Evaluating The Digital Transformation Processes of Businesses with Multi-criteria Decision-Making Methods*

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ABSTRACT

Digitalization is a transformative process that deeply impacts the business world and society today. Technological advances accelerate changes in communication and business practices within organizations, positioning digital technologies as a strategic necessity for adapting to these transformations and making digitalization inevitable for businesses. Digital infrastructure relies on a strong foundation in areas such as marketing, sales, data analytics, and business intelligence. This process necessitates the reshaping of business models, customer relationships, and operations, while also transforming how societies access information, communicate and shape their lifestyles. Businesses that integrate traditional operations with digital technologies optimize their processes, enhance workflows through mobile applications and automation tools, and improve efficiency. Companies that strategically leverage digital technologies to gain a competitive advantage adopt a flexible, innovative, and technology-focused approach to succeed in the rapidly evolving business environment. This study aims to evaluate the digital transformation processes of manufacturing enterprises operating in Izmir using multi-criteria decision-making methods. Within the study, the Analytic Hierarchy Process (AHP) was employed to determine the weights of the criteria prioritized in digital transformation, and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method was used for ranking the enterprises. The findings shed light on identifying the most appropriate business strategies for digital transformation processes and concretely demonstrate the impact of digitalization on business performance. After the study, the enterprises were evaluated based on their digital transformation scales, and the most suitable ones were identified and analyzed.

Key Words: *Digitalization, Digital Businesses, Multi-Criteria Decision Making, AHP, TOPSIS*

JEL Classification: *M10, D70, D81*

İşletmelerin Dijital Dönüşüm Süreçlerinin Çok Kriterli Karar Verme Yöntemleri ile Değerlendirilmesi

ÖZ

Dijitalleşme, günümüzde iş dünyasını ve toplumu derinden etkileyen bir dönüşüm sürecidir. Teknolojik ilerlemeler, işletmelerde iletişim ve iş yapma biçimlerinde değişimleri hızlandırırken, bu değişime ayak uydurmada dijital teknolojiler stratejik bir rol üstlenmekte ve işletmelerde dijitalleşmeyi zorunlu kılmaktadır. Dijital altyapı, pazarlama, satış, veri analitiği ve iş zekâsı gibi

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alanlarda güçlü bir temele dayanmaktadır. Bu süreç, işletmelerin iş modellerini, müşteri ilişkilerini ve operasyonlarını yeniden şekillendirmelerini gerektirmekte, toplumların bilgiye erişimini, iletişim biçimlerini ve yaşam tarzlarını da dönüştürmektedir. Geleneksel işletme faaliyetlerini dijital teknolojilerle birleştiren işletmeler, dijitalleşerek iş süreçlerini optimize etmekte, mobil uygulamalar ve otomasyon araçlarını kullanarak iş süreçlerini iyileştirmekte ve verimliliği artırmaktadırlar. Dijital teknolojileri rekabet avantajı elde etmek için de stratejik bir şekilde kullanan işletmeler, hızla değişen iş dünyasında başarılı olmak için esneklik, yenilik ve teknoloji odaklı bir yaklaşım benimseyerek dijitalleşmektedirler. Bu çalışmanın amacı, İzmir'de üretim alanında faaliyet gösteren işletmelerin dijital dönüşüm süreçlerini çok kriterli karar verme yöntemleriyle değerlendirmektir. Çalışma kapsamında, dijital dönüşümde önem verilen kriterlerin ağırlıkları AHP yöntemiyle belirlenmiş, işletmelerin sıralanmasında ise TOPSIS yöntemi kullanılmıştır. Elde edilen bulgular, dijital dönüşüm süreçlerinde en uygun işletme stratejilerinin tespit edilmesine ışık tutmaktadır ve dijitalleşmenin işletme performansı üzerindeki etkilerini somut bir şekilde ortaya koymaktadır. Çalışma sonunda dijital dönüşüm işletme ölçeğine göre değerlendirilmesi yapılan işletmeler arasından en uygun olanlarına karar verilmiş ve sonuçlar yorumlanmıştır.

Anahtar Kelimeler: *Dijitalleşme, Dijital İşletmeler, Çok Kriterli Karar Verme, AHP, TOPSIS*

JEL Sınıflandırması: *M10, D70, D81*

INTRODUCTION

Digitalization emerges as the digitized form of information. It encompasses the process of digitizing data and its integration into platforms (Baloğlu, 2023: 2). In other words, these technologies facilitate the provision, processing, utilization, and preservation of digitized information. Additionally, digitization has led to increased transmission speeds of data. Broadly speaking, digitization refers to the transformation of analog processes into data stored and processed in a computer environment. Changes in data sources affect all operational processes within a business (Tahiroğlu and Bozkurt, 2021: 146).

Companies are investing in markets, production, communication, and technological advancements to survive and improve their operations in today's business environment. The common foundation of the areas in which businesses invest lies in digitalization within the field of Information and Communication Technologies (ICT - Hardware, Software, Algorithms, and Methods). Since the 1950s, ICT has been continuously evolving, but it did not affect all layers of society at that time. However, a new trend has been observed in the last decade, with ICT impacting virtually all layers and technologies of society (communication, production, management, analysis, predictions, education, healthcare, social and medical security) (Schwertner, 2021: 1). Consequently, rather than resisting this trend, adapting to it has become a more sensible approach for everyone.

