Studies in Systems, Decision and Control 497

Ruben Pereira
Isaias Bianchi
Álvaro Rocha *Editors*

Digital Technologies and Transformation in Business, Industry and Organizations

Volume 2

Springer

Studies in Systems, Decision and Control

Volume 497

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Ruben Pereira · Isaias Bianchi · Álvaro Rocha
Editors

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Editors
Ruben Pereira
Instituto de Telecomunicações (IT)
Instituto Universitário de Lisboa
ISCTE-IUL
Lisbon, Portugal

Isaias Bianchi
Federal University of Santa Catarina
Florianópolis, Santa Catarina, Brazil

Álvaro Rocha
ISEG
University of Lisbon
Lisbon, Portugal

ISSN 2198-4182 ISSN 2198-4190 (electronic)
Studies in Systems, Decision and Control
ISBN 978-3-031-40709-3 ISBN 978-3-031-40710-9 (eBook)
https://doi.org/10.1007/978-3-031-40710-9

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

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Preface

In an era of rapid technological advancements, the need for continuous learning, growth, and adaptation is paramount. Since the publication of the first edition of "Digital Technologies and Transformation in Business, Industry, and Organizations," the digital ecosystem has experienced significant developments, prompting a timely update to the book's content.

This second edition has been meticulously crafted to incorporate the latest scientific contributions, focusing primarily on systematic literature reviews while also employing other methodologies. With 14 chapters dedicated to new content, we aim to provide a comprehensive, up-to-date resource for both academia and industry professionals.

Throughout this edition, we delve into emerging trends, innovative technologies, and recent research findings that are shaping the future of digital transformation. Each chapter is designed to stand on its own, addressing specific aspects of digital technologies and their impact on various sectors. We have enlisted the expertise of renowned scholars and industry practitioners to ensure the highest level of rigor and relevance in our content.

Some of the key topics explored in this edition include, but are not limited to, the integration of artificial intelligence in business processes, the ethical and legal implications of data-driven decision-making, the role of digital platforms in fostering innovation, and the potential of blockchain and distributed ledger technologies in revolutionizing industries.

The second edition also delves into new methodologies and frameworks that have emerged in response to the digital transformation, offering valuable guidance for those seeking to implement and manage such changes within their organizations. Furthermore, we have dedicated a section to examining the impact of the COVID-19 pandemic on the acceleration of digital transformation, providing insights into the challenges and opportunities that have arisen as a result.

As you navigate through the chapters, we hope that this second edition will not only expand your knowledge but also spark new ideas, ignite meaningful conversations,

and encourage further research in the realm of digital technologies and transformation. May this book serve as a valuable reference and a source of inspiration for your academic or professional pursuits.

Welcome to the second edition of "Digital Technologies and Transformation in Business, Industry, and Organizations." Let us continue our exploration into the fascinating world of digital innovation.

Lisbon, Portugal — Ruben Pereira
Florianópolis, Brazil — Isaias Bianchi
Lisbon, Portugal — Álvaro Rocha

Contents

IT Governance Mechanisms to Foster Digital Transformation in Higher Education Institutions

Isaías Bianchi, Nursultan Shurenov, Nataliya Tovma, Irina Maslova, and Ablaikhan Shansharkhanov

Abstract Digital transformation (DT) has emerged as an important phenomenon that attracts the attention of both researchers and practitioners in all kind of industry and refers to the changes experienced by institutions and society in general as a consequence of the use of new digital technologies. In order to support the management of these digital technologies IT governance (ITG) plays an important role in organizations' digital initiatives in particular in Higher education institutions (HEIs), adopting formal ITG mechanisms. Few studies have investigated the ITG mechanisms in Digital Transformation. This paper aims to analyse the ITG mechanisms that influence digital transformation in a Higher Education Institution based on eleven dimensions of DT in HEIs. A case study was carried out in a large and public university in the Republic of Kazakhstan. This study identified how IT governance mechanisms may impact each one of these eleven dimensions and how these mechanisms can foster DT in a university. Findings revealed that mechanisms related to innovation, tests and experiments of solutions, sharing knowledge, training, are some examples that contribute to the university enhancing DT. This study contributes to topic that is little explored and deserves more research. This article concludes by presenting key contributions, limitations and future work.

