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PREPARING FOR BIG DATA: DIGITAL TRANSFORMATION STRATEGIES OF HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

The aim of this study is to examine the digital transformation strategies employed by higher education institutions in their preparation for the use of big data. The emergence of digital transformation has the potential to precipitate radical changes in the education sector. The application of big data analytics facilitates more effective decision-making processes. Accordingly, the present study examines the digital transformation strategies and big data readiness levels of Turkish higher education institutions. Furthermore, the impact of these processes on educational and managerial processes was evaluated. In this context, the study was conducted with the participation of information technology specialists and managers from various higher education institutions in Türkiye. The findings indicate that organizational culture is a significant determinant of the success of digital transformation strategies. Nevertheless, it has been observed that a culture of data-driven decision-making is necessary for the effective management of digital transformation processes. This paper examines the opportunities provided by big data analytics in the education sector and the strategic approaches required for the successful implementation of these opportunities.

INTRODUCTION

Digital transformation is a process by which organizations are made more efficient, flexible, and innovative by restructuring their business processes, corporate cultures, and customer experiences with digital technologies. This transformation facilitates the transition from traditional methods to new technologies, including virtual or physical systems, smart factories, the Internet of Things (IoT), and big data (Boz Eravci, 2020). Big data is defined as the abundance and diversity of data, as well as the emergence of new tools and approaches that exceed traditional data analysis methods (Şeker, 2015). The application of big data analytics enables organizations to make decisions based on a greater quantity and diversity of data, thereby facilitating data-driven decision-making processes and increasing operational efficiency. The

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effective use of big data in the digital transformation process allows organizations to reshape their growth and development strategies. However, this transformation also creates radical changes in the education sector (Boz Eravci, 2020).

In the context of the digital transformation of the education sector, the application of big data analytics has the potential to enhance the effectiveness of decision-making processes. In this context, the capacity to leverage big data is regarded as a crucial factor for universities in developing their data analytics capabilities and integrating these capabilities into their strategic planning processes (Daniel, 2015; Long & Siemens, 2011; Tabrizi et al., 2019). Higher education institutions leverage the potential of big data analytics in their digital transformation processes. The incorporation of these technologies facilitates the development of more effective and efficient educational environments (Picciano, 2012).

The implementation of digital transformation processes in universities enhances the capacity for big data analytics, thereby facilitating innovation and efficiency in educational and research activities (Tabrizi et al., 2019). Big data analytics offers numerous opportunities, including the prediction of student success, the creation of personalized learning experiences, and the optimization of resource allocation (Daniel, 2017). However, ethical and privacy considerations must be considered for the successful implementation of these processes (García-Morales et al., 2021).

The study underscores the pivotal role of digital transformation and data-driven organizational culture in universities' adaptation to big data. It offers crucial insights into the potential of these technologies for strategic decision-making processes. At the same time, this study provides recommendations for enhancing institutional efficiency and educational quality using data analytics in higher education.

DIGITAL TRANSFORMATION STRATEGIES AND BIG DATA

Digital transformation can be defined as the process of restructuring business methods and processes with the aid of digital technologies. This process contributes to organizations becoming more efficient, flexible, and innovative through the integration and adoption of digital technologies (Nambisan et al., 2019). In the context of education, digital transformation refers to the integration of digital tools and platforms into teaching methods, learning environments, and management processes (García-Morales et al., 2021). Higher education institutions employ a range of strategies in these processes. These strategies encompass a multitude of elements, including but not limited to leadership, technology infrastructure, staff training, and cultural change. The role of leadership in the digital transformation process is of critical importance, as it establishes the vision of the institution (Warner & Wäger, 2019). The technology infrastructure is responsible for ensuring the integration of digital tools and platforms. The objective of staff training is to enhance the digital competencies of academic and administrative personnel. Cultural change is the overcoming of resistance within the organization and encouraging digital innovation for digital transformation to be successful (Brynjolfsson & McAfee, 2013; Crawford et al., 2020).

