YÖNETİM BİLİŞİM SİSTEMLERİ DERGİSİ
http://dergipark.gov.tr/ybs

Yayın Geliş Tarihi: 08.11.2019
Yayına Kabul Tarihi: 23.11.2019
Online Yayın Tarihi: 31.12.2019

Cilt:5, Sayı:2, Yıl:2019, Sayfa:44-55
e-ISSN: 2630-550X

DETERMINING THE PRIORITIES OF CHIEF DATA OFFICERS FOR BUILDING DATA CULTURE[1]

Serra ÇELİK[1], Seda TAŞ[1]

[1] Informatics Department, Istanbul University, Istanbul Turkey

ABSTRACT

New business models are revealed by digitization world. With a data-driven business approach, organizations must keep pace with digital transformation. Digital transformation will be facilitated with the Data Culture, which is a work environment based on data, to be formed in organizations. In this study, the hierarchical structure was constituted for data culture. The hierarchy consists of four main criteria and 17 sub-criteria. The main criteria (dimensions) are defined as organizational factors, stakeholders (such as customers, suppliers, business partners), financial factors, and technological factors. With this study, it is aimed to find out what criteria are most important for the managers who responsible for digital transformation in their data culture building process. Analytic Hierarchy Process (AHP) designed questionnaire survey has reached managers who work as in CIO, CAO, and CDO positions at different industries. Main and sub-criteria weights were determined by using the AHP. The results of the AHP analysis revealed that managers attach the most important to the stakeholder dimension in creating data culture and give the least importance to the financial dimension. In the sub-criteria, it was most important to obtain the ability of Stakeholder-driven business while the increase in the profitability of organization was the least significant.

Keywords: Analytic Hierarchy Process, Digital Transformation, Data Culture, Chief Data Officers, Big Data

INTRODUCTION

Thanks to improving technology, the data which can be produced more, stored easily, and analyzed faster can be turned to value now. According to IDC (2014) report, at the global level, organizations, which care their data, will capture $1.6 trillion more in value from their data and analytics investments over the next four years. Besides, the financial performance of the organizations, which are good at using their data, more than their competitors is at least three times better (EIU, 2013). The traditional organizations, which are aware of the value of their data, have started to convert their business processes and production methods into digital. Even when traditional goods and services are not being replaced with digital alternatives, information technology is firmly integrated as a tool in basic research, product design, sourcing, manufacturing, logistics, sales, marketing, and service (Downes & Nunes, 2014).

The term “transformation” expresses the comprehensiveness of the actions that need to be taken when organizations are faced with new technologies. Thus, a digital transformation typically involves a company-wide digital (transformation) strategy, which goes beyond functional thinking and holistically addresses the opportunities and risks that originate from digital technologies. A digital transformation strategy guides the organization in its journey toward being digitally transformed (Singh & Hess, 2017). Between years of 2015 and 2020, the digital share of a gross domestic product has the potential to grow

[1] This work was presented at the 19th International Symposium on Econometrics, Operations Research & Statistics and published in the conference abstract book.

which is equal to 12.5 percent increase worldwide. Today, 22 percent of the global retail industry's output is derived from digital thus it can be said digital skills and digital technologies are having an impact across various world economies (Knickrehm et al., 2016).

If organizations do not well plan their digital transformation strategy, they may encounter operational difficulties. The person who responsible for the digital transformation process should have sufficient experience. In matter fact, there is no complete definition of which manager should be (Matt et al., 2015). Ashwell (2017) defines a chief digital and information officer (CDIO) as an individual to provide the focus for digital transformation. The CDIO helps shape and drive the vision for the digital transformation, making the most effective use of emerging technologies and thoroughly engaging people across the organization. Any organization can digitally transform, in their way. However, the changes that organizations make for digitalization will fail if the employees are not empowered. Empowered employees will ensure that the digitization process is permanent and sustainable (Becerra, 2017).

In Turkey, a result of "Industry 4.0 In Turkey as an Imperative for Global Competitiveness an Emerging Market Perspective" report, 77 percent of the organizations stated that they had information about digital transformation in the industry by the year 2016 (TUSIAD, 2017a). In 2017, this rate increased to 90 percent (TUSIAD, 2017b). 95% of the organizations indicate that they are interested in the issue of digital transformation in the industry. Also, only 61% of the organizations think that their companies are ready for this transformation (TUSIAD, 2017b).