I. Bianchi (✉) · N. Shurenov · N. Tovma
Al-Farabi Kazakh National University, Almaty, Kazakhstan
e-mail: Isaias.bianchi@gmail.com

N. Shurenov
e-mail: nursultan.shurenov@kaznu.edu.kz

N. Tovma
e-mail: nataliya-tovma@mail.ru

I. Maslova
Economics, Finance and Accounting, Orel State University, Oryol, Russia
e-mail: tera_27@mail.ru

A. Shansharkhanov
Turan University, Almaty, Kazakhstan
e-mail: ablai4me@gmail.com

R. Pereira et al. (eds.), *Digital Technologies and Transformation in Business, Industry and Organizations*, Studies in Systems, Decision and Control 497,
https://doi.org/10.1007/978-3-031-40710-9_5

Keywords Digital transformation · IT governance mechanisms · Higher education

1 Introduction

In higher education institutions (HEIs) DT has become a priority in this second decade of the twenty-first century, and this is a natural and necessary process for organizations that claim to be leaders of change and be highly competitive in their domain.

According to [28] digital transformation refers to the IT-enabled change in organizations through the digitalization of products, services, core processes, customer touch points and business models. In higher education institutions, digital transformation has been a driver for the improvement of processes and technologies such as big data, artificial intelligence, the internet of things, cloud computing, mobility, connectivity, 3D printing, social business, etc.) but on using it to achieve new objectives based on innovation and creativity, which could not be achieved without them.

Information Technology has become essential for higher education institutions in teaching, research and management issues in particular during the Pandemic. Moreover, IT can be a strategic tool for universities and have an enormous impact on educational performance, learning system, research productivity, experiences with students, projects of internationalization and interaction with universities from other countries [51]. ITG involves a set of high-level definitions, such as principles, values and goals, operationalized through mechanisms. ITG mechanisms are the practical manifestation of these high level definitions that are turned part of the day-by-day activities as a way to turn the ITG practicable [64]. An effective ITG helps an institution in achieving its goals by applying IT resources in optimal ways [40]. On the other hand, ineffective IT governance might affect the organization performance, quality of services, management of operations and costs. In universities, ineffective ITG might affect the quality of teaching, research and management of internal processes (e.g., access to online courses, software, academic databases among others) [5, 6, 8, 51]. It is quite clear that organizations with complex IT, need to have formal ITG to see worthy organizational performance.

While the IT governance in the literature is related mostly to accountability, decision making, monitoring, control among other ITG issues such as [29, 64, 65]. During the Pandemic the universities sought to IT solutions in order to mastering the e-learning courses and foster education. Thus, this research seeks to understand particular ITG mechanisms implemented in a public university and how this mechanism may foster digital transformation.

Reference [3] identified eleven dimensions in HEI that have been permeated by DT processes found in the literature are: teaching, infrastructure, curriculum, administration, research, business process, human resource, extension, digital transformation governance, information, and marketing.

ITG is fundamental for the DT implementation by making sure IT delivers value to enterprise sustainability and growth. This study intends to contribute to the body

of knowledge on the governance of IT analyzing the impact of mechanisms on digital transformation by answering the following research question: How and which are the ITG mechanisms may impact Digital Transformation in higher education?

The remainder of this paper is structured as follows. Section 2 outlines the theoretical background, including IT governance in general and IT governance in higher education institutions. Section 3 describes the research design and approach, while Sect. 4 reports the study findings with the discussion and conclusion. Section 5 discusses some limitations and suggestions for future research.

2 Theoretical Background

2.1 Digital Transformation in Higher Education Institutions

In recent years, digital transformation (DT) has emerged as an important phenomenon that attracts the attention of both researchers and practitioners in all kind of industry [36]. According to Vial [60] DT refers to the changes experienced by institutions and society in general as a consequence of the use of new digital technologies. DT states to the changes that digital technologies can bring to a company's business model or its products or organizational structures or processes [30].

In higher education institutions (HEIs) DT has become a priority in this second decade of the twenty-first century, and this is a natural and necessary process for organizations that claim to be leaders of change and be highly competitive in their domain [3]. In accordance with [36] the university is an institution that has always been committed to knowledge, education and training. Throughout history, it has taken on new functions and missions induced by the sometimes disruptive changes experienced by society. The advent of artificial intelligence (AI) technology in the education sector has largely taken over conventional classrooms and revolutionized the way education is conducted to the admiration of many. Table 1 presents the eleven dimension and a definition.

As shown in the Table 1 regarding the dimensions table, each of these dimensions needs mechanisms to efficiently govern the digital transformation. IT governance mechanisms can assist in governance in each of these dimensions so that the university has a greater impact on the digital transformation at the university. The next section presents IT governance mechanisms in higher education institutions.