Studies on the digital transformation strategies of higher education institutions examine the challenges that institutions face in these processes and the strategies they develop to overcome these challenges. For example, Hanelt et al. (2021) underscored the significance of leadership and management competencies for the success of digital transformation. Similarly, Ebert and Duarte (2018) highlighted the technical and operational challenges associated with the integration of digital technologies. These challenges encompass internal barriers, such as the adaptation of

existing organizational structures and cultures to align with digital transformation and the absence of comprehensive digital transformation strategies.

The term "big data" is used to describe the collection and analysis of large volumes of data sets from a variety of sources. In the context of education, big data encompasses a diverse array of data sources, including student performance data, online learning activities, and social media interactions (Daniel, 2015). The process of big data analytics entails the examination and transformation of data into meaningful information. The application of big data analytics in education offers a multitude of potential benefits, including the ability to predict student success, optimize teaching methods, and support institutional decision-making (Tabrizi et al., 2019).

The integration of digital technologies into business processes enables organizations to become more efficient, flexible, and innovative. This process, known as digital transformation, allows for the restructuring of business operations. Big data, defined as the process of analyzing large data sets obtained during this transformation process and transforming them into meaningful information, is a key component of digital transformation. The integration of big data analytics into higher education institutions allows for the prediction of student success, optimization of teaching methods, and the making of more informed institutional decisions.

Big Data Readiness

The focus of digital transformation strategies is on critical elements such as leadership, talent management, technology, and decision-making (Iivari et al., 2020; McAfee & Brynjolfsson, 2012). The level of big data readiness of higher education institutions is directly related to the effective management of these elements (Mergel et al., 2019). In this context, it is essential to evaluate the role and importance of each element separately. The role of leadership is of particular importance in providing strategic direction and support (Warner & Wäger, 2019). Talent management entails the hiring of specialized personnel and the development of their competencies (Hanelt et al., 2021). Technology is utilized to create the necessary infrastructure for data management and to automate its processes (Nambisan et al., 2019). Data-driven decision-making enables strategic decisions to be made in line with the information provided by data (Priyono et al., 2020). The success of the digital transformation strategies of higher education institutions is contingent upon the harmonious management of these elements (Crawford et al., 2020).

Big data is defined as data that exceeds the capacity of a single server, lacks the structured format typical of row-column databases, or is generated in a continuous stream that is incompatible with conventional data warehouses (Davenport, 2018). It also encompasses the unprecedented ability to collect and analyze data in ways that were previously deemed impractical (Marr, 2019).

Organizational readiness for big data analytics is defined as the capacity to utilize big data effectively. It encompasses methodologies for the acquisition, retention, manipulation, and examination of data. The level of readiness is influenced by a few factors, including the presence of a robust and scalable technology infrastructure, effective data management policies, skilled and trained staff, and a corporate culture that encourages data-driven decision-making. These elements are of paramount importance for organizations to fully leverage the potential of big data (Webber & Zheng, 2020). The term "technology infrastructure" encompasses the hardware and software systems that are necessary for the implementation of big data analytics. The

policies that govern the management of data determine the manner in which data is collected, stored, and processed. In order to be effective, staff must possess the requisite expertise and experience in big data analytics. Organizational culture creates an environment that encourages data-driven decision-making and innovation (Daniel, 2017).

Studies on big data readiness examine the factors affecting these readiness levels and how these factors can be managed. Davenport (2018) examines the impact of technology infrastructure and data management policies on big data readiness. Bahram and Daim (2020) underscore the significance of human, technological infrastructure, legal, and organizational factors in the success of big data projects. Accordingly, the process of achieving big data readiness is influenced by a multitude of factors (Molina, 2019). In this context, various models have been developed to assess big data readiness and big data maturity. Austin (2018) developed the FAIR model, which was subsequently adopted by the G20 in 2016. This model emphasizes that data should be findable, accessible, interoperable and reusable. Davenport (2018) created the DELTTA model to determine the level of big data skills. This model includes the following six domains: Data, Enterprise, Leadership, Targets, Technology, and Analysts and Data Scientists.

An alternative approach is the "Five Management Challenges" model, which serves as the foundation for the study. McAfee and Brynjolfsson (2012) assert that businesses that are unable to effectively manage change will be unable to capitalize on the opportunities presented by the transition to big data. This transition encompasses five core areas: Leadership, Talent Management, Technology, Decision Making, and Company Culture (Figure 1).