The managers working in positions such as CIO (Chief Information Officer), CAO (Chief Analytics Officers) and CDO (Chief Data Officers) come to the forefront in managing the Digital Transformation process of organizations. These managers are responsible for developing their data strategies, managing the data ecosystem and educating their employees about the understanding of data. Thus, organizations that will have data culture will be able to reshape data usage and develop digital business strategies.

The study aims to seek which criteria are most important for CIOs to create a data culture in their organization. This paper is organized as follows: following this section first data-driven culture is described. Next, analysis method and criteria are defined. In following section, research findings are placed. In the final section, conclusions are discussed.

DATA-DRIVEN CULTURE

In many organizations, data are considered to be an essential lever for digital transformation and value creation, now and in the next decade (Davenport 2014; Mayer-Schönberger & Cukier 2013). In organizational settings, the information technology (IT) function is tasked with managing and integrating data as an enabler of data-driven business processes and decision-making (Chandler et al., 2011; Lycett, 2013).

Living in the data age is forced to change business structures and cultures (Bange et al., 2014). Using big data enables managers to decide from evidence rather than intuition. For that reason, it has the potential to revolutionize management. New opportunities to collect and leverage data have led many managers to change how they make decisions relying less on intuition and more on data (McAfee & Brynjolfsson, 2012; Brynjolfsson & McElheran, 2016). According to Ramaswamy (2015), a data-driven culture is an organization that bases decisions on data, not gut instinct. An evolution is occurring in the development of a data-driven culture, typically based on the use of analytics and business intelligence (HBR, 2012).

Organizations transform into a more collaborative environment, so digitalization requires new forms of working. New team structures, responsibilities, and deliverables must be adopted by employees. This working form only can be done, if management assured the value of adapting the organizational structure (Becerra, 2017).

According to Davenport & Bean (2018), firms need more-concerted programs to achieve data-related cultural change. Many startups have created data-driven cultures from their beginning, which is an important reason why ample, established firms fear disruption from them While data-driven companies are Internet companies like Google, Amazon, and Facebook, companies like Walmart, which can be considered traditional, have long adopted a data-driven business. Walmart uses its data since the 1970s by building massive data warehouses (Patil & Mason, 2015).

Traditional organizations care about their experience and intuition instead of their data. While data is a tool for traditional organizations, young organizations use the data in long-term competitive strategies (Ramaswamy, 2015). According to Patil (2011), data-driven organizations care about their data for developing new products and gaining competitive advantage. Data culture play an essential role in organizations to develop their business strategies (Ramaswamy, 2015). Best companies choose data instead of gut feel. Thus, they achieve a data culture that turns the information data into a competitive advantage (Bange et al., 2014).

Kniberg (2014) defines "Data-Driven Decision" as a decision based on data not on the gut feeling of a manager. Bladt & Filbin (2014) say that making a decision on data is the winner in the point of executives. Adopting a data-driven culture is often difficult. Some employees can resist transformation. Thus, to understand the psychology of their resistance is the first step (Bladt & Filbin, 2014).

A top-down, data-driven culture where the CEO and his subordinates make decisions inspired by data combined with business intuition will catalyze a trickle-down effect of data-based decision making throughout the organization (Verbeke et al., 2018). The role of the CIO within the organization has shifted from a service provider to an essential strategic and technological partner. Today's successful CIO is an influential IT leader with technical knowledge to solve business needs and manage digital innovation. CIOs are at the forefront of providing innovative customer solutions in their organizations. The CIOs also served as a bridge between business and technical teams in the organization (Arkhipova & Bozzoli, 2018). What is expected of CIOs is that they should go through the opportunities and determine the right path for their business and make enough changes at the right time (Bongiorno et al., 2018). As digitalization and innovation put more emphasis on the information rather than the technology in “IT,” the CIO’s role is transforming from delivery executive to business executive from controlling costs and re-engineering processes to driving revenue and exploiting data (Gartner, 2017). Theoretically, improvements in technologies that collect or analyze data can reduce error in information (Brynjolfsson et al., 2011).

Ramaswamy (2015) suggest that the following steps will help guide CDOs to create thriving data culture. These steps are mapping the organization’s data supply chain, focusing on the current situation, being transparent about data, developing reward-sharing workings, identifying areas of friction within the organization, focusing on strategy and innovation.

