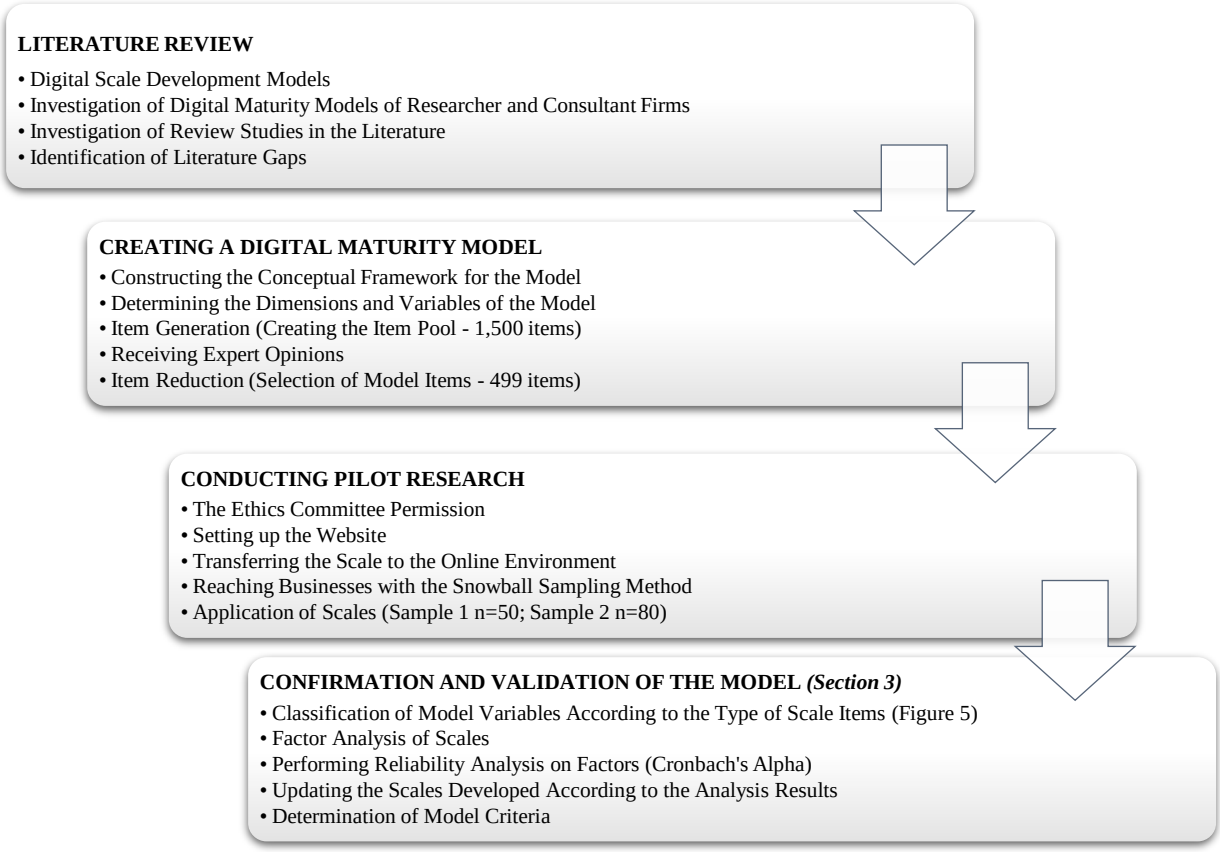


Figure 1. *Conceptual framework of the study*

In the study, firstly, the models developed by academic and consultancy firms were reviewed and evaluated. As a result of the evaluations, the scales developed in the study, in other words, the dimensions of the model were determined as Strategy (S), Customers (C), Employees (E), Process Management (PM), Technology and Data Management (T), Organizational Culture (OC), and Innovation (IN). An item pool of 1,500 items was created for the determined dimensions. Concerning the research dimensions and items, the opinions and suggestions of academic, private sector, and consultancy company experts were obtained. Existing items were reduced and updated with the opinions and orientation of the experts. Orientation was shaped according to the responses to the items in the research, and orientation was also provided between the items or variables. Therefore, there is no clear number of items that participants need to respond to in the model. However, the maximum number of items to be responded to is 499. To enable the participants to respond to these items properly and facilitate the analysis, the items were grouped. According to this grouping, criteria, variables, and items were named and coded. The variable codes in the model were formed by adding numbers to the abbreviation of the dimension the variable was included in. For example, the code of the 1st variable in the Strategy (S) dimension is S1. S1-1 represents the 1st item of the 1st variable. The 1st, 2nd, and 3rd items of the 1st variable constituted a certain factor. The 2nd question in the Strategy (S) dimension, that is, S2 variable group is a table question, and each column represents a variable. In other words, S2 variable consists of two sub-variables as S2-A and S2-B. Item S2-1A points to the first item of sub-variable S2-A. If only one of the given items was allowed to be selected, it was referred to as Likert Scale (LS), and if more than one option could be selected, it was referred to as Multiple Choice (MC). The structure including these variables and items indicated the size of the scale, in other words, the model. The digital maturity model was established by determining the evaluation characteristics and levels of the scales.