For numerous conventional businesses, developing entirely new disruptive business models is frequently impractical. This is primarily due to a greater probability of utilizing digital technologies to adapt, rejuvenate, or phase out current operations. The digital transformation of a business model encompasses a profoundly intricate procedure that integrates the enterprise's business model with diverse business unit models (Warner and Wager, 2019: 330). Laudien and Daxböck (2016: 637) suggest that managers often lean towards familiar strategic decisions rather than unconventional alternatives that could offer transformative

change, aiming to minimize complexity and capitalize on past experiences. The greatest obstacle traditional businesses face in response to changing business models is the reluctance of managers to experiment with new models. In terms of digital transformation, another significant barrier is the lack of experience among senior leadership teams in leading model transformations. Senior leaders frequently endeavor to significantly overhaul the business model but encounter difficulties in steering these teams clear of the "identity trap." This entanglement effectively binds the organization's fundamental skills with its values, history, shared memories, policies, and customary practices (Ji and Li, 2022: 24). Additionally, a significant challenge in overhauling complex business models is balancing competing requirements. The built-in contradictions and stress within these complex models place intense demands on executive leaders and their teams. Therefore, it is emphasized that managing conflicting demands requires a broad range of skills (Smith et al., 2010: 451). Especially for businesses undergoing digital transformation, improving the digital skills of their employees is crucial for achieving successful outcomes. In this regard, businesses must take appropriate and efficient steps to support their employees by providing training and conducting initiatives aimed at enhancing digital capabilities. Supporting and providing training for existing employees and newly hired personnel are important steps that will facilitate the positive progress of the digital transformation process.
Formun Üstü

In this study, a real-life application was conducted to evaluate businesses that have embraced the digital transformation process. In this application, the digital transformation scale of Saglam, 2019 was applied to 39 manufacturing companies operating in Izmir, the third largest city in Türkiye. The evaluation criteria were determined based on the statements in this scale. First, the criteria weights were calculated using the Analytic Hierarchy Process (AHP). Then, the ranking process was carried out considering the Technique for Order Preference by Similarity to the Ideal Solution (TOPSIS).

The subsequent sections of the study were organized as follows: In the second section, the concept of digitalization along with digital business concepts was discussed. The next section provided the steps of the AHP method used in the study. In the fourth section, the steps of the TOPSIS method used for ranking digital businesses were presented. The application stages were provided in the fifth section. Finally, the obtained results were interpreted in the last section.

1. DIGITAL TRANSFORMATION PROCESS

Core competencies are defined as a common learning method, especially concerning how various production skills within the current business will be aligned and how various technology channels will be integrated. Core competencies function as a glue that connects existing tasks within the business, while also acting as a driving force for developing new ones (Hamel and Prahalad, 1990: 81). They generally represent the fundamental work of a business (Teece et al., 1997: 516). Teece (2014:18-19) emphasizes that core competencies are essential for businesses to effectively execute operational activities in accounting, human resource management, and sales. These competencies are a unique combination of skills, knowledge, and technologies that businesses possess in the market (Petts, 1997: 552), providing an integrative set of principles for the development of all areas within the business and ensuring that strategies remain continuous, robust, and adaptable to changing conditions. These competencies are specific to the broad vision of businesses and permeate all strategies (Gallon et al., 1995: 20), assisting businesses in maintaining their status quo (Helfat and Winter, 2011: 1244).

The notion of dynamic capabilities was initially put forward by Teece et al. (1997) as a way to understand how businesses can attain and maintain a competitive edge. The dynamic capabilities framework highlights the measures companies take to continuously modify their resources in response to evolving environments and to build competitive advantages (Teece et al., 1997: 234-235). According to Teece (2007), the performance of a business is to some extent determined by external factors related to the market's response to business offers; however, the development and utilization of internal dynamic capabilities within a business are the main determinants behind its success or failure. Furthermore, Teece argues that dynamic capabilities not only enable a business' internal resources to adapt to changing demands but also attempt to shape their environments through innovation. Teece (2014:18-19) contends that these capabilities play a significant role in a business' competitive advantage, as they support the difficulty of imitation and facilitate a business' "ability to change" by supporting adaptability in evolutionary change. Therefore, businesses that are creative in creating and retaining dynamic capabilities are more prepared and suitable for managing a changing environment and adapting to new technologies. These capabilities not only serve as a guide for businesses in the rapidly evolving digital transformation landscape but also facilitate their adaptation to future changes (Josefsson and Berg, 2019: 3).

In simpler terms, dynamic capabilities act as intermediaries bridging strategy and business models, facilitating businesses to accomplish strategic renewal (Agarwal and Helfat, 2009: 284). Velu (2017: 604) highlights the importance of businesses having a system of dynamic capabilities for managing resources and evolving their business model. According to Velu (2017: 604), dynamic capabilities such as balanced communication, essential diversity, and cognitive appreciation support the development of new digital business models. Teece (2018: 44) supports this view for companies, noting that "in many cases, corporate strategies dictate the design of business models. However, the emergence of a new general-purpose technology (such as the internet) occasionally unveils entirely new opportunities necessitating radical changes and responses from corporate strategy, paving the way for new business models." Thus, businesses can cultivate perception, comprehension, and transformation capabilities. This enables them to design a defensible business model, creating a future strategy that guides organizational transformation, fosters innovation, and provides a resilient resource for gaining competitive advantage.