METHOD

The Analytic Hierarchy Process (AHP) is a fundamental approach to decision making. It is designed to cope with both the rational and the intuitive to select the best from many alternatives evaluated concerning several criteria. In this process, the decision maker carries out püre pairwise comparison judgments which are then used to develop overall priorities for ranking the alternatives. The AHP both allows for inconsistency in the judgments and provides a means to improve consistency (Saaty & Vargas, 2012).

The AHP uses a fundamental scale of absolute numbers that have been proven in practice and validated by physical and decision problem experiments. The fundamental scale is a scale that captures individual preferences for quantitative and qualitative attributes just as well or better than other scales (Saaty 1990).

The four steps are needed to decompose the decision to generate priorities. First, the problem and the kind of knowledge sought should be defined. Secondly, the decision hierarchy from the top to the lowest level must be structured. In the third step, a set of pairwise comparison matrices must be constructed. In the last step, the priorities obtained from the comparisons to weigh the priorities in the level immediately below must be used. This must be done for every element. For each element in the level below add its weighed values and obtain its global priority. The process of weighing and adding until the final priorities of the alternatives in the bottom-most level are obtained must be continued (Saaty, 2008).

To make comparisons, a scale of numbers is needed which indicates how many times more important or dominant one element is over another element concerning the criterion or property for which they are compared (Saaty, 2008). Table 1 exhibits the scale.

Table 1. The Fundamental Scale (Saaty, 1990)

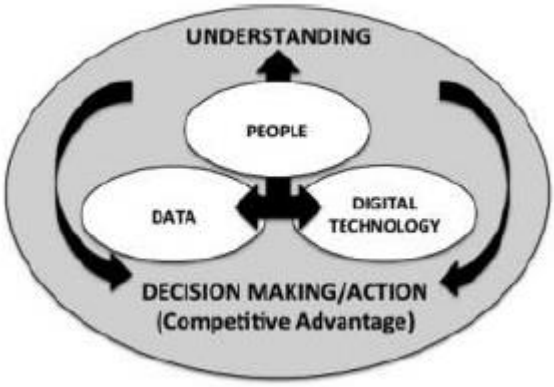
INTENSITY OF IMPORTANCE	DEFINITION
1	Equal importance
3	Moderate importance of one over another
5	Strong importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	Intermediate values between the two adjacent judgements
Reciprocals	If activity *i* has one of the above numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*
Rationals	Ratios arising from the scale

AHP is a convenient handy tool if the goal is extracting the comments of individuals such as experts and decision makers. It applies to handle the problems arising in an uncertain environment in which multiple evaluation criteria exist. A comprehensive analysis is conducted via the process of quantification to assist decision makers in the selection of appropriate plans (Shiau et al., 2002).

If the individuals are experts, the geometric mean is used for combining the judgments. If the individuals have different priorities of importance, their judgments are raised to the power of their priorities, and then the geometric mean is formed (Saaty, 2008).

Independent of the organizations, digital transformation strategies have some aspects in common. Matt et al. (2015) define these elements as four essential dimensions: use of technologies, changes in value creation, structural changes, and financial aspects. Roger (2016), the other hand, describes five domains for the landscape of digital transformation for business today. These domains are customers, competition, data, innovation, and value. Ashwell (2017) suggests the elements of digital transformation as data, digital technologies, and people and their interrelationship (Figure 1).

Figure 1. Digital Transformation Model (Ashwell, 2017)



Digital transformation is a huge challenge and support for the process needs to be fostered by an open organization culture (WEF, 2016). EIU (2013) defines that a data-driven culture needs as follows: Data should be shared and utilized by any employees. In organizations, data collection should be the primary goal of all departments. Data must be a powerful resource. Latecomer (traditional) organizations are embarking on digitization face opportunities. They can learn from best practices of firms in industries already digitized, but they must also choose which processes to digitize and how to execute technology investments successfully. Business leaders of latecomer organizations look to their CIOs to participate in making digitization choices and to orchestrate technology as well as people, operational processes and policies to impact the firm's top and bottom lines (Kohli & Johnson, 2011). Organizations that were established before the Internet need to realize that many of their fundamental assumptions must now be updated. Table 2 sets out the changes in these strategic assumptions as businesses move from the analog to the digital age (Rogers, 2016).