In the research model, all the variables and sub-variables in the scales and the number of items they contain are given in Figure 2.

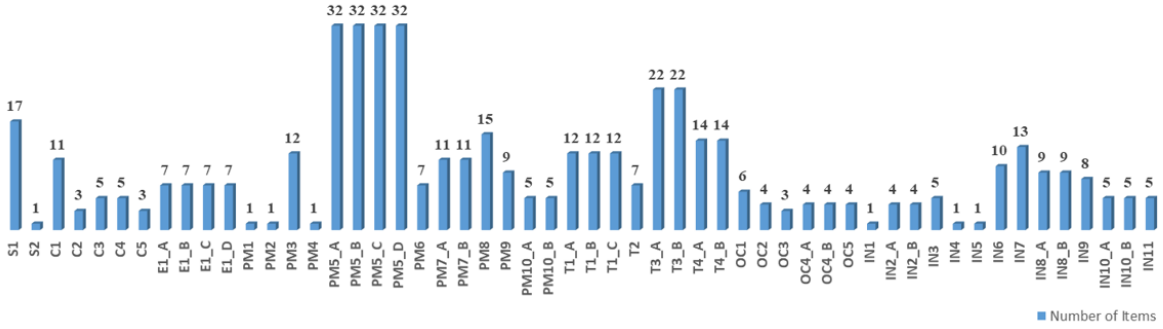


Figure 2. *Distribution of the variables and items in the scales*

According to Figure 2, the model included maximum 38 variables that needed to be responded to. It was observed that "Strategy" contained 2 variables and 18 items, "Customers" 5 variables and 27 items, "Employees" 1 variable, 4 sub-variables, and 28 items, "Process Management" 10 variables, 8 sub-variables and 206 items, "Technology and Data Management" 4 variables, 7 sub-variables, and 115 items, "Organizational Culture" 5 variables, 2 sub-variables, and 25 items, and "Innovation" 11 variables, 6 sub-variables, and 80 items. Apart from the dimensions determining digital maturity, 14 "Demographic" and 5 "Non-Evaluating" items directed to businesses were also included in the scale. In the model, it was observed that there were mostly items for "Process Management", followed by the "Technology and Data Management", and "Innovation" dimensions.

After determining the dimensions, variables and items of the research, the developed scales were proven to be usable. To this end, the model, which was transferred to the online environment by creating a website, was applied to 50 and then 80 businesses selected through the snowball sampling method, one of the non-probability sampling methods. As a result of the pilot studies, the reliability and validity analysis of the model was carried out. The developed scales were also edited according to the results received from the analysis. Furthermore, the factor analysis results of the scales were evaluated, and the criteria of the model were determined.

For the validity of the scales, explanatory factor analysis (EFA) was performed in the study. Explanatory factor analysis is a method that enables correlated variables to turn into a lower number of significant and independent factors [78]. The purpose of exploratory factor analysis is to classify the items by reducing the number of factors. EFA consists of four main stages [31, 79]. In Figure 3, the scale reliability and validity test stages and the accepted values of the statistical variables examined are presented [80–85].