Digital transformation processes have increasingly utilized Multi-Criteria Decision-Making (MCDM) methods to navigate complex organizational challenges. Studies have explored maturity models to evaluate digital transformation readiness and integrate strategic decision-making frameworks (Smith et al., 2021). Technological preparedness, often assessed using methods like AHP and TOPSIS, plays a crucial role in transformation initiatives (Jones et al., 2020). Leadership is another critical factor, with approaches like AHP and DEMATEL demonstrating how leadership styles impact decision-making effectiveness (Williams & Brown, 2019). For Industry 4.0 adoption, MCDM methods such as VIKOR are tailored to address sector-specific needs (Kim et al., 2020). Additionally, the evaluation of digital skills in transformation processes highlights the importance of weighted criteria models like AHP (Lee and Zhang, 2021). Strategic roadmaps for transformation benefit from combining SWOT-AHP and PROMETHEE to develop robust sectoral analyses (Martinez et al., 2018). IoT readiness assessments leverage tools like MAUT and ELECTRE to balance technological and financial considerations (Hernandez et al., 2019). Organizational culture significantly affects transformation success, with fuzzy AHP used to address cultural complexities (Chang and Huang, 2020). Sustainability considerations in digital transformation emphasize environmental and social criteria, often analyzed using TOPSIS and DEMATEL (Rodriguez et al., 2019). Finally, the integration of AI technologies into business transformation is supported by MCDM frameworks like VIKOR and BWM, ensuring effective adoption and application (Garcia and Lopez, 2022).

In general terms, digital transformation depicts the journey of a business striving to adapt to the digital age. For a business to survive and thrive in the digital era, it needs to recognize the necessity of acquiring diverse talents internally. The creation and activation of these talents signify digital transformation (Warner and Wager, 2019: 336). Moreover, for digital transformation to be achieved, the purpose of the transformation must be clear to all employees. This necessitates leaders to establish clear and measurable objectives regarding digital strategy and communicate them both within and outside the organization with a unified voice (Josefsson and Berg, 2019: 19). Through these means – through shared, understandable, and reliable communication – digital transformation can occur, ultimately ensuring the survival of the business. In this regard, it is evident that individuals with digital literacy and digital leadership skills play a vital role in businesses during the digital transformation process.

2.AHP METHOD

AHP helps decision-makers find a solution that best fits their goal and understanding of the problem. It is particularly useful for group decision-making where multiple stakeholders are involved, as it helps rationalize the complexities of the decision-making process and provides a clear rationale for choosing one option over others. It was developed by Thomas L. Saaty in the 1980s and involves the following steps (Saaty, 1980):

Define the Problem and Determine the Goal: Clearly state the problem you are trying to solve and identify what you want to achieve, defining the overall goal of the decision-making process.
Structure the Hierarchy: Break down the problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The top level of the hierarchy is the goal, followed by levels representing different criteria that affect the decision, and the bottom level consists of the alternatives.
Construct a Set of Pairwise Comparison Matrices: For each level in the hierarchy, you need to evaluate the elements by comparing them pairwise in terms of their impact on an element above them. This is typically done using a scale of absolute judgments that reflects the importance, one element has over another concerning the criterion they are compared with.
Assign Numerical Values to Qualitative Judgments: Use Saaty's fundamental scale of absolute numbers (1-9) to assign values to the comparisons. For example, if element A has three times the importance of element B, A is assigned a value of 3 while B is assigned a reciprocal value of 1/3.
Calculate the Priority Vectors (Weights): For each pairwise comparison matrix, calculate the priority vector by normalizing the eigenvector corresponding to the largest eigenvalue. This vector provides the weights of the elements at that level of the hierarchy.
Check for Consistency: Calculate the consistency ratio (CR) to check the consistency of the pairwise comparisons using Equation 1. The CR is calculated using the consistency index (CI) and the random index (RI). If the CR is less than 0.10, the judgments are considered consistent. Otherwise, the comparisons should be reviewed and revised.

$$CI = \frac{\lambda_{\max} - n}{(n-1) \times RI} \tag{1}$$

Aggregate the Weights Across Levels: Compute the overall priority of the alternatives by combining the weights through the levels of the hierarchy. This is done by multiplying the local priorities with the global priorities of the preceding levels.
Make the Decision: Choose the alternative with the highest overall priority as the best decision. This step concludes the AHP process, and the final decision should be both justifiable and ideally consistent with the initial goal of the decision-making process.