Table 2. Changes in Strategic Assumptions fom the Analog to the Digital Age (Rogers, 2016)

ANALOG	DIGITAL
Data is expensive to generate in firm	Data is continuously generated everywhere
Challenge of data is storing and managing it	Challenge of data is turning it into valuable information
Firms make use only of structured data	Unstructured data is increasingly usable and valuable
Data is managed in operational silos	Value of data is in connecting it across silos
Data is a tool for optimizing processes	Data is a key intangible asset for value creation
Decisions made based on intuition and seniority	Decisions made based on testing and validating

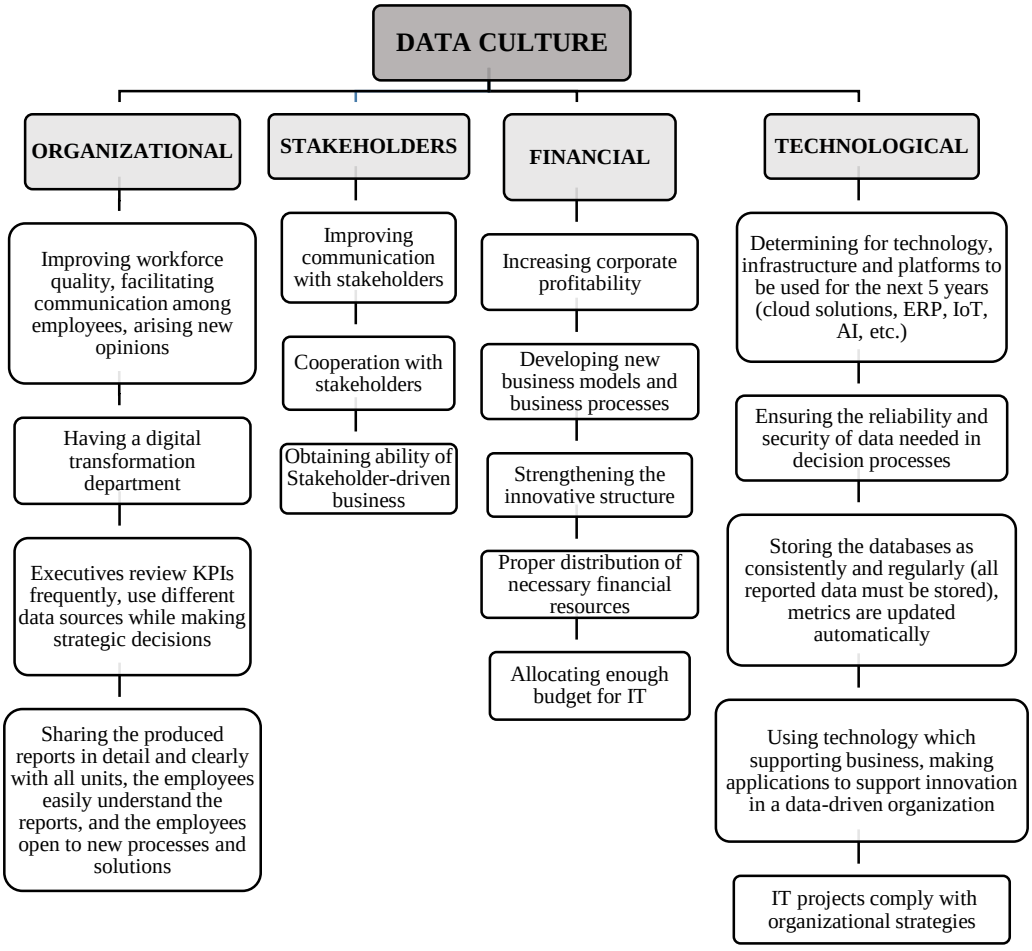
Using data and advanced analytics to make solutions to the problems and make better decisions requires new business acts in the organization. Creating value from data is not a technological challenge; it is an organizational challenge. The employee may need to share and collaborate more; functions may need to set up different or complementary business processes; managers and executives may need to make sure incentives are realigned around using analytics to promote innovation and growth (Schrage, 2014). The most critical component of digital transformation is the people (Ashwell, 2017). This component has emerged as a vital part to revealed value and ensuring the sustainability of the changes. In areas such as leadership development and external talent development in new business (digital) environments, organizations need to be prepared quickly and should provide the opportunity for each employee to participate in this new environment (Becerra, 2017). According to Patil & Mason (2015), data culture needs every single employee to enable them to reach data and see what they learn. Creating data culture does not happen with a few data scientist but all employee.