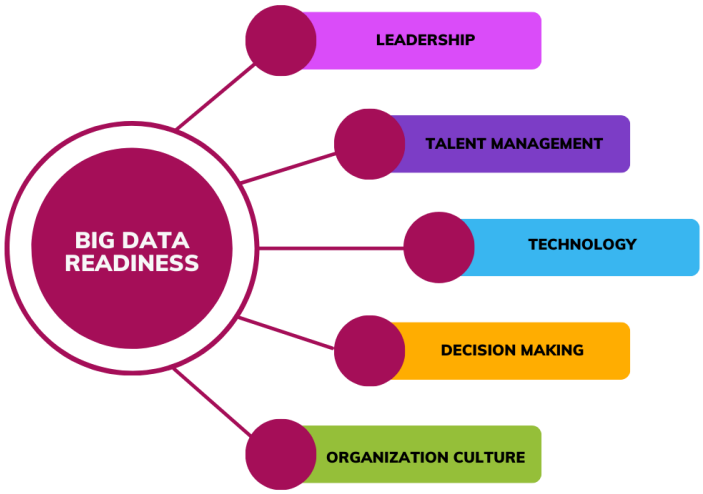

Figure 1. Components of Big Data Readiness

The five components of management challenges are as follows (McAfee & Brynjolfsson, 2012):

- Leadership requires vision and human foresight to succeed in the big data era. It is incumbent upon leaders to establish transparent objectives, discern market prospects, and persuade employees of the vision.
- Talent Management places a premium on the recruitment of data scientists and computer scientists who are adept at working with big data. These professionals must possess a range of critical skills, including data cleansing, organization, and visualization.

- Technology encompasses the tools and software necessary for processing big data, yet these technologies demand novel skills within IT departments.
- Decision-making necessitates aligning knowledge and decision-making authority; leaders must establish flexible organizational structures.
- Organizational culture requires a transition to a data-driven approach, which fosters informed rather than intuitive decisions. These five domains are pivotal to the success of a big data strategy.

Background and Hypotheses of the Study

The advent of digital transformation and big data has precipitated a profound transformation in the education sector in recent years. Digital transformation represents a radical shift in the operational processes of educational institutions, teaching methods, and student interactions. This transformation extends beyond the traditional boundaries of education, paving the way for more personalized and data-driven approaches to education (García-Morales et al., 2021). The application of big data analytics enables educational institutions to more accurately monitor student performance, optimize instructional strategies, and streamline decision-making processes (Daniel, 2015). Big data can be derived from a wide range of data sources, including student records, exam results, interactions on online learning platforms, and even social media data. The analysis of this data facilitates the prediction of student success, the identification of potential problems at an early stage, and the enhancement of educational processes in terms of efficiency (Daniel, 2017). Furthermore, digital transformation and big data have the potential to enhance accessibility and equity in education. These technologies facilitate the provision of more effective services to students with diverse learning requirements (Nambisan et al., 2019; Daniel, 2017).

H_1: Big data readiness significantly affects the digital transformation rates of higher education institutions.

The sub-hypotheses formed based on hypothesis H_1 are listed below.

H_{1a}: Leadership, one of the dimensions of Big Data Readiness, significantly affects the digital transformation rates of higher education institutions.

H_{1b}: Talent Management, one of the dimensions of Big Data Readiness, significantly affects the digital transformation rates of higher education institutions.

H_{1c}: Technology, one of the dimensions of Big Data Readiness, significantly affects the digital transformation rates of higher education institutions.

H_{1d}: Decision Making, a dimension of Big Data Readiness, significantly affects the digital transformation rates of higher education institutions.

H_{1e}: Organizational Culture, one of the Big Data Readiness dimensions, significantly affects the digital transformation rates of higher education institutions.

Method

This section outlines the research design, participant information, data collection methodology, data analysis techniques, limitations of the study, and the findings obtained.