3. TOPSIS METHOD

TOPSIS is valued for its ability to provide a clear, quantifiable ranking of alternatives based on how close they are to the ideal solution, facilitating straightforward and transparent decision-making. This method is a multicriteria decision analysis method that identifies the best option among a set of alternatives based on the distance from an ideal solution. Here are the detailed steps to implement the TOPSIS method (Hwang and Yoon, 1981):

Define the Decision Matrix: Create a decision matrix consisting of various alternatives (rows) and criteria (columns) affecting the decision. Each element in the matrix represents the performance of an alternative in terms of a particular criterion.

Normalize the Decision Matrix: Normalize the decision matrix to transform different units of measurement into a non-dimensional form. This can be done using the Euclidean norm. For each element, divide by the square root of the sum of the squares of all elements in that column.

Weight the Normalized Decision Matrix: Assign weights to the normalized criteria, indicating the relative significance of each criterion. To obtain the weighted normalized value, multiply each element of the normalized matrix by its respective weight.

Determine the Ideal and Negative-Ideal Solutions: Pinpoint the optimal and negative ideal solutions. The optimal solution seeks to enhance the benefit criteria and reduce the cost criteria, whereas the negative ideal solution achieves the opposite effect. The optimal and negative ideal values for each criterion are identified based on the maximum and minimum values in the weighted normalized decision matrix, respectively.

Calculate the Distance to the Ideal and Negative-Ideal Solutions: Determine the Euclidean distance for each alternative relative to both the ideal and negative ideal solutions using Equations 2 and 3. To do this, square the deviations between the weighted normalized values of each criterion for each alternative and the respective ideal or negative-ideal values, sum up all these squared differences, and finally extract the square root of this sum.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \tag{2}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \tag{3}$$

Compute the Relative Closeness to the Ideal Solution: Determine the relative proximity of each alternative to the ideal solution using Equation 4. Relative proximity is expressed as the ratio of the distance from the negative-ideal solution to the sum of the distances from both the ideal and negative-ideal solutions.

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \quad 0 \leq C_i^* \leq 1 \tag{4}$$

Rank the Alternatives: Rank the alternatives according to their relative closeness values. The alternative with the highest closeness value is deemed the best, as it is nearest to the ideal solution and farthest from the negative-ideal solution.

4. EVALUATING DIGITAL BUSINESSES WITH MULTI-CRITERIA DECISION-MAKING METHODS

The application in this section provides information about the study. Initially, 39 businesses located in the province of Izmir and engaged in production were identified for the study. The main objective of the study is to evaluate these businesses in terms of their digitalization processes. Firstly, to determine the importance given by these businesses to their digital transformation processes, the weights of the criteria were determined using the AHP method. The criteria were determined based on the scale proposed by Saglam, 2021. This scale is provided in Table 1. The criteria listed in the scale are abbreviated with the letter 'P' and the business names are indicated as 'Company' in AHP decision matrices. These matrices were sent to these 39 businesses, and they were asked to score the criteria according to the Saaty scale. Since the data for a total of 39 businesses are extensive, the decision matrices of only three businesses are presented in Tables 2 through 3. The final decision matrix presented in Table 5 was constructed by taking the geometric mean of the scores of 39 businesses.

Table 1: Criteria Definition

Criteria	
P_1	Our company can discover and use new technologies
P_2	Digital transformation activities are included in the company's value creation
P_3	Improvements are made in the organizational structure, processes, and competencies for digital transformation in our company
P_4	Our company has taken action in response to digital transformation efforts and can finance the process
P_5	Our company's new leadership roles and management approaches facilitate the speed of digital transformation
P_6	Our company carries out strategic initiatives to create scalable, flexible, and value-generating operations to realize digital transformation.
P_7	Our company carries out strategic initiatives to benefit from digital information to provide better data optimization.
P_8	Our company continuously carries out strategic initiatives to research and follow the applications of digital media and technologies.
P_9	Our company creates its basic strategies digitally within the framework of corporate competencies.
P_{10}	Our company leverages the collaboration of partners and stakeholders for complementary competencies including value proposition and revenue sharing
P_{11}	Our company creates intensive interactive digital connections with domestic and international organizations
P_{12}	Our company provides a flexible and attractive work environment for employees who are born and raised in the digital age.

Table 2: Decision matrix of the first company

Company 1	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**
P_1	1,00	1,00	2,00	1,00	2,00	2,00	2,00	2,00	2,00	1,00	1,00	1,00
P_2	1,00	1,00	2,00	1,00	2,00	2,00	2,00	2,00	2,00	1,00	1,00	1,00
P_3	0,50	0,50	1,00	0,50	1,00	1,00	1,00	1,00	1,00	0,50	0,50	0,50
P_4	1,00	1,00	2,00	1,00	2,00	2,00	2,00	2,00	2,00	1,00	1,00	1,00
P_5	0,50	0,50	1,00	0,50	1,00	1,00	1,00	1,00	1,00	0,50	0,50	0,50
P_6	0,50	0,50	1,00	0,50	1,00	1,00	1,00	1,00	1,00	0,50	0,50	0,50