2.2 ITG Mechanisms in Higher Education

Information Technology has become crucial for higher education institutions in teaching, research and management issues. Moreover, IT can be a strategic tool for universities and have an enormous impact on educational performance, learning

Table 1 Dimensions of the DT in HEIs adapted from [3]

	Dimension	Topics related and definition
1	Teaching	Digital platforms and contents for teaching and learning, Innovate pedagogical methodologies, digital literacy and digital skills, teaching administration process
2	Infrastructure	Digital infrastructure for teaching, Data and security infrastructure, software infrastructure for HEIs
3	Curriculum	Curriculum modernization, digital curriculum
4	Administration	Financial and technological aspects, financial and technological aspect, making Informed Decisions
5	Research	Research is forced to align with the DT to fulfil with requirement and expectations of the actors involved in the research processes
6	Human resource	Competent digital workforce
7	Extension	The use of independent certification of competence and the establishment of integration links between universities, specialized secondary schools, major enterprises, and public administration in the region
8	DT governance	Understanding and managing digital innovations
9	Information	Aligned and be consistent with the business architecture of the HEI
10	Marketing	Digital marketing model
11	Business process	The use of digital technologies to improve, enhance, or replace traditional services with digital ones, to simplify the processes involved in educational service delivery and operational complexity

system, research productivity, experiences with students, projects of internationalization and interaction with universities from other countries [51]. Empirical studies in this field are still scarce, particularly, in universities as identified in previous research [38, 48].

As universities rely more and more on IT to improve educational performance, teaching and learning, research and service become more dependent on IT services. Essential for success, IT governance has been pointed out in the top ten IT issues at universities calling the attention to the effective implementation of some ITG mechanisms as well as IT frameworks and applications. However, empirical studies in this field are still scarce, particularly, in universities as identified in previous research.

Complex organizations, such as universities, should devote particular attention to their mechanisms for the governance of IT to better deal with innovation and changes in their environment and adapt to new technologies. While providing high quality services and delivering value, universities should also consider risk. Pandemic brought several challenges for universities in IT issues. The universities needed to reinvent and working to provide better services and IT tools to students, professors and administrative staff. Recently, proposed by [51] ITG baseline in particular for higher education institutions, identifying several mechanisms in addition to the financial industry. Table 2 presents IT mechanisms in particular for higher education institutions.

Table 2 IT governance mechanisms in higher education [51]

		IT governance practice	Description
Structures	S1	IT organisation structure	The adoption of an IT organization structure for better decision-making in the institution
	S2	IT strategy committee	A committee at the institutional level with the mission of ensuring that IT is included on the agenda, to assist its alignment with institutional strategies
	S3	IT steering committees/ councils	A responsible committee to determine the IT priorities at the institution and implement IT strategy. This committee can be divided into several subcommittees or functions, with the role of discussing activities in teaching, learning,
	S4	Roles and responsibilities	A definition of roles and responsibilities with formal functions and clear definition
	S5	Project management office	A project management office to manage all kinds of IT projects at the institution
	S6	Process management office	A process management office composed of IT staff and academics to identify areas to be improved at universities. A function defined at the IT department level of the institution
	S7	ITG function/officer	A formal function within the institution, responsible for promoting, driving and managing all ITG processes
	S8	Security/compliance/risk officer	Function responsible for security, compliance and/or risk which possibly impacts IT
	S9	Business/IT relationship managers	Business/IT relationship managers working as intermediaries between IT and other areas of the institution, such as in teaching, learning, and administrative tasks

(continued)

Table 2 (continued)

		IT governance practice	Description
	S10	CIO on executive committee	The CIO of an executive committee with the aim of representing IT, showing the benefits for and the impacts on the university and in all aspects of education
Processes	P1	Strategy information system planning	A strategic plan aligned with the objectives and goals of the institution, defining all priorities and investments
	P2	Frameworks and standards ITG	The adoption of frameworks and standards to help IT governance at universities
	P3	Test and experiments of solutions	An environment with the possibility of tests and experiments regarding solutions in information technology
	P4	Dashboard	Tools widely used by IT professionals which are easy to utilise by academic staff, to analyse data at the organisational level
	P5	Methodology to manage disruptive innovation	A methodology to manage disruptive innovation in universities
	P6	International standards/ common solutions	The adoption of international standards. A common solution adopted by several universities in the same country (i.e., the same software as ITSM, Business Intelligence)
	P7	Portfolio management	Prioritisation of processes for IT investments and projects in the institution
	P8	IT budget control and reporting	Process used to monitor and control the IT budget and investments in projects. Define an IT budget to ensure investments and priorities for IT projects