Decisions are no longer taken by managerial instincts (WEF, 2016). Organizations want to involve their employee in their decision-making process (Bange et al., 2014). Decisions are backed by insights driven by data. All employees of the organization should be empowered; thus self-management will be increased (WEF, 2016). Digital technologies can improve relationships between the organization, its stakeholders (customers, other industry players, etc.), and products. This requires the capture and exploitation of information generated in the organization's digital ecosystem (Becerra, 2017). However, organizations need to deconstruct "data-driven decision making" a bit in order to refine their strategies and signal to stakeholders what they are interested in doing with these new types of data, and which types are most important (Davenport, 2014). Today's customers have become stakeholders with whom companies collaborate. Digitization converts the relationship between customers and organizations into a new form based on data (Accenture, 2017).

The organizations which have a culture conducive to digital transformation have a strong propensity to encourage risk-taking, foster innovation and develop collaborative work environments (Kane et al., 2015). Organizations are interested in collecting, storing and analyzing data to create business value (Hartmann et al., 2016). According to McAfee & Brynjolfsson (2012), organizations relying more on data-driven decision-making are performing better in terms of productivity and profitability. Most organizations today recognize that analytics has excellent potential to create a competitive advantage (Schalekamp et al., 2015). Gartner (2018) projected a 3.2% increase in worldwide IT spending, going from $3.7 trillion in 2018 to $3.8 trillion next year. Technology drives the need for digital transformation and supports the digitization of an organization. Andriole et al. (2018) state that digital transformation and immediate emerging technology adoption are inseparable partners. The organizations that have developed a data culture focus on their data clean, organized, well documented, formatted, and error-free (Patil & Mason, 2015). In this study, the hierarchical structure (Figure 2) was constituted using the following studies: Becerra (2017), Econsultancy (2017), and Hartmann (2014). Main criteria (dimensions) are defined as organizational factors, stakeholders (such as customers, suppliers, business partners), financial factors, and technological factors.

These dimensions also have sub-dimensions. Sub-dimensions of organizational factors are Improving workforce quality, facilitating communication among employees, arising new opinions, having a digital transformation department, executives review KPIs frequently, use different data sources while making strategic decisions, and sharing the produced reports in detail and clearly with all units, the employees easily understand the reports, and the employees open to new processes and solutions. Stakeholders dimension has three sub-dimensions which are improving communication with stakeholders, cooperation with stakeholders, and obtaining ability of Stakeholder-driven business. Another dimension is financial factors. It has five sub-dimensions; increasing corporate profitability, developing new business models and business processes, strengthening the innovative structure, proper distribution of necessary financial resources, and allocating enough budget for IT. The last dimension is technological factors which have five dimensions; determining for technology, infrastructure and platforms to be used for the next 5 years (cloud solutions, ERP, IoT, AI, etc.), ensuring the reliability and security of data needed in decision processes, storing the databases as consistently and regularly (all reported data must be stored), metrics are updated automatically, using technology which supporting business, making applications to support innovation in a data-driven organization, and IT projects comply with organizational strategies.

Figure 2. Hiearchy of Data Culture



RESEARCH FINDINGS

In this study, AHP designed questionnaire survey has reached 217 managers who work as in CIO, CAO and CDO positions at different industries. Only 12 of the managers completed the survey. Four main criteria, 17 sub-criteria were determined in the study, and the questionnaire consisted of 35 comparative questions. The 1–9 scale (1: equal importance, 9: extreme importance) was used in the pairwise comparisons. The geometric mean was used to bring together the final judgments. The results of the AHP analysis calculated with MS Excel.

In our study, Consistency Ratio (CR) was calculated for Organizational, Stakeholders, Financial, Technological dimensions that as 0.0226, 0.0017, 0.0127, 0.0089 respectively. Consistency Ratio of the four main dimensions is 0.0048. As the value of CR is less than 0.1, the judgments are acceptable. Table 3 and Table 4 summarize the AHP results.

Table 3 Main Criteria Priorities

RANK	MAIN CRITERIA (λ=4.0129-CI=0.0043-CR=0.0048)	PRIORITIES
4	Organizational	0.1750
1	Stakeholders	0.3466
3	Financial	0.2095
2	Technological	0.2690

When the priority vectors are examined, it is seen that the most urgent priority for "Data Culture" is Stakeholder dimension with 35% weight (0.3466). Stakeholders term represents customers, suppliers, business partners. The second priority is the Technological dimension (0.02690). The financial dimension is the third dimension (0.2095), and the last priority is the Organizational dimension with 0.1750. When the sub-criteria is examined, it is seen that "Obtaining ability of Stakeholder-driven business" is the most important criteria with 16 percent. The second and third criteria following this sub-criteria, which are also under the main stakeholder dimension, are "Cooperation with stakeholders" (10%), and "Improving communication with stakeholders" (9%). "Executives review KPIs frequently, use different data sources while making strategic decisions" is the fourth with 7 percent.