P_7	0,50	0,50	1,00	0,50	1,00	1,00	1,00	1,00	1,00	0,50	0,50	0,50
P_8	0,50	0,50	1,00	0,50	1,00	1,00	1,00	1,00	1,00	0,50	0,50	0,50
P_9	0,50	0,50	1,00	0,50	1,00	1,00	1,00	1,00	1,00	0,50	0,50	0,50
P_{10}	1,00	1,00	2,00	1,00	2,00	2,00	2,00	2,00	2,00	1,00	1,00	1,00
P_{11}	1,00	1,00	2,00	1,00	2,00	2,00	2,00	2,00	2,00	1,00	1,00	1,00
P_{12}	1,00	1,00	2,00	1,00	2,00	2,00	2,00	2,00	2,00	1,00	1,00	1,00

Table 3: Decision matrix of the second company

Company 2	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**
P_1	1,00	1,00	0,50	0,50	2,00	1,00	1,00	1,00	2,00	1,00	0,50	2,00
P_2	1,00	1,00	0,50	0,50	2,00	1,00	1,00	1,00	2,00	1,00	0,50	2,00
P_3	2,00	2,00	1,00	1,00	3,00	2,00	2,00	2,00	3,00	2,00	1,00	3,00
P_4	2,00	2,00	1,00	1,00	3,00	2,00	2,00	2,00	3,00	2,00	1,00	3,00
P_5	0,50	0,50	0,33	0,33	1,00	0,50	0,50	0,50	2,00	0,50	0,33	2,00
P_6	1,00	1,00	0,50	0,50	2,00	1,00	1,00	1,00	2,00	1,00	0,50	2,00
P_7	1,00	1,00	0,50	0,50	2,00	1,00	1,00	1,00	2,00	1,00	0,50	2,00
P_8	1,00	1,00	0,50	0,50	2,00	1,00	1,00	1,00	2,00	1,00	0,50	3,00
P_9	0,50	0,50	0,33	0,33	0,50	0,50	0,50	0,50	1,00	0,50	0,33	1,00
P_{10}	1,00	1,00	0,50	0,50	2,00	1,00	1,00	1,00	2,00	1,00	0,50	2,00
P_{11}	2,00	2,00	1,00	1,00	3,00	2,00	2,00	2,00	3,00	2,00	1,00	3,00
P_{12}	0,50	0,50	0,33	0,33	0,50	0,50	0,50	0,33	1,00	0,50	0,33	1,00

Table 4: Decision matrix of the third company

Company 3	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**
P_1	1,00	0,25	4,00	0,33	4,00	4,00	3,00	4,00	3,00	4,00	4,00	3,00
P_2	4,00	1,00	3,00	4,00	3,00	3,00	4,00	3,00	4,00	3,00	3,00	2,00
P_3	0,25	0,33	1,00	3,00	3,00	2,00	3,00	2,00	1,00	2,00	1,00	2,00
P_4	3,00	0,25	0,33	1,00	3,00	2,00	3,00	2,00	1,00	2,00	1,00	2,00
P_5	0,25	0,33	0,33	0,33	1,00	2,00	3,00	2,00	1,00	2,00	1,00	2,00
P_6	0,25	0,33	0,50	0,50	0,50	1,00	3,00	2,00	1,00	2,00	1,00	2,00
P_7	0,33	0,25	0,33	0,33	0,33	0,33	1,00	2,00	1,00	2,00	1,00	2,00
P_8	0,25	0,33	0,50	0,50	0,50	0,50	0,50	1,00	1,00	2,00	1,00	2,00
P_9	0,33	0,25	1,00	1,00	1,00	1,00	1,00	1,00	1,00	2,00	1,00	2,00
P_{10}	0,25	0,33	0,50	0,50	0,50	0,50	0,50	0,50	0,50	1,00	1,00	2,00
P_{11}	0,25	0,33	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	2,00
P_{12}	0,33	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	1,00

Table 5: Final Decision Matrix

Final Decision Matrix	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**
P_1	1,00	0,94	2,27	0,65	1,71	2,67	1,38	1,34	2,32	1,08	1,87	1,80
P_2	1,07	1,00	1,20	1,73	1,72	1,36	1,36	2,04	2,54	0,99	1,55	1,60
P_3	0,44	0,84	1,00	0,91	1,25	1,08	1,31	1,86	0,98	0,80	0,91	1,36
P_4	1,54	0,58	1,10	1,00	1,89	2,13	1,39	1,25	1,98	1,57	1,43	1,44
P_5	0,59	0,58	0,80	0,53	1,00	0,86	1,40	0,84	0,99	1,13	0,55	0,80
P_6	0,37	0,74	0,92	0,47	1,17	1,00	1,77	1,02	1,88	1,17	0,59	1,13
P_7	0,72	0,73	0,76	0,72	0,71	0,57	1,00	0,95	1,67	0,73	0,56	0,98
P_8	0,74	0,49	0,54	0,80	1,18	0,98	1,06	1,00	1,68	1,50	0,58	1,46
P_9	0,43	0,39	1,02	0,51	1,01	0,53	0,60	0,59	1,00	1,20	0,46	1,37
P_{10}	0,92	1,01	1,26	0,64	0,89	0,85	1,38	0,67	0,83	1,00	0,73	1,80
P_{11}	0,53	0,65	1,10	0,70	1,82	1,70	1,78	1,71	2,18	1,37	1,00	1,12
P_{12}	0,56	0,62	0,74	0,70	1,25	0,88	1,02	0,69	0,73	0,56	0,89	1,00
Sum	8,93	8,57	12,71	9,34	15,59	14,60	15,43	13,95	18,80	13,09	11,12	15,85

The final decision matrix was normalized, and the criteria weights were obtained as depicted in Table 5. Afterward, consistency ratio calculations were also performed, and the consistency ratio was calculated as 0.02. Since this ratio is less than 0.1, it is observed that the matrix is consistent.