(continued)

Table 2 (continued)

		IT governance practice	Description
	P9	IT performance measurement	The adoption of metrics and indicators in IT to assist managers in visualising and understanding the strategic objectives of the institution. To measure the organisation's performance through the use of satisfaction surveys, as well as an analysis of service quality and all issues regarding operational excellence
	P10	Benefits management and reporting	Processes used to monitor IT benefits for teaching and learning activities, during and after implementation A way to show IT investments in projects and the real impact on the university
Relational mechanisms	R1	Knowledge management (on IT)	Share knowledge on IT at the university, such as information about technology, frameworks, best practices, tasks, responsibilities, and publish the information in the intranet, blogs or a university portal. The purpose of this is to store and create an organisational memory of IT knowledge, which should be available whenever it is necessary to recover any information
	R2	Knowledge sharing among universities	Share knowledge of IT among IT managers, IT directors, and the CIO in universities by e-mail, forum, and a discussion group. Exchange experiences and best practices for software, infrastructure and training, and issues related to IT problems and solutions
	R3	IT leadership	Have an IT leader to promote and lead IT projects. This leader should be the CIO or the IT representative, with higher IT decision-making responsibilities
	R4	Training and education	A formalised program of training and education for business and IT professionals

(continued)

Table 2 (continued)

		IT governance practice	Description
	R5	University and software industry partnership	Partnership among the university and software industry, aiming to acquire solutions for education. A good starting point is to establish a partnership with Google or Microsoft, where they provide a range of free and affordable tools for education
	R6	Corporate communication	Formal institution communication to address general IT issues Use formal and best practices to communicate IT to all stakeholders
	R7	Engagement between IT and academia	Engagement and relationship with academia (e.g., school of engineering, systems information, computer science) aiming to develop projects and solve real IT problems. The researchers and professors in the faculties work in partnership with the IT professionals
	R8	Shared understanding of business/IT objectives	To share the understanding of business/IT objectives among the main stakeholders in the institution. To clearly show the IT activities and the importance of each one

The next section presents the IT governance mechanisms that may influence digital transformation.

2.3 ITG Mechanisms Influencing Digital Transformation

Previous research has found that ITG structures, processes, and relational mechanisms improve business performance [57]. Traditional ITG mechanisms may no longer be applicable in the digital age [7, 45]. Few studies have been conducted to study ITG processes that modulate DT [58]. A recent literature review of 46 articles from Mulyana et al. [45] has identified 28 ITG mechanisms that influence DT (Table 3).

Upon examining Table 3, the study identified several mechanisms that are linked to digital processes, competences, and agile management. Indeed, in this digital age,

Table 3 IT governance mechanisms that influence digital transformation adapted from [45]

		ITG mechanisms	Sources
Structures	1	Chief information officer	[24, 58]
	2	Chief digital officer	[24, 58, 61]
	3	Chief data officer/digital unit	[52, 66]
	4	Digital unit	[24, 58, 61]
	5	Transformation board	[24, 58, 61]
	6	Digital committee	[24, 32, 58]
Processes	1	Digital strategy management	[9, 32, 34, 61]
	2	Agile EA management	[17, 22, 25, 61]
	3	Agile business process management	[1, 17, 61]
	4	Big data management	[39, 42]
	5	Cybersecurity mgt	[2, 49]
	6	Agile portfolio management	[31, 53, 58, 61]
	7	Agile project management	[18, 20, 58]
	8	Agile sysdev. mgt	[21, 58]
	9	Digital outsourcing mgt	[19, 50]
	10	Digital competency mgt	[56, 63]
	11	Digital knowledge mgt	[33, 62]
	12	Digital innovation management	[37, 47, 58, 62]
	13	Agile change management	[26, 43, 55, 58]
	14	Agile risk management	[10, 58, 62]
	15	Digital business value management	[23, 47, 62]
	16	Digital maturity management	[35, 54, 61]
	17	Agile audit and assurance management	[41, 44, 58, 61]
Relational mechanisms	1	Transformational leadership	[19, 34, 58, 61]
	2	Digital organizational culture	[14, 17, 27, 61]
	3	Cross-functional collaboration	[24, 58, 61]
	4	Cross-functional training	[32, 58]
	5	External collaboration	[14, 24, 32, 58]

universities that seek to promote digital transformation must adopt agile methodologies and prioritize digital skills, along with innovation. These mechanisms can significantly benefit universities and impact their teaching, research, and extension activities.