RESEARCH DESIGN

The objective of this study is to ascertain the preparedness of public and foundation universities in Turkey for the integration of big data technologies and to evaluate the extent to which these universities possess the requisite big data skills. In accordance with the objectives of the study, a survey technique, one of the quantitative research methods, was employed. Furthermore, prior to the commencement of data collection, the research proposal was submitted to and approved by the Süleyman Demirel University Social and Human Sciences Ethics Committee. In accordance with the decision of the board dated April 27, 2022, numbered 120/41, the application phase was initiated, as it was determined that the project was "*in accordance with ethical principles and human rights in terms of scope and application.*"

The Big Data Readiness Scale was translated into Turkish by the researcher. To facilitate comprehension of the scale and its constituent statements, the statements were subjected to discussion with an expert in the field of big data and analytics, operating within a large-scale enterprise in the IT supply sector in Turkey. Subsequently, the content of the statements was discussed with a contracted IT professional who is an expert in software development at a university. In the context of peer review, the clarity of the statements was evaluated by two academic experts. In terms of content validity, the clarity and measurability of the statements were discussed by two academics with expertise in measurement and evaluation. In the subsequent phase, the questionnaire items were discussed individually with 10 software development experts at Süleyman Demirel University. The scale was finalized by selecting the most appropriate expressions. It was determined that the adapted structure of the scale into Turkish was compatible with the original structure consisting of 31 statements. It is believed that the scale, in its current state, will contribute to the measurement of big data readiness for competitive advantage and efficient use of technology for organizations.

PARTICIPANTS

The participants in this study were staff and administrators with expertise in information technology (IT) who were employed in IT departments or similar units at higher education institutions in Turkey. The participants were selected from among those with expertise in areas such as big data, analytics, data management, data science, software, and data visualization. A total of 164 participants were included in the study, with seven individuals declining to specify their university affiliation. The study employed the "Is your company ready for big data?" instrument developed by McAfee and Brynjolfsson (2013) as a measurement tool. Furthermore, five statements from the "Big Data Skill Level Assessment Questionnaire" developed by Davenport (Davenport, 2018) were adapted into Turkish. In addition to the "Big Data Readiness" scale, participants were asked to rate their organization's level of digital transformation on a scale of 1 to 100.

DATA COLLECTION PROCESS

The survey form was distributed to the participants via email using the "Microsoft Forms" online survey system. As Baş (2010) asserts, the data collection process aimed to present the participants as integral members of a professional research endeavor, instilling a sense of contribution to the advancement of knowledge within their field and providing information that would foster a sense of value and importance. During the implementation process, a number of technical solutions were attempted in order to enhance the participation rate. To avoid the

possibility of the e-mails being classified as spam and the e-mail addresses being banned, the e-mail addresses were randomly mixed when sending e-mails to 1996 people at the same time. A maximum of 10 emails per day were sent to the same university by randomly mixing email addresses. The objective was to reduce the likelihood of the e-mails being classified as spam (junk) and consequently blocked by the recipient's spam filter. The e-mail sending process was conducted via the "Mail Merge" function of the Microsoft Word program. The Mail Merge feature enabled the creation of personalized emails. A description of the study, a link to the questionnaire, and the website created to promote the study were sent to 400 email addresses per day. In the initial phase of the study, participation in the scale was limited to 100 individuals. Due to the lower-than-anticipated level of participation, email addresses that could not be reached, were marked as junk mail, or were rejected by the server were removed from the list, and a second reminder email was sent. Additionally, an effort was made to reach specialized personnel through WhatsApp groups of contracted IT personnel. Of the respondents who returned, 96% consented to participate in the study.

DATA ANALYSIS

The data were organized using Microsoft Excel and analyzed using Jamovi, an open-source statistical software program. Inferential statistical methods were employed to analyze the data. In the analysis process, regression analysis was employed to ascertain the impact of big data readiness dimensions on digital transformation. It should be noted that the findings of this study may not be generalizable to all universities, as it only included IT employees from a limited number of institutions. It was assumed that the respondents provided truthful and honest responses to the questionnaire statements. The data set encompasses a specific temporal scope (April 2022 to July 2022) and the universities of the respondents who returned.