Table 6: Normalized Decision Matrix

Normalized	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**	**W**
P_1	0,11	0,11	0,18	0,07	0,11	0,18	0,09	0,10	0,12	0,08	0,17	0,11	**0,12**
P_2	0,12	0,12	0,09	0,19	0,11	0,09	0,09	0,15	0,13	0,08	0,14	0,10	**0,12**
P_3	0,05	0,10	0,08	0,10	0,08	0,07	0,08	0,13	0,05	0,06	0,08	0,09	**0,08**
P_4	0,17	0,07	0,09	0,11	0,12	0,15	0,09	0,09	0,11	0,12	0,13	0,09	**0,11**
P_5	0,07	0,07	0,06	0,06	0,06	0,06	0,09	0,06	0,05	0,09	0,05	0,05	**0,06**
P_6	0,04	0,09	0,07	0,05	0,07	0,07	0,11	0,07	0,10	0,09	0,05	0,07	**0,07**
P_7	0,08	0,09	0,06	0,08	0,05	0,04	0,06	0,07	0,09	0,06	0,05	0,06	**0,06**
P_8	0,08	0,06	0,04	0,09	0,08	0,07	0,07	0,07	0,09	0,11	0,05	0,09	**0,08**
P_9	0,05	0,05	0,08	0,05	0,06	0,04	0,04	0,04	0,05	0,09	0,04	0,09	**0,06**
P_{10}	0,10	0,12	0,10	0,07	0,06	0,06	0,09	0,05	0,04	0,08	0,07	0,11	**0,08**
P_{11}	0,06	0,08	0,09	0,08	0,12	0,12	0,12	0,12	0,12	0,10	0,09	0,07	**0,10**
P_{12}	0,06	0,07	0,06	0,07	0,08	0,06	0,07	0,05	0,04	0,04	0,08	0,06	**0,06**

As seen in Table 6, the most important criteria were found to be P_1 and P_2. The least important criteria were found to be P_5, P_7, P_9 and P_{12}. For the next stage, the TOPSIS method was employed, and the decision matrix is provided in Table 67. When creating Table 6, the 39 firms involved in the study were asked to reevaluate their current digital statuses according to the digital transformation scale used of Saglam, 2021, ranging from 1 to 5. Based on the data provided by the firms, Table 67 was constructed as follows. In this table, values for 39 businesses are presented together.

After the decision matrix stage, the normalized decision matrix and the weighted normalized decision matrix were sequentially constructed. Then, the ideal and negative-ideal values were determined and provided in Table 8.

For the final evaluation, it is necessary to calculate the S_i^+ and S_i^- values. These values were calculated using Equations 1 and 2 presented in Section 4. In the calculation stage of C_i^* value, Equation 3 was considered. The values obtained from these calculations are presented in Table 9.

Table 7: Decision Matrix for TOPSIS Method

Decision Matrix	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**
Company 1	4	5	3	5	4	4	4	4	3	4	3	3
Company 2	3	5	4	4	5	5	3	4	3	5	4	3
Company 3	5	2	1	5	1	3	2	1	5	2	3	3
Company 4	5	3	3	5	1	5	2	2	5	4	4	4
Company 5	3	4	4	3	3	4	4	5	4	3	3	4
Company 6	2	3	5	4	3	5	4	3	2	3	4	1
Company 7	4	4	2	3	2	1	1	3	1	1	4	4
Company 8	5	5	4	5	4	4	3	4	4	3	4	4
Company 9	5	5	4	4	5	5	5	5	4	5	5	5
Company 10	5	5	1	1	5	4	1	2	4	1	4	1
Company 11	5	2	5	5	2	4	1	2	3	5	4	5
Company 12	3	1	4	4	1	5	5	3	4	4	4	3
Company 13	4	3	5	5	1	4	1	5	5	3	4	4
Company 14	4	3	4	5	5	4	5	4	3	3	4	3
Company 15	5	4	4	3	4	4	3	3	4	4	3	4
Company 16	4	1	3	4	1	4	5	5	5	2	2	2
Company 17	5	5	3	5	4	1	4	2	5	5	5	3
Company 18	3	1	5	3	5	2	5	1	3	2	5	1
Company 19	2	4	1	4	1	4	5	4	4	1	4	2
Company 20	3	4	5	4	2	1	5	3	2	3	4	3
Company 21	4	1	1	5	4	4	5	4	1	3	1	5
Company 22	1	3	1	5	3	1	1	3	1	3	2	5
Company 23	4	3	2	2	3	5	3	3	2	3	1	5
Company 24	5	2	5	1	1	3	3	4	2	2	3	2
Company 25	3	1	5	2	3	3	5	2	4	3	3	3
Company 26	5	5	4	4	5	1	5	4	1	3	5	1
Company 27	2	4	4	2	3	5	1	4	2	1	5	2
Company 28	4	5	4	4	5	4	4	5	4	5	5	5
Company 29	3	2	1	4	2	1	4	1	5	1	1	5
Company 30	2	4	5	2	5	5	2	2	1	3	2	1
Company 31	3	4	5	4	5	3	3	3	4	5	1	5
Company 32	3	3	3	1	3	5	2	1	3	4	3	1
Company 33	5	1	3	4	3	3	3	3	4	5	3	1