The subsequent section presents a case study wherein these mechanisms will be validated and analyzed within a higher education institution. As highlighted in the literature, there are relatively few studies examining how and which mechanisms may influence ITG on digital transformation.

3 Methodology

This is an exploratory and confirmatory study in its nature seeking to understand the IT governance mechanisms implemented in a university [67]. The case study method is particularly appropriate for these types of studies and well suited to capture knowledge and develop theories. It is adopted when investigating the "how" or "why" research questions and when the phenomenon is new [4, 67].

3.1 The Case

The case study was carried out in a large and public university in The Republic of Kazakhstan. The choice of this university was motivated that the government of The Republic of Kazakhstan is investing on digital transformation to improve knowledge economy. This study is a part of the project focused on the Digital Kazakhstan program; The strategy "Kazakhstan-2050: a new political course of the established state." Higher education institutions have an essential role in this process helping digital transformation.

Aiming to understand how the ITG mechanisms can help this process, this study analyzes the ITG mechanisms implemented in a particular university. The unit of analysis is the IT department in a public university with over 20.000 students and 3000 administrative staffs.

3.2 Data Collection and Data Analysis

In order to identify implemented ITG mechanisms as well as understand these mechanisms at a particular that influences digital transformation at the university, we did semi-structured interviews, collected data from documents, wed did observations and field notes. We adopted a convenience sampling to select this university. The interviews were carried out with CIOs, IT Coordinators and IT Directors since they are the IT decision-makers at top management and medium levels responsible for IT issues and also two professors. Table 4 shows the profile of each interviewee. The questionnaire to frame the interview was developed in three parts: the first part, with general questions about the institution; the second part, with personal questions about the interviewee; the third part, with questions regarding the ITG mechanisms and in each dimension influences digital transformation. Table 5 presents a summary of these mechanisms and also excerpts from the interviews.

Regarding the validity of our qualitative research, we followed the parameters suggested by Venkatesh et al. [59]. We analyzed each mechanism in the following

Table 4 Interviewees profile

	Position	Education	Experience in IT (years)	Experience in the position (years)
1	Manager programmer of the first category	Master	20–24	3 or less
2	Head of IT department	Master	14–19	3 or less
3	Head of the service department	Bachelor	14–19	4–6
4	Engineer	Bachelor	14–19	10 or more
5	System engineer technician	Bachelor	14–19	4–6
6	Head of the service department	Bachelor	14–19	3 or less
7	IT specialist	Bachelor	25 or more	10 or more
8	Leading specialist of the IT department	Bachelor	14–19	10 or more
9	Assistant professor	Master	10	5
10	Foreigner professor	Ph.D.	14–19	10

dimension found in the literature: teaching, infrastructure, curriculum, administration, research, business process, human resource, extension, digital transformation governance, information, and marketing.

In this study, we analyzed 56 particular mechanisms and how these mechanisms helped the university in the supporting digital transformation using the experiences and challenges from the Pandemic to foster DT. Table 6 presents examples of quotes during interviews.

The study conducted face-to-face interviews from September 2021 to November 2021, while field notes were collected between December 2021 and April 2022. The interviews were conducted following Myers and Newman's recommendations [46]. To gain a better understanding of the solutions adopted, we visited different laboratories and departments and acquired several field notes. The field research provided insights into how these ITG mechanisms impact digital transformation at the university across all dimensions of DT. The interviews were conducted in Russian and later translated into English, which was reviewed by two authors, who also collected field notes together.

Examples of evidence mentioned by informants in the mechanisms, "University and Software Industry Partnership".

…. signed a memorandum with Microsoft. Microsoft has provided a free license to … for the use of all software products. Another example of the quote in the interview is the mechanism "International Standards/Common Solutions" … *The site-system "Univer", which is used in 14 universities of the Republic of Kazakhstan, has been developed by IT-specialists of … named after.*

Table 5 presents evidences from data collection from interviews and examples of notes and observations, referring to the mechanisms of the study and [45] the