Prior to commencing the analysis, it was necessary to ascertain whether there were any outliers or missing values. Upon examination, it was determined that there were no missing values or outliers. Subsequently, Confirmatory Factor Analysis was performed to confirm the structural validity of the "Big Data Readiness/Big Data Skill Level" scale. Upon examination of the goodness-of-fit values for the measurement tool, it was determined that the five-dimensional factor structure of the scale, comprising the factors of "Leadership," "Talent Management," "Software Technology," "Data-Driven Decision Making," and "Data-Driven Organizational Culture," exhibited acceptable fit values. The chi-squared value (x^2) was 401, with a degree of freedom (df) of 306, resulting in a x^2/df ratio of 1.31. The comparative fit index (CFI) and the Tucker-Lewis index (TLI) were 0.962, while the root mean square approximation error (RMSEA) was 0.0434. The results of this analysis indicate that Leadership $\alpha = 0.955$, Talent Management $\alpha = 0.857$, Technology $\alpha = 0.622$, Decision Making $\alpha = 0.783$, and finally Organizational Culture $\alpha = 0.724$.

LIMITATIONS OF THE STUDY

The study is limited to IT staff in specific universities in Turkey. This may limit the generalizability of the results. The study results may not be representative of all higher education institutions. It is assumed that the participants who contributed to the survey understood the questions and gave correct answers. The survey was designed as a cross-sectional research design. This does not allow for observing changes over time. Consequently, the study is unable to provide information on the long-term effects of digital transformation processes and changes in big data readiness levels. Digital transformation and big data technologies are undergoing

rapid change. The findings of this study may not fully reflect the effects of technological and policy changes.

Findings

Upon analysis of the results, it was determined that there were statistically significant correlations between the rate of digital transformation and all scale dimensions, with the exception of leadership (Table 1). A high degree of correlation was observed with regard to organizational culture.

Table 1. Correlation Table

		Leadership	Talent Management	Technology	Decision Making	Corporate Culture
Digital Transformation Rate	Pearson's r	0.210	0.398 ***	0.313 **	0.334 **	0.509 ***
	p-value	0.051	< .001	0.003	0.002	< .001

Furthermore, an examination of the normal distribution results reveals a p-value greater than 0.05. An investigation of the collinearity test (Collinearity Statistics) indicates that there is no issue with multiple collinearity between the variables, as evidenced by a VIF value less than 10 and a Tolerance value greater than 0.2. The Durbin-Watson test was conducted to ascertain the presence of autocorrelation, which represents the final condition. Upon analysis of the DW Statistics values, it was determined that the values fell between 1.5 and 2.5, indicating the absence of autocorrelation in the regression model (Table 2).

Table 2. Regression Analysis Assumption Checks

Normality Test (Shapiro-Wilk)

Statistic	**p**
0,990	0,746

Collinearity Statistics

	VIF	**Tolerance**
Talent Management	2,27	0,440
Technology	2,56	0,391
Decision Making	3,22	0,310
Corporate Culture	2,11	0,473

Durbin–Watson Test for Autocorrelation

Autocorrelation	**DW Statistic**	**p**
0.00308	1,97	0,858

The regression analysis (Table 3) indicates that, when all assumptions are met ($R^2 = 0.279$), the multiple regression model can explain 27.9% of the change in digital transformation. Furthermore, the Standard Estimates value suggests that this effect is positive.

Table 3. Regression Model

Model Fit Measures

				Overall Model Test			
Model	**R**	**R^2**	**Adjusted R^2**	**F**	**df1**	**df2**	**p**
1	0,528	0,279	0,244	7,94	4	81	<,001

Model Coefficients - Digital Transformation Rate

Predictor	**Estimate**	**SE**	**t**	**p**	**Stand. Estimate**
Intercept	18,24	10,16	1,795	0,076	
Talent Management	3,53	3,25	1,085	0,281	0,1534
Technology	2,76	4,87	0,568	0,572	0,0851
Decision Making	-4,56	4,55	-1,002	0,319	-0,1687
Corporate Culture	13,58	3,80	3,572	**<,001**	0,4869

Upon examination of Table 3, it becomes evident that the impact of Leadership, Talent Management, Technology, and Decision Making on digital transformation is not statistically significant ($p < .001$). Consequently, sub-hypotheses H_{1a}, H_{1b}, H_{1c}, and H_{1d} are rejected. However, the influence of Organizational Culture on digital transformation processes was found to be significant. Therefore, sub-hypothesis H_{1e} is accepted. These findings indicate that the most crucial factor in university digital transformation is organizational culture.