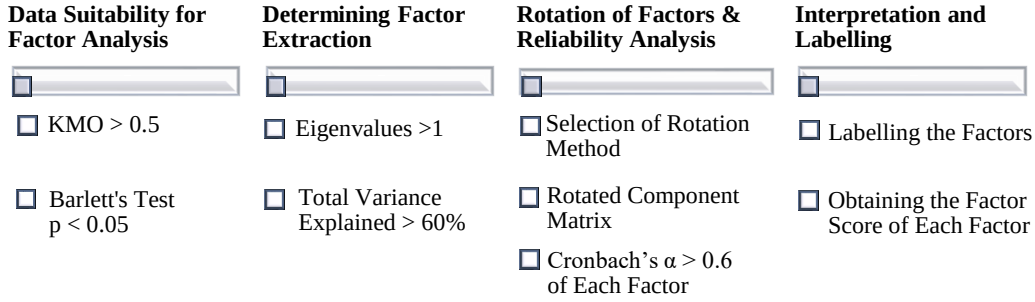


Figure 3. *Validity and reliability of the scales*

As seen in Figure 3, the first stage to determine sample suitability is to measure sample adequacy with the KMO test. The second stage is to evaluate the suitability of the data set for explanatory factor analysis, in other words, whether there is a high correlation between the variables, with Bartlett's test. At the second stage, the number of factors to be obtained is determined. The third stage is factor rotation. At this stage, the items in the scale are updated according to the results of the rotated component matrix, and the factors are defined. At the last stage, these defined factors are named, and their scores are determined. Variables are grouped according to their factor loading [86, 87].

Although many methods are used in exploratory factor analysis, the most used method in data science and machine learning applications is Principal Component Analysis (PCA) [78, 88]. It is tried to identify the factors that are the composition of the items observed in PCA. In this study, the PCA method was used in the factor analysis of the scales since there were too many variables [79], and the evaluation model was developed [31].

The reliability of the factors constructed through the exploratory factor analysis was checked, and the reliability of the scale and the consistency of the correlations between the items in the same factor were measured. Cronbach's alpha coefficient, which is the most used method for the reliability of the scale, was applied in the study [89, 90].

In the digital maturity model developed within the scope of the research, environmental factors were assessed comprehensively, unlike other studies. While confirmation and validation were carried out with case studies in many studies in the literature, confirmation and validation of the model developed in this study were determined as a result of EFA and Cronbach's alpha reliability analysis test. Furthermore, in the study, a model that could be applied to businesses of all sizes and all sectors was developed to meet the need for developing a more general strategy that could be applied to large areas. Thus, it will be possible to compare businesses according to their sizes or sectors. On the other hand, “I don't know” and “I don't want to share information” options were also added to the Likert-type questions in the scales developed. With these options, it was aimed to evaluate the digital maturity of businesses as well as their knowledge about external sharing culture, digital processes, and technologies.

4. FINDINGS

4.1. Sample and Data Collection

To verify the model developed within the scope of the study, the questionnaire was applied to first 50 and then 80 businesses operating throughout Turkey through the website.

To test the reliability and validity of the items given within the scope of the digital maturity model, the items were classified as evaluation and information items. In Figure 4, the classification of the items in the scales, the variables included in each class and the total number of items are presented.