Table 5 Interviewees from data collection

	ITG mechanisms		
	ITG mechanisms DT [45]	**EVI**	**FNO**
S1	Digital unit	Very effective	Very effective
S2	Transformation board	Very effective	–
S3	Digital committee	Very effective	–
P4	Digital strategy management	Very effective	–
P5	Big data management	Very effective	Very effective
P6	Digital competency mgt.	Very effective	–
P7	Digital knowledge mgt.	Very effective	–
P8	Digital innovation management	Very effective	–
R9	Transformational leadership	Very effective	
R10	Digital organizational culture	Very effective	Very effective
R11	Cross-functional collaboration	Very effective	Very effective
R12	Cross-functional training	Very effective	Very effective
R13	External collaboration	Very effective	Very effective
	ITG mechanisms for HEIs [51]		
S1	Project management office	Very effective	Very effective
S2	Process management office	Very effective	Very effective
P3	Test and experiments of solutions	Very effective	Very effective
P4	Dashboard	Very effective	Very effective
P5	Methodology to manage disruptive innovation	Very effective	Very effective
P6	International standards/common solutions	Very effective	Very effective
R7	Knowledge sharing among universities	Very effective	Very effective
R8	University and software industry partnership	Very effective	Very effective
R9	Engagement between IT and academia	Very effective	Very effective
R10	Training and education	Very effective	Very effective

studies of the mechanisms that affect digital transformation. The column (EVI) means Examples of Evidences from Interviews/ Focus Group ant the column (FNO) means Fields notes and Observations.

Table 6 summarizes the qualitative analysis, using the lens from digital transformation and ITG mechanisms based on the Creswell [11] recommendations. Qualitative analysis involves dense and rich text and image data, and not all of it can be utilized in the analysis [11]. Therefore, researchers need to focus on representative and important data relevant to the study's topic during data analysis. To extract the maximum benefits from data, Creswell [11]suggests aggregating it into a smaller number of themes.

Our analysis reveals that mechanisms related to innovation, knowledge sharing, training and education, data management, software, and technologies have a direct

Table 6 Analysis DT × ITG mechanisms

	ITG mechanisms	DT dimension										
		1	2	3	4	5	6	7	8	9	10	11
S1	Digital unit	x	x	x	x	x	x	x	x	x		x
S2	Transformation board	x	x	x	x	x	x	x	x	x		x
S3	Digital committee	x	x	x	x	x	x	x	x	x		x
P4	Digital strategy management	x	x	x	x	x	x	x	x	x		x
P5	Big data management	x	x	x	x	x	x	x	x	x	X	x
P6	Digital competency mgt.	x	x	x	x	x	x	x	x	x		x
P7	Digital knowledge mgt.	x	x	x	x	x	x	x	x	x	X	x
P8	Digital innovation management	x	x	x	x	x	x	x	x	x	X	x
R9	Transformational leadership	x	x	x	x	x	x	x	x	x		x
R10	Digital organizational culture	x	x	x	x	x	x	x	x	x	X	x
R11	Cross-functional collaboration	x	x	x	x	x	x	x	x	x	X	
R12	Cross-functional training	x	x	x	x	x	x	x	x	x		
R13	External collaboration	x	x	x	x	x	x	x	x	x	X	
	ITG mechanisms for HEIs											
S1	Project management office	x	x	x	x	x	x	x	x	x		x
S2	Process management office	x	x	x	x	x	x	x	x	x		x
P3	Test and experiments of solutions	x	x	x	x	x	x	x	x	x	x	x
P4	Dashboard	x	x	x	x	x	x	x	x	x		x
P5	Methodology to manage disruptive innovation	x	x	x	x	x	x	x	x	x		x
P6	International standards/common solutionsn	x	x	x	x	x	x	x	x	x	X	x
R7	Knowledge sharing among universities	x	x	x	x	x	x	x	x	x		x
R8	University and software industry partnership	x	x	x	x	x	x	x	x	x		x
R9	Engagement between IT and academia	x	x	x	x	x	x	x	x	x	X	x
R10	Training and education	x	x	x	x	x	x	x	x	x	X	x

impact on the eleven dimensions. Marketing, particularly digital marketing is also related to the use of technologies, software, testing and experimentation of solutions, and the use of platforms for training. The next section presents the discussion and conclusion.

4 Discussion and Conclusion

This study aimed to understand the effectiveness of IT governance mechanisms in a particular university in a developing country, Kazakhstan. The results of this study are in line with the model proposed by [51]. We focused on specific mechanisms

implemented ad how these mechanisms can foster digital transformation and helped the university during the Pandemic.