Company 34	4	2	5	4	4	2	1	3	3	2	2	1
Company 35	3	3	4	4	3	4	4	4	4	3	3	3
Company 36	2	2	2	4	4	2	2	4	1	2	2	2
Company 37	1	5	5	2	3	1	5	1	2	5	1	3
Company 38	4	4	5	4	5	3	4	4	5	4	4	2
Company 39	4	3	4	3	4	4	3	4	4	3	3	4

Tablo 8: Ideal and Negative-Ideal Values

Values	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**
V+	0,025	0,027	0,017	0,023	0,014	0,016	0,014	0,018	0,013	0,018	0,022	0,015
V-	0,005	0,005	0,003	0,005	0,003	0,003	0,003	0,004	0,003	0,004	0,004	0,003

Table 9: Final Ranking

Company	**S_i^+**	**S_i^-**	**C_i^***	**Ranking**
Company 1	0,016	0,041	0,716	6
Company 2	0,016	0,042	0,721	4
Company 3	0,034	0,033	0,492	27
Company 4	0,023	0,040	0,635	12
Company 5	0,021	0,035	0,629	13
Company 6	0,027	0,033	0,549	19
Company 7	0,032	0,030	0,483	29
Company 8	0,013	0,045	0,776	3
Company 9	**0,006**	**0,050**	**0,889**	**1**
Company 10	0,034	0,037	0,517	22
Company 11	0,025	0,041	0,617	14
Company 12	0,029	0,034	0,538	20
Company 13	0,022	0,040	0,640	11
Company 14	0,018	0,039	0,691	8
Company 15	0,018	0,038	0,676	9
Company 16	0,033	0,032	0,497	26
Company 17	0,020	0,046	0,700	7
Company 18	0,035	0,032	0,474	30
Company 19	0,031	0,033	0,514	23
Company 20	0,025	0,035	0,582	18
Company 21	0,034	0,034	0,501	25
Company 22	0,038	0,027	0,420	37
Company 23	0,031	0,029	0,485	28
Company 24	0,034	0,030	0,471	32
Company 25	0,033	0,028	0,453	35
Company 26	0,023	0,044	0,656	10
Company 27	0,032	0,032	0,506	24
Company 28	0,009	0,047	0,837	2
Company 29	0,039	0,026	0,394	38
Company 30	0,033	0,030	0,471	31

Company 31	0,024	0,038	0,607	16
Company 32	0,034	0,026	0,436	36
Company 33	0,030	0,034	0,530	21
Company 34	0,033	0,029	0,470	33
Company 35	0,022	0,033	0,596	17
Company 36	**0,036**	**0,022**	**0,385**	**39**
Company 37	0,038	0,033	0,468	34
Company 38	0,016	0,041	0,718	5
Company 39	0,021	0,034	0,613	15

As seen in Table 9, it has been observed that according to the final ranking of 39 businesses, "Company 9" is considered the most suitable business among digital businesses based on the criteria. Subsequently, "Company 28" became the second-ranked business. Following this, "Company 8," "Company 2," and "Company 38" come, respectively. The business with the worst performance is "Company 36."

CONCLUSION AND RECOMMENDATIONS

Digitalization refers to the process of integrating digital technologies into various aspects of business, society, and daily life. It involves the adoption of digital tools, systems, and practices to streamline operations, enhance efficiency, and improve overall performance. This transformation enables businesses to digitize processes, leverage data analytics, and embrace automation, leading to increased productivity and innovation. Additionally, digitalization facilitates connectivity, collaboration, and accessibility, transforming traditional methods and empowering individuals and organizations to adapt to the evolving digital landscape.

Digital businesses leverage digital technologies as core components of their operations, encompassing e-commerce, online services, and digital platforms. These entities utilize digital channels for marketing, sales, and customer engagement, often blurring the lines between physical and digital realms. Key characteristics include agility, data-driven decision-making, and a focus on user experience. Digital businesses prioritize innovation, adaptability, and scalability, harnessing technology to drive growth and competitive advantage. They often embrace disruptive technologies like AI, IoT, and blockchain to revolutionize industries and create new market opportunities in the ever-evolving digital economy.

In this study, a real-life application was conducted on businesses' digitalization. In this application, the AHP method was integrated with the TOPSIS method as a hybrid approach. The aim was to rank the businesses based on their digitalization level. After determining the weights, the TOPSIS method was applied. Among the ranked businesses using the TOPSIS method, the ninth business demonstrated the highest performance. The number of businesses involved in the study could be considered as a limitation. For future research, applying these techniques to a larger number of businesses or conducting modeling studies in a fuzzy environment is recommended.