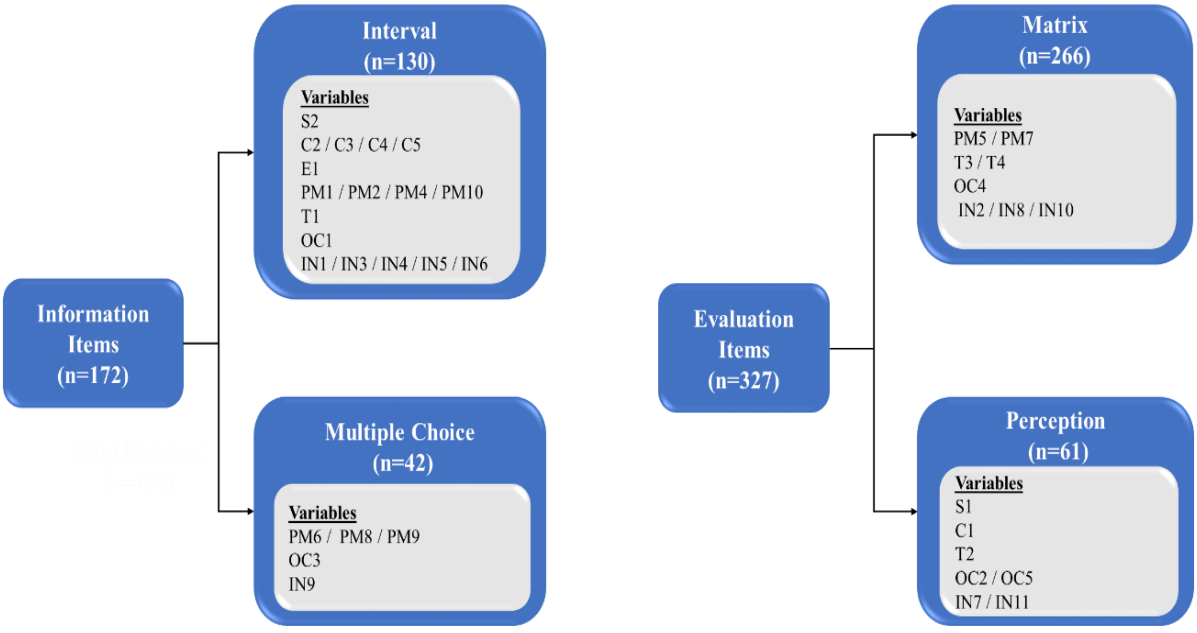


Figure 4. *Classification of the research model*

In the information items in the scales, it was requested to choose the suitable work and business processes of the business. In the evaluation items, Likert-type questions were directed to measure the perception of the effectiveness of processes within the business. With the perception items among evaluation items, attitude toward the item in the scale was measured. Matrix items were responded to when an item, about which information had been obtained, was implemented within the business. With these items, the perception of the effectiveness of this implementation in the business was measured.

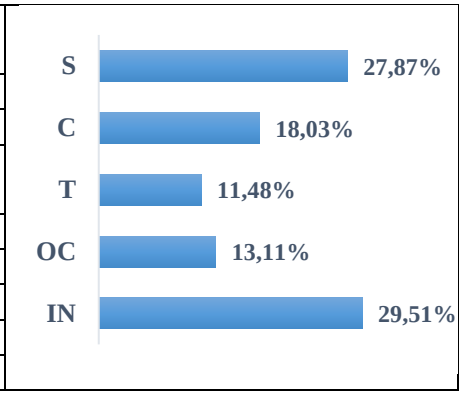
As given in Figure 4, 65.6% of the items in the scale consisted of evaluation items, and 34.5% consisted of information items. On the other hand, 81.3% of the evaluation items were included in the matrix item group, and 18.7 % in the perception item group. Additionally, information items contained 22 variables, and evaluation items contained 15 variables. To measure the level of perception of everyone about these evaluation items, reliability and validity analyses of the perception items of the scale were performed. In matrix evaluation items, information could not be obtained because the businesses participating in the evaluation did not implement the points given in the item, did not have adequate information or did not want to share information. Therefore, they were not included in the reliability and validity analysis.

4.2. Reliability and Validity Analysis

In the digital maturity model, the distribution of the variables was reviewed before the explanatory factor analysis. In Table 1, the item numbers of the variables used in the developed scale are shown.

Table 1. *Statistical results of perception items*

Dimension / Scale	**Variable**	**Number of Items**	**%**
Strategy (S)	S1	17	27.87
Customers (C)	C1	11	18.03
Technology & Data Management (T)	T2	7	11.48
Organizational Culture (OC)	OC2	4	6.56
	OC5	4	6.56
Innovation (IN)	IN7	13	21.31
	IN11	5	8.20
Total		**61**	**100.00**



According to the results obtained in Table 1, it was observed that there was a total of 61 perception items, and 27.87% of these items consisted of strategy items, and 29.51% of innovation items.

After the review of the distributions, explanatory factor analysis was conducted on the data. The number of items of the scales according to the dimensions, and the KMO and Bartlett's Test significance values are given for both samples. According to analysis results, it was observed that the sample size of each variable in the first and second samples was sufficient (KMO>0.50), and the data set was suitable for explanatory factor analysis (sig<0.05).

In the analysis, it was aimed to measure the necessity of excluding the items directed to businesses in each variable from the scale and to determine the order of items. Therefore, the order of perception items for each dimension, standardized factor loadings (λ) and Cronbach's alpha coefficients (α) were calculated for both samples. The obtained results are respectively presented in from Tables 2 to 6.