Regarding the mechanisms that can influence digital transformation at the university, this study, through field data collection and interviews, identified five mechanisms related to structure, Digital unit Transformation board, Digital committee [24, 58, 61]. These mechanisms are mainly committee-related and ensure that DT is on the agenda in the organization as well as the Process Management Office and Project Management Office mechanisms [51]. In addition, a committee that deals with issues related to digital transformation and innovation is also considered necessary. The organization needs to have digital transformation and innovation on its agenda and with defined attention. While the literature review [45, 51] presents 58 mechanisms, this study identified 23 ITG mechanisms that may promote digital transformation, five related to structure, nine to processes and nine to relational mechanisms.

The mechanism "International Standards /Common Solutions" suggest the adoption of international standards. A common solution adopted by several universities in the same country (i.e. same software as ITSM, Business Intelligence). It could be easier to share information, to promote training, and reduce costs in the software development. To adopt the same international standard or even a solution is a huge challenge to universities. However, it is interesting that increasing number of universities adopt identical solutions to easier develop training together, to create software solutions, what consequently leads to reducing the procurement costs. An example of the effectiveness of this mechanism in practice is the same adoption of the software "Univer", which is used in 14 universities of the Republic of Kazakhstan. On the basis of the information complex Univer 2.0, a digital register of official documents of the learning process using blockchain technology is being developed, which allows to record the progress history of each student and control stages of the entire educational period and automatically generate electronic samples of educational documents. The university operates and is constantly improving an online platform and an online portal for accepting documents from applicants. Using the online system significantly reduces the time for submitting and receiving documents, as well as administrative barriers. The whole process of accepting documents is fully automated and is carried out in the application in 3 languages—Russian, English and Kazakh. The university maintains a program for foreign professors. Aiming at internationalization and knowledge sharing, during the during the pandemic, the university hired a numerous of foreign professors to teach online. This experience was only possible due to the systems being developed in three languages, which made it easier. Furthermore, the use of tools such as Microsoft Teams to record and make available online classes was essential during this period. It is perceived that universities can have numerous benefits by adopting solutions from companies such as Google and Microsoft. At the time of the pandemic, to teach online classes it was necessary to have an infrastructure that could support simultaneous access by thousands of users. Due to limited people and resources, the university was not fully prepared for this. In this sense, by adopting known solutions in the market, costs were reduced and quality was improved.

The 'University and Software Industry Partnership' mechanism between the software industry and universities is essential to a complex and open-minded environment to develop new ideas, create knowledge and propose solutions to complex problems. Students and teachers need to test and know a variety of IT solutions. At universities, the IT department is responsible for providing the infrastructure with laboratories and software to meet the teaching–learning requirements. However, many universities face severe financial restrictions in spending money with new software acquisitions. To promote new software alternatives and provide a larger range of technologies to students and professors, a partnership with the software industry may be essential. In fact, several organizations have educational programs specific to universities such as Microsoft, Google aiming to delivery IT systems [51]. Moreover, this partnership can bring many other advantages for universities such as cost reduction in software, material for training, support, and knowledge for students and professors. The university of this study has a partnership with the company Microsoft. Microsoft has provided a free license to for the use of all software products. All university employees work with Microsoft office 365 software. Cloud services are used. All data is stored in the cloud. The use of services in the cloud brought several benefits to the university such as cost reduction, improving of services quality, security, among others. It is quite notorious that after a partnership with Microsoft the university reduces costs with infrastructure adopting and migrating the services such as e-mail to the cloud. The results are in consonance with other universities pointed out in the study from [51]. Increasingly, the universities are searching for alternatives in order to reduce IT costs and improving the IT quality, security. One way to do this is creating and adopting. Companies such as Microsoft and Google provide several benefits for higher education institutions. In the context of a pandemic, it became obvious that without information technology, it is impossible to carry out the full functioning of the university's work. The entire educational process and all events, meetings are held online thanks to information technology. Basically, information products such as: ZOOM platform, Microsoft Teams, Microsoft Outlook, Microsoft Sharing Point for internal Services and Microsoft Power BI for Business Intelligence. Today, the university has its own corporate information system KIS, represented by a set of programs aimed at automating and managing various business processes of the university, based on the process approach, which allows the systematic development of each direction of the university's activities and organize work on the creation and maintenance of software developments by employees of information departments University. In the digital era in order to implement digital transformation in the university the following business processes have been digitized within the corporate information system:

- University management (administrative and managerial activities)
- Management of educational and methodological activities
- Management of the educational process
- Management of research activities
- Management of electronic educational resources
- Management of financial and economic activities.