DISCUSSION AND CONCLUSION

The present study sought to investigate the impact of higher education institutions' readiness for big data on their digital transformation rates. The findings indicate that only the "Organizational Culture" dimension was found to significantly affect digital transformation rates. The remaining dimensions (leadership, talent management, technology, and decision-making) did not demonstrate a significant impact on digital transformation.

In the existing literature, the critical role of corporate culture in digital transformation is frequently emphasized. For example, McAfee and Brynjolfsson (2012) posit that data-driven decision-making processes are integral to the digital transformation processes of organizations. Similarly, Davenport (2018) posits that a culture that is driven by data is critical for the effective implementation of digital transformation strategies. The findings of this study provide further support for and extend the points made in the existing literature on this topic.

The digital transformation process directly affects the level of big data readiness of higher education institutions. Organizational culture is identified as a significant factor in the effective implementation of digital transformation processes. The integration of digital transformation processes into the strategic planning processes of institutions increases data analytics capacities. This process provides various benefits, including the optimization of student data management processes and the improvement of educational quality. In other words, it can be stated that corporate culture plays a significant role in encouraging and supporting digital transformation. The influence of other dimensions, including leadership, talent management, technology, and

decision-making, on digital transformation rates was found to be insignificant. This demonstrates that the success of digital transformation in higher education institutions is contingent upon the prevailing culture within the institution being receptive to data-driven decision-making and innovative technologies.

This study makes the following contributions to the existing literature:

1. This study addresses a significant gap in the existing literature by underscoring the pivotal role of organizational culture in the digital transformation processes of higher education institutions.
2. By examining the impact of other big data readiness dimensions on digital transformation, the study provides new insights on how digital transformation strategies should be developed in higher education institutions.

The following recommendations are offered for consideration by higher education institutions seeking to successfully manage their digital transformation processes:

It is advised that institutions cultivate a data-driven organizational culture and facilitate the involvement of all stakeholders in data-driven decision-making processes. It is recommended that training programs on data management and analytics be developed and implemented to enhance the knowledge and skills of staff in these areas. Leadership and Governance: It is possible to establish robust leadership structures in order to facilitate the implementation of digital transformation strategies. It is essential to identify capable managers who can spearhead digital transformation initiatives and ensure that they have access to the requisite resources. It is recommended that the technology infrastructure be strengthened by investing in modern and flexible information technology infrastructures. Advanced technologies such as cloud computing and big data analytics platforms can be integrated. Furthermore, it is advised that data-driven decision making be encouraged by providing personnel with data analytics tools in decision-making processes. Finally, it is proposed that data management processes be improved to enhance data quality.

In addition, it is suggested that talent management and training be developed through the implementation of training programs and collaborations to train personnel specialized in digital transformation and big data analytics. Furthermore, it is recommended that continuous training opportunities be offered to improve the digital skills of existing staff.

The objective of this study is to examine the influence of big data readiness levels among higher education institutions on their digital transformation rates. In the regression analysis, which employed the five dimensions of the big data readiness scale (Leadership, Talent Management, Technology, Decision Making, Organizational Culture), only the "Organizational Culture" dimension was found to significantly affect digital transformation rates. This result indicates that organizational culture plays a pivotal role in the successful management of digital transformation processes in higher education institutions.

It is recommended that future research on this topic should consider the following suggestions:

Longitudinal studies are recommended for future research in this area. Longitudinal studies can be conducted to examine the long-term effects of digital transformation processes and changes in big data readiness levels over time.

Contextual Variation Across Regional and Cultural Settings: Conducting similar studies at higher education institutions in different countries or regions allows for the examination of the effects of regional and cultural factors on digital transformation and big data readiness.

Qualitative Research: Qualitative research (e.g., case studies and in-depth interviews) can be conducted to gain a deeper understanding of the challenges faced in digital transformation processes and their impact on the day-to-day operations of higher education institutions.

Student and Academic Staff Perspective: Research can be conducted from the perspective of students and academic staff to examine the impact of digital transformation on student achievement and academic staff productivity.

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