Table 2. *Factor loadings of the Strategy (S) scale and results of reliability analysis*

Items	**Factor loadings (n=50)**			**Items**	**Factor loadings (n=80)**		
	1	**2**	**3**		**1**	**2**	**3**
S1-15	0.839			S1-17	0.818		
S1-16	0.815			S1-15	0.805		
S1-17	0.785			S1-16	0.799		
S1-14	0.744			S1-4	0.715		
S1-4	0.725			S1-14	0.686		
S1-10	0.686			S1-7		0.819	
S1-6	0.587			S1-11		0.725	
S1-11		0.773		S1-10		0.705	
S1-3		0.754		S1-6		0.656	
S1-12		0.703		S1-12		0.607	
S1-7		0.657		S1-2			0.853
S1-13		0.497		S1-1			0.824
S1-9			0.842	S1-9			0.723
S1-2			0.791	S1-5			0.636
S1-1			0.780				
S1-8			0.627				
S1-5			0.576				
Cronbach's α	**0.914**	**0.840**	**0.805**		**0.883**	**0.860**	**0.825**

According to the results of the explanatory factor analysis performed for the perception items of the Strategy scale;

- In the first sample, the values of all items were high enough, and factor loadings were large enough (>0.05). These results indicated that the developed scale was consistent. Based on EFA, the perception items of the scale were divided into three factors. Cronbach's α coefficients of the factors were 0.914, 0.840, and 0.805, respectively. Since Cronbach's α coefficient was above 0.60, it was observed that the strategy dimension was measured with adequate reliability through the three factors created.
- In the second sample, items S1-3, S1-8, and S1-13, which had overlapping factor loadings, were excluded from the scale to ensure the consistency of the sample. After this process, it was observed that the values of all items were high enough, and factor loadings were large enough (>0.05). Factor loadings in the second sample were found to be higher than those in the first sample. These results showed that the developed scale was consistent. Based on EFA, the scale's perception items were divided into 3 factors. Cronbach's α coefficients of the factors were 0.883, 0.860, and 0.825, respectively. Since Cronbach's α coefficient was above 0.60, it was observed that the strategy dimension was measured with adequate reliability through the three factors created.

Table 3. *Factor loadings of the Customers (C) scale and results of reliability analysis*

Items	**Factor loadings (n=50)**			**Items**	**Factor loadings (n=80)**		
	1	**2**	**3**		**1**	**2**	**3**
C1-1	0.927			C1-3	0.883		
C1-11	0.759			C1-4	0.882		
C1-2	0.712			C1-9	0.784		
C1-10	0.591			C1-1		0.857	
C1-5	0.586			C1-11		0.768	
C1-4		0.907		C1-2		0.743	
C1-3		0.888		C1-6			0.793
C1-9		0.667		C1-8			0.740
C1-8			0.874	C1-7			0.725
C1-6			0.791				
C1-7			0.779				
Cronbach's α	**0.847**	**0.875**	**0.827**		**0.888**	**0.822**	**0.825**

According to the results of the explanatory factor analysis performed for the perception items of the Customers scale;

- In the first sample, the values of all items were high enough, and factor loadings were large enough (>0.05). These results showed that the developed scale was consistent. Based on EFA, the scale's perception items were divided into three factors. Cronbach's α coefficients of the factors were 0.847, 0.875, and 0.827, respectively. Since Cronbach's α coefficient was above 0.60, it was observed that the customers dimension was measured with adequate reliability through the three factors created.
- In the second sample, items C1-5 and C1-10, which had overlapping factor loadings, were excluded from the scale to ensure the consistency of the sample. After this process, it was observed that the values of all items were high enough, and factor loadings were large enough (p>0.05). Factor loadings in the second sample were found to be higher than those in the first sample. These results showed that the developed scale was consistent. Based on EFA, the perception items of the scale were divided into three factors. Cronbach's α coefficients of the factors were 0.888, 0.822, and 0.825, respectively. Since Cronbach's α coefficient was above 0.60, it was observed that the customers dimension was measured with adequate reliability through the three factors created.

Table 4. *Factor loadings of the Technology and Data Management (T) scale and results of reliability analysis*

Items	**Factor loadings (n=50)**	**Items**	**Factor loadings (n=80)**
	1		**1**
T2-7	0.902	T2-7	0.902
T2-5	0.848	T2-5	0.848
T2-2	0.823	T2-2	0.823
T2-1	0.770	T2-1	0.770
T2-3	0.767	T2-3	0.767
T2-4	0.765	T2-4	0.765
T2-6	0.745	T2-6	0.745
Cronbach's α	**0.906**		**0.906**

According to the results of the explanatory factor analysis performed for the perception items of the Technology and Data Management scale;

- In the first sample, the values of all items were high enough, and factor loadings were large enough (p>0.05). These results showed that the developed scale was consistent. Based on EFA, the perception items of the scale were divided into a single factor. Cronbach's α coefficient of the factors was 0.906. Since Cronbach's α coefficient was above 0.60, it was observed that the

technology and data management dimension was measured with adequate reliability through the single factor created.

- In the second sample, it was observed that the values of all items were high enough, and factor loadings were large enough (p>0.05). Factor loadings in the second sample were found to be higher than those in the first sample. These results showed that the developed scale was consistent. Based on EFA, the perception items of the scale were divided into a single factor. Cronbach's α coefficient of the factors was 0.908. Since Cronbach's α coefficient was above 0.60, it was observed that the technology and data management dimension was measured with adequate reliability through the single factor created.

Table 5. *Factor loadings of the Organizational Culture (OC) scale and results of reliability analysis*

Items	**Factor loadings (n=50)**		**Items**	**Factor loadings (n=80)**	
	1	**2**		**1**	**2**
OC5-3	0.841		OC5-3	0.813	
OC5-2	0.766		OC5-2	0.785	
OC5-4	0.773		OC5-1	0.770	
OC5-1	0.750		OC5-4	0.746	
OC2-2		0.916	OC2-2		0.902
OC2-1		0.910	OC2-1		0.890
OC2-4		0.848	OC2-4		0.839
Cronbach's α	**0.851**	**0.933**		**0.872**	**0.953**

According to the results of the explanatory factor analysis performed for the perception items of the "Organizational Culture" scale;

- In the first sample, item OC2-3, which had overlapping factor loadings, was excluded from the scale to ensure the consistency of the sample. After this process, the values of all items were high enough, and factor loadings were large enough (p>0.05). These results showed that the developed scale was consistent. Based on EFA, the scale's perception items were divided into two factors. Cronbach's α coefficients of the factors were 0.851 and 0.933, respectively. Since Cronbach's α coefficient was above 0.60, it was observed that the "Organizational Culture" dimension was measured with adequate reliability through the two factors created.
- In the second sample, it was revealed that the values of all items were high enough, and factor loadings were large enough (p>0.05). Factor loadings in the second sample were found to be higher than those in the first sample. These results showed that the developed scale was consistent. Based on EFA, the perception items of the scale were divided into two factors. Cronbach's α coefficients of the factors were 0.872 and 0.953, respectively. Since Cronbach's α coefficient was above 0.60, it was determined that the "Organizational Culture" dimension was measured with adequate reliability through the two factors created.

Table 6. *Factor loadings of the Innovation (IN) scale and results of reliability analysis*

Items	**Factor loadings (n=50)**		**Items**	**Factor loadings (n=80)**	
	1	**2**		**1**	**2**
IN7-3	0.930		IN7-3	0.935	
IN7-6	0.908		IN7-6	0.908	
IN7-13	0.898		IN7-13	0.907	
IN7-10	0.875		IN7-10	0.883	
IN7-8	0.853		IN7-8	0.862	
IN7-7	0.839		IN7-7	0.860	
IN7-9	0.817		IN7-9	0.835	
IN7-2	0.806		IN7-2	0.819	
IN7-12	0.723		IN7-11	0.714	
IN7-11	0.713		IN7-12	0.710	
IN7-4	0.697		IN7-4	0.679	
IN7-5	0.521		IN7-5	0.513	
IN11-3		0.886	IN11-3		0.885
IN11-5		0.860	IN11-5		0.860
IN11-4		0.802	IN11-2		0.809
IN11-2		0.802	IN11-4		0.801
IN11-1		0.630	IN11-1		0.601
Cronbach's α	**0.954**	**0.875**		**0.953**	**0.870**

According to the results of the explanatory factor analysis performed for the perception items of the "Innovation" scale;

- In the first sample, item IN7-1, which had overlapping factor loadings, was excluded from the scale to ensure the consistency of the sample. After this process, the values of all items were high enough, and factor loadings were large enough ($p>0.05$). These results showed that the developed scale was consistent. Based on EFA, the perception items of the scale were divided into two factors. Cronbach's α coefficients of the factors were 0.954 and 0.875, respectively. Since Cronbach's α coefficient was above 0.60, it was observed that the "Innovation" dimension was measured with adequate reliability through the two factors created.
- In the second sample, it was revealed that the values of all items were high enough, and factor loadings were large enough ($p>0.05$). Factor loadings in the second sample were found to be higher than those in the first sample. These results show that the developed scale is consistent. Based on EFA, the perception items of the scale were divided into two factors. Cronbach's α coefficients of the factors were 0.953 and 0.870, respectively. Since Cronbach's α coefficient was above 0.60, it was identified that the "Innovation" dimension was measured with adequate reliability through the two factors created.

In the analysis, it was investigated whether the correlation values of the matrix diagonal were greater than 0.50 in the anti-image correlation matrix for each dimension, and if any, the items with lower values were excluded from the scale. According to the results obtained from both sample analyses, the correlation value of the matrix diagonal was greater than 0.50 for the items that constituted all the variables. Therefore, no items other than those previously excluded were excluded from the scale. The items excluded from the scales were excluded due to items' loading in more than one factor.

After determining the existing scales in factor analysis, these factors were named. In the study, the results of both samples were reviewed, and the variables, the number of factors they formed and the factor names are presented in Table 7.

Table 7. *Labelling the factors*

Dimension / Scale	**Number of Factors**	**Factor No**	**Factor Label**	**Number of Items**
Strategy (S)	3	1	Sa	5
		2	Sb	5
		3	Sc	4
Customers (C)	3	1	Ca	3
		2	Cb	3
		3	Cc	3
Technology & Data Management (T)	1	1	Ta	7
Organizational Culture (OC)	2	1	OCa	4
		2	OCb	3
Innovation (IN)	2	1	Ina	12
		2	INb	5

As a result of the analyses and reductions, it was observed that the items related to the perception evaluation questions were comprised of a total of 20 factors and 54 items. While naming the factors, "a, b, c" were added to the end of the dimension name in alphabetical order. According to Table 7, the perception items of the S dimension were constructed from three factors. Therefore, factor names were determined as Sa, Sb, Sc.

The summary results obtained from the analyses and the items excluded from the scales are given in Table 8.

Table 8. *Summary results*

			Sample 1 (n=50)			**Sample 2 (n=80)**		
Dimension / Scale	**Variable**	**Factor**	**Removed**	**KMO**	**α**	**Removed**	**KMO**	**α**
Strategy (S)	S1	Sa	---	0.836	0.914	S1-3	0.853	0.883
		Sb			0.840	S1-8		0.860
		Sc			0.805	S1-13		0.825
Customers (C)	C1	Ca	---	0.754	0.847	C1-5	0.795	0.888
		Cb			0.875	C1-10		0.822
		Cc			0.827			0.825
Technology & Data Management (T)	T2	Ta	---	0.834	0.906	---	0.869	0.908
Organizational Culture (OC)	OC5	OCa	OC2-3	0.775	0.851	OC2-3	0.859	0.872
	OC2	OCb			0.933			0.953
Innovation (IN)	IN7	Ina	IN7-1	0.767	0.954	IN7-1	0.748	0.953
	IN11	INb			0.875			0.870

The summary results of the analysis given in Table 8 showed that all values in the model were at an acceptable level, and three items were excluded from the Strategy dimension, two from the Customers dimension, and one from each of the "Organizational Culture" and "Innovation" dimensions. Hence, the total number of perception items in the model was reduced to 54.

4.3. Determination of Model Criteria

The criteria for both dimensions were determined by evaluating the results obtained from the factor analysis of the perception items in the model, the contents of the other items in the model other than the perception items, and the models reviewed in the literature. The dimensions and criteria of the digital maturity model developed within the scope of the study are stated in Figure 5.