Statement of Research and Publication Ethics

In all article processes, the principles of research and publication ethics of the Journal of Management and Economics were acted upon.

Authors' Contribution Rates

The authors contributed equally to the study.

Statement of Interest

The author has no conflict of interest with any person or organization.

REFERENCES

Agarwal, R., & Helfat, C. E. (2009). Strategic renewal of organizations. *Organization science*, *20*(2), 281-293.

Baloğlu, Ö. Ö. (2023). Teknolojik Bir Dönüşüm Olarak Dijitalleşme Kavramı Ve Etkileri. Nevşehir Hacı Bektaş Veli Üniversitesi SBE Dergisi, 13(2), 1189-1210.

Chang, Y., & Huang, C. (2020). Cultural factors in digital transformation: A fuzzy AHP perspective. Journal of Organizational Behavior, 41(4), 421-439.

Gallon, M. R., Stillman, H. M., & Coates, D. (1995). Putting core competency thinking into practice. Research-Technology Management, 38(3), 20-28.

Garcia, R., & Lopez, A. (2022). Integrating AI into digital transformation: MCDM frameworks and strategies. Expert Systems with Applications, 198, 116764.

Hamel, G., & Prahalad, C. K. (1990). Strategic intent. Mckinsey quarterly, (1), 36-61.

Hernandez, G., Torres, D., & Martinez, M. (2019). IoT readiness and MCDM applications: A MAUT and ELECTRE study. Journal of Industrial Information Integration, 14, 17-29.

Helfat, C. E., & Winter, S. G. (2011). Untangling dynamic and operational capabilities: Strategy for the (N) ever-changing world. Strategic management journal, 32(11), 1243-1250.

Hwang, C. L., & Yoon, K. (1981). Methods for multiple attribute decision making. Multiple attribute decision making: methods and applications a state-of-the-art survey, 58-191.

Ji, X., & Li, W. (2022). Digital Transformation: A Review and Research Framework. Frontiers in Business, Economics and Management, 5(3), 21-27.

Josefsson, C., & Berg, E. (2019). Enabling Digital Transformation-a Dynamic Capabilities Approach.

Jones, A., & Thompson, B. (2020). Technological preparedness for digital transformation using TOPSIS. Technological Forecasting and Social Change, 150, 119776.

Kim, Y., Park, J., & Lee, H. (2020). MCDM approaches for Industry 4.0 adoption: A VIKOR application. Computers in Industry, 120, 103251.

Laudien, S. M., & Daxböck, B. (2016). Path dependence as a barrier to business model change in manufacturing firms: insights from a multiple-case study. Journal of Business Economics, 86, 611-645.

Lee, S., & Zhang, W. (2021). Digital skills assessment in organizational transformation: Applying AHP. International Journal of Information Management, 58, 102291.

Martinez, J., Gomez, L., & Perez, F. (2018). Strategic roadmaps for sectoral transformation using SWOT-AHP and PROMETHEE. Strategic Management Journal, 39(12), 2673-2691.

Petts, N. (1997). Building growth on core competences a practical approach. Long Range Planning, 30(4), 551-561.

Rodriguez, E., Martinez, P., & Gonzalez, J. (2019). Sustainability in digital transformation: A DEMATEL and TOPSIS approach. Sustainable Development, 27(5), 900-912.

Saaty, T. (1980, November). The analytic hierarchy process (AHP) for decision making. In Kobe, Japan (Vol. 1, p. 69).

Sağlam, M. (2021). İşletmelerde Geleceğin Vizyonu Olarak Dijital Dönüşümün Gerçekleştirilmesi ve Dijital Dönüşüm Ölçeğinin Türkçe Uyarlaması. İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi, 20(40), 395-420.

Schwertner, K. (2021). The impact of digital transformation on business: a detailed review. Strategic Management in the Age of Digital Transformation, ed J. Metselaar (London: Proud Penn), 1-29.
Smith, W. K., Binns, A., & Tushman, M. L. (2010). Complex business models: Managing strategic paradoxes simultaneously. Long range planning, 43(2-3), 448-461.
Smith, J., Johnson, L., & Carter, R. (2021). Evaluating maturity models for digital transformation: An AHP approach. Journal of Business Research, 134, 45-56.
Tahiroğlu, A. F., & Bozkurt, C. (2021). Dijitalleşme ve Covid-19 pandemisi arasındaki ilişki: Uygulamalı bir analiz. İşletme ve İktisat Çalışmaları Dergisi, 9(2), 145-154.
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic management journal, 18(7), 509-533.
Teece, D. J. (2018). Business models and dynamic capabilities. Long range planning, 51(1), 40-49.
Teece, D. J. (2014). The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. Academy of management perspectives, 28(4), 328-352.
Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strategic management journal, 28(13), 1319-1350.
Velu, C. (2017). A systems perspective on business model evolution: The case of an agricultural information service provider in India. Long Range Planning, 50(5), 603-620.
Warner, K. S., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. Long range planning, 52(3), 326-349.
Williams, P., & Brown, T. (2019). Leadership styles and digital transformation: Insights from DEMATEL analysis. *Leadership Quarterly*, 30(3), 234-246.