Table 4. Sub Criteria Weights

RANK	SUB CRITERIA	PRIORITIES	GLOBAL WEIGHTS
	ORGANIZATIONAL (λ=4.0609-CI=0.0203-CR=0.0226)		
16	Improving workforce quality, facilitating communication among employees, arising new opinions	0.1501	0.0263
15	Having a digital transformation department	0.1536	0.0269
4	Executives review KPIs frequently, use different data sources while making strategic decisions	0.4406	0.0771
10	Sharing the produced reports in detail and clearly with all units, the employees easily understand the reports, and the employees open to new processes and solutions	0.2557	0.0447
	STAKEHOLDERS (λ=3.020-CI=0.0010-CR=0.0017)		
3	Improving communication with stakeholders	0.2557	0.0886
2	Cooperation with stakeholders	0.2930	0.1015
1	Obtaining ability of Stakeholder-driven business	0.4514	0.1564
	FINANCIAL (λ=5.0570-CI=0.0142-CR=0.0127)		
17	Increasing corporate profitability	0.1184	0.0248
8	Developing new business models and business processes	0.2255	0.0472
6	Strengthening the innovative structure	0.3412	0.0715
14	Proper distribution of necessary financial resources	0.1494	0.0313
13	Allocating enough budget for IT	0.1655	0.0347
	TECHNOLOGICAL (λ=5.0399-CI=0.0100-CR=0.0089)		
12	Determining for technology, infrastructure and platforms to be used for the next 5 years (cloud solutions, ERP, IoT, AI, etc.)	0.1528	0.0411

11	Ensuring the reliability and security of data needed in decision processes	0.1640	0.0441
9	Storing the databases as consistently and regularly (all reported data must be stored), metrics are updated automatically	0.1697	0.0457
7	Using technology which supporting business, making applications to support innovation in a data-driven organization	0.2356	0.0634
5	IT projects comply with organizational strategies	0.2779	0.0747

Criteria which are claimed to be essential for digital transformation are accepted as low priorities by managers. These criteria are "Sharing the produced reports in detail and clearly with all units, the employees easily understand the reports, and the employees open to new processes and solutions," "Having a digital transformation department," "Improving workforce quality, facilitating communication among employees, arising new opinions." Their priorities are 4.47, 2.69, 2.63 respectively. "Increasing corporate profitability" is the last one with 2.48 percent.

CONCLUSION

In the context of digitization, Data Culture is getting more critical for organizations. The CIO's role has changed from an internally oriented manager of a technical support function to an externally oriented executive who is responsible for aligning business and technology to produce competitive advantages for the firm (Chen et al., 2010). Thus, CIOs in Turkey pay attention to their customers, business partners, and suppliers. For the perspective of this study, the high priority of data culture is stakeholders. "Obtaining ability of stakeholder-driven business" (0.1564), "Cooperation with stakeholders" (0.1015), "Improving communication with stakeholders" (0.0886) are the three most important objectives for data culture. These top dimensions belong to the stakeholder dimension.

A result of the study, it is possible to say that CIOs tend to use the existing technologies and the technology they will use in the future. On the other hand, CIOs did not found important the criteria, which have an essential role in the digitization process, as "having a digital transformation department," "increasing corporate profitability," and "allocating enough budget for IT." At this point, these results confirm the Accenture (2017) survey. According to this survey, most of the Turkish organizations have not a digital transformation department or team.

As another result of the study, it can be said, CIOs will consider more investment to digitalization because of they care two criteria: "Strengthening the innovative structure" and "Developing new business models and business processes."

In this study, it is aimed to see what digitization criteria are most important for CIOs at their transformation process. Different kind of dimensions for digitization was suggested. In our study, we tried to build a data culture hierarchy model as using four main and 17 sub-criteria. The primary (Stakeholders, Technological, Financial and Organizational) and sub-criteria weights were determined by the Analytic Hierarchy Process. This study explored the relative weights that CIOs assign to the factors fundamental data culture objectives. From this aspect, this research has a first study feature for a data culture. In future studies, the hierarchical structure can be modified according to these results.

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