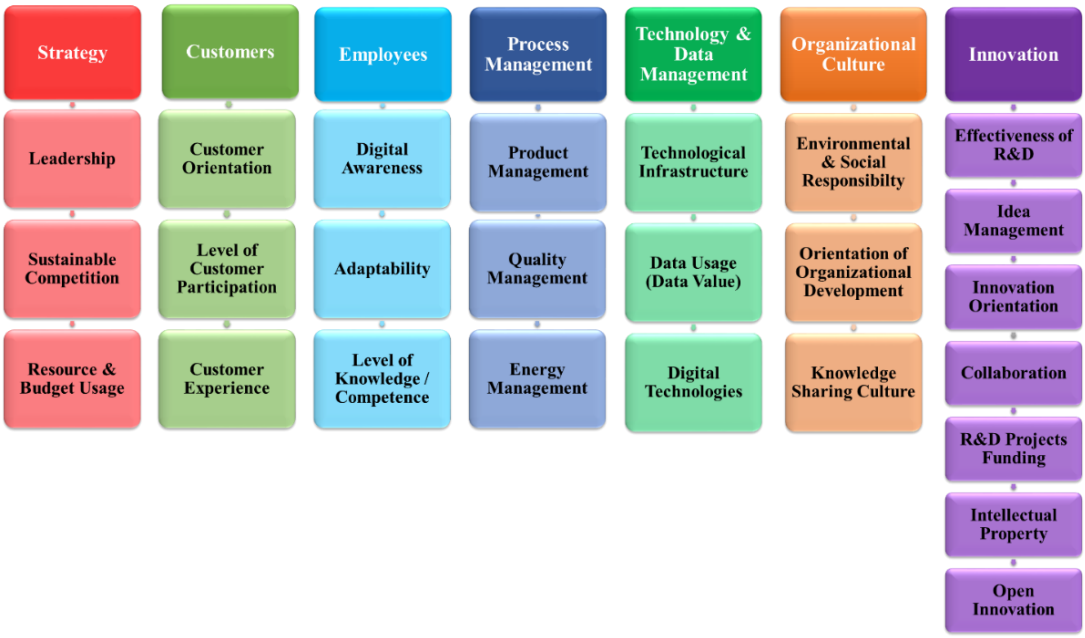


Figure 5. *Digital maturity model structure*

As can be seen in Figure 5, the model consisted of three criteria in the dimensions of “Strategy”, “Customers”, “Employees”, “Process Management”, “Technology and Data Management” and “Organizational Culture”, and seven criteria in the “Innovation” dimension. In the model, there were 7 dimensions and 25 criteria in total.

Upon reviewing the criteria formed, quality management, energy management, and environmental/social responsibility were considered as separate criteria. Furthermore, the level of use of business resources for digital transformation in the dimension of Strategy was also examined.

5. CONCLUSION AND DISCUSSION

Digital transformation has become important in the emergence of needs such as triggering change in businesses and creating organizational value [13]. Digital transformation is that a business undergoes a very serious change in its digital systems. Workflows are reconsidered, and manual processes can become fully digital processes. This transformation can lead to digital maturity in businesses. Therefore, it is necessary to determine the current situation of businesses and initiate the necessary improvements and changes within the business. Thus, it will be possible for businesses to develop a roadmap that they can follow for the digital transformation process [77].

In this study, it was aimed to develop a digital maturity model evaluating environmental factors (sustainability) and to conduct confirmation and validation tests of the developed model. After an in-depth literature review for scale development, the dimensions were specified for the model, and an item pool was created. After this stage, the items and dimensions in the model were determined by receiving expert opinions.

Within the scope of the developed model, items regarding environmental/social responsibility, energy management, and product recovery activities were included. Moreover, since the model addressed businesses of all sizes and all sectors, the analysis results of large-scale businesses and SMEs could be compared and classified according to sectors. Additionally, "I don't know" and "I don't want to share information" options were also added to the items constructed in the form of the Likert-type scale in the developed model, unlike other models. By this means, through the scale developed, it was aimed to learn the digital awareness of businesses and the culture of external sharing. From all these perspectives, the model is expected to contribute to businesses and researchers.

The confirmation and validation of the model were carried out with two sample businesses operating in Turkey. Explanatory factor analysis and Cronbach's alpha coefficient methods were used for the confirmation and validation of the scale. The analysis results indicated that the model developed within the scope of the study was consistent and could be perceived by everyone in the same way.

The findings obtained as a result of the study revealed that the developed digital maturity model was applicable for businesses in Turkey. With the implementation of the model developed in the research, it was aimed for businesses to set forth their status and digital goals. However, the study also has some limitations. Limitations of the study include the fact that the study only addressed manufacturing businesses, not all the manufacturing sectors could be reached, the study could not be conducted at a global scale since it was in Turkish, and the management levels of the business participants were not equal.

The evaluation method of the maturity model developed and its levels can be determined in future research. With these evaluations, scores of the criteria and dimensions can be weighted. Moreover, a contribution to the literature can be made by classifying the digital maturity levels of businesses according to business characteristics.

Reshaping technological developments in such industries as big data and analytics, cloud computing, artificial intelligence, robotic systems, machine learning and mobile technologies, and the internet of things will accelerate digital transformation. It will have a great effect on the business and organizational activities, processes, and the increase in the competencies of the businesses, and the business models will undergo a profound transformation. New systems and technologies are introduced to the market every day. The more businesses adopt and adapt to digital solutions as part of their production processes, the higher their competitive advantage in the market will be. Besides, the businesses that reach digital maturity have a chance to surpass their peers and gain a larger share of their customer base in the industry.

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CONFLICTS OF INTEREST

No conflict of interest was declared by the authors.

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