An innovation of the university in the field of information technology application is the transition from projects to interactive displays. The university purchased 65 interactive displays. The displays have dashboards for helping the decision makers at the university to visualize and to make better decision. In addition, the data show to the society. The information made available for easy interpretation is essential for management, since the data can be in different systems and it generates a large amount of work to consolidate and present them in a friendly way. The information made available for easy interpretation is essential for management; since the data can be in different systems and it generates a large amount of work to consolidate and present them in a friendly way.

Organizations, according to Dover [13], depend on various people and sources of information to understand their situation, wasting time in data collection, correcting duplicate and/or incomplete information. As a result, the author concludes that there is a lack of relevant, timely insights, this delays diagnosis and a response to the problem.

On the other hand, the dashboards implementation in organizations allows a faster identification of problems, as well as support in corrective actions. The right decisions depend on accurate information extracted in a quickly, timely manner. For this, it is necessary to determine the quantifiable metrics and indicators, thus allowing an analysis based on KPI (Key Performance Indicators).

Dashboards allows monitoring organization's performance, however, dashboards need to strike a balance between the visuals and the information contained for decision support [68]. The idealization of a dashboard visual design is a determining factor for its success or failure. A major challenge is to make use of visualization to facilitate the extraction of information contained in the panel [15]. In addition, a panel should provide unambiguous information, which should not be prone to misinterpretation [12]. The mechanism dashboard has a high impact in digital transformation at the university.

This study confirmed that these ITG mechanisms implemented by the university has a positive impact on ITG in digital transformation. The mechanisms are essential to improve and to adapt in activities in the teaching, learning and management. In contrast with other type of industry, the higher education industry, in particular public universities in developing countries to foster digital transformation must be collaborate with other universities, to adopt international standards and same solutions. Universities increasingly need to be innovative to address the market's requirements, promote better processes and services for teaching, research, and service activities. In this sense, is crucial that they to manage innovation inside their IT departments by testing and implementing new solutions to provide the same services, products, and courses with low and affordable prices.

Moreover, internal integration among the IT, schools and faculties of the university is necessary to have an overview about the needs of the IT. All of these elements, the IT and academia people, must be engaged with a unique purpose of promoting better IT governance. Formation of an innovative and enterprising environment expected because of this co-operation and integration. Therefore, it is necessary for the universities in order to have an effective IT governance, to focus on the innovation managing

by providing an environment for testing and experimenting new solutions, sharing their knowledge with other universities, going into partnerships with industry, and engaging in relationships with internal schools and faculties. Sharing of the models, practices, and problems' solutions with others, universities, particularly in the public sector, must be permanent to help to choose and manage a model which is easy to implement and operate model.

5 Theoretical and Managerial Implications

The main theoretical contribution of our research provides support that the ITG mechanisms analyzed may impact digital transformation. This study analyzed IT governance mechanisms that may impact the digital transformation in higher education institutions. Digital transformation refers to technology, processes and people. In order to have a digital transformation in higher education institutions, it is essential to partner with technology companies, use the same solutions adopted by other universities. In universities where the environment is complex, with numerous processes in different departments, a formal structure facilitates the promotion of digital transformation. This study identified that in developing countries, particularly in public universities, the budget and human resources are sometimes limited. In this sense, it is essential to partner with the software industry to acquire systems to promote digital transformation. The study shows that the partnership with Microsoft has several benefits with the adoption of different technologies. Digital transformation is related to people and processes and a specific mechanism for this is fundamental. While Bianchi et al. [51] focus is on the Project management office, this study shows that organizations have to adopt agile project management methodologies aimed at digital transformation. The objective of this study was to analyze and validate which are the mechanisms that may foster the university in a process of digital transformation, based on eleven dimension of DT in HEIs adapted from [3]. In order to have a digital transformation in higher education institutions, it is necessary to have an agile management of technologies. Digital transformation is related to process optimization, data driven culture, innovation and nowadays focused on remote work adoption [16]. The next section presents the limitation and future research.

5.1 Limitations and Future Research

This study has some limitations. First of all, the collected data was limited to one country and one university. Therefore, caution is advised in the way results can be used and generalized. Since the impact of IT governance mechanisms on digital transformation is a new and emergent topic, we would suggest future research using a quantitative approach with a larger sample to test a model and analyse how each

mechanism impact on in each dimension. Additionally, what are the main challenges in this particular sector.

Acknowledgements This research has been funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (AP09057847 « Formation and development of a knowledge economy in the condition of digitalization of the Republic of Kazakhstan: conceptual basis and implementation perspective